California Regional Water Quality Control Board
Los Angeles Region

Winston H. Hickox
Secretary for 'nvironmental Protection

320 W. 4th Street, Suite 200, Los Angeles, CA 90013
Phone (213) 576-6600 FAX (213) 576-6640

Gray Davis
Governor

TO: Interested Parties

FROM: Parvaneh Khayat

DATE: June 5, 2000

SUBJECT: SUPPLEMENTAL EVIDENCE FOR THE SUSMP STATE BOARD MEETING

I have enclosed additional evidence that was submitted by our office for the SUSMP State Board Meeting on June 7, 2000.

If you have any questions or concerns please let me know

Thank you,

Parvaneh Khayat

Enclosure.

California Regional Water Quality Control Board

Los Angeles Region

Winston H. Hickox
Secretary for Environmental Protection

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640
Internet Address: http://www.swrcb.ca.gov/~rwqcb4

Gray Davis
Governor

May 31, 2000

Ms. Elizabeth Jennings
Senior Staff Counsel
Office of Chief Counsel
State Water Resources Control Board
P. O. Box 100
Sacramento, CA 995812-0100

Dear Ms. Jennings:

EVIDENCE AND EXHIBITS SUPPLEMENT TO THE ADMINISTRATIVE RECORD – IN RE: THE CITIES OF BELLFLOWER, ET AL., CITY OF ARCADIA, AND WESTERN STATES PETROLEUM ASSOCIATION (REVIEW OF JANUARY 26, 2000, ACTION OF THE REGIONAL BOARD AND IT EXECUTIVE OFFICER PURSUANT TO ORDER NO. 96-054, PERMIT FOR MUNICIPAL STORM WATER AND URBAN RUNOFF DISCHARGES WITHIN LOS ANGELES COUNTY [NPDES NO. CAS614001]). [SWRCB/OCC FILES A-1280, A-1280(a) AND A-1280 (b)]

Please find enclosed our "Evidence and Exhibits Supplement to the Administrative Record" for the hearing scheduled in the above matter.

The submittal includes, (i) selected papers on storm water pollution and new development designs for water quality, (ii) a summary paper on the impact of storm water runoff on Santa Monica Bay, (iii) a storm water informative videotape, (iv) a memorandum on the "Definition of Maximum Extent Practicable" issued by the Office of Chief Counsel, (v) a letter from the plaintiffs attorneys, (vi) policy statements from the State of Washington and the State of Maryland, (vii) a letter of support from U.S.EPA Region 9. We are awaiting policy statements on controls on new development from USEPA Headquarters – Engineering Analysis Division, the State of Florida, and the State of Virginia. These may have been mailed directly to you. We reserve the right to supplement the record for the hearing with the above documents and other related materials not made a part of the package at this time.

If you have any questions or need more information, please call me at (213) 576 – 6605 or Dr. Xavier Swamikannu at (213) 576 – 6754, or Regional Board Counsel, Jorge Leon at (916) 657-2428.

Sincerely,

Dennis A. Dickerson
Executive Officer

Enclosure

cc: Jorge Leon, OCC, State Water Resources Control Board
Richard Montivedo, Esq., Rutan & Tucker
Stephen P. Deitsch, Esq., Mayer, Brown & Platt
Lyman C. Welch, Esq., Best, Best, & Krieger
David Beckman / Alex Helperin, Natural Resources Defense Council
Steven Fleischli, Santa Monica Bay Keeper
Heather Hoecherl/ Mark Gold, Heal the Bay

CENTER FOR WATERSHED PROTECTION

HEADQUARTERS

8391 MAIN STREET
ELLICOTT CITY, MD 21043
(410) 461-8323
(410) 461-8324 FAX
WWW.CWP.ORG
EMAIL CENTER@CWP.ORG

THOMAS R. SCHUELER
EXECUTIVE DIRECTOR

RICHARD A. CLAYTON, JR., P.E.
PRINCIPAL ENGINEER

HYE YEONG KWON
ASSISTANT DIRECTOR

January 11, 2000

Dennis Dickerson
Executive Director
Los Angeles Regional Water Quality Control Board
320 W. 4th Street, Suite 200
Los Angeles, California 90013

Re: Support for the 3/4 inch standard to reduce runoff from new and redevelopment

Dear Mr. Dickerson:

I recently have had the chance to review the standard urban stormwater mitigation plan for Los Angeles County and Cities in Los Angeles County. Treatment of the stormwater quality is an essential element for protecting local watersheds, and is widely used by many municipalities around the country. I strongly support the three-quarter inch runoff treatment standard based on past scientific research on the performance of stormwater best management practices. I have also enclosed a recent article on stormwater strategies for arid and semi-arid watersheds that may be helpful in adapting effective stormwater practices for your region.

Thank you for the opportunity to comment on the proposed stormwater mitigation plan. Adoption of the three quarter inch standard will help to protect the creeks and coastlines of Los Angeles from the impacts of stormwater pollutants, and represents a fair, equitable and achievable threshold for stormwater treatment.

Sincerely,

Thomas R. Schueler
Executive Director

cc Mark Gold

attachment

II. Stormwater Strategies for Arid and Semi-Arid Watersheds

Water supply and flood control have traditionally dominated watershed planning in arid and semi-arid climates. Until recent years, stormwater quality has simply not been much of a priority for water resource managers in the west. This situation is changing rapidly, as fast growing communities are responding to both emerging water quality problems and new federal regulations. In particular, larger cities in the west have gradually been dealing with stormwater quality to meet the requirements of the first phase of EPA's municipal stormwater NPDES program. Soon, thousands more smaller communities will need to develop stormwater quality programs when the second phase of this national stormwater regulatory program is rolled out later this year.

At first glance, it seems ludicrous to consider managing the quality of stormwater in arid regions where storms are such a rare and generally welcome event— sort of like selling combs at a bald convention. The urban water resources of the southwest, however, are strongly influenced by stormwater runoff and by the watershed development that increases it. Indeed, the flow of many urban streams in the southwest is generated almost entirely by human activity: by urban storm flow, irrigation return flow and wastewater effluent. Thus, the quality of both surface water and groundwater in urbanizing areas of arid and semi-arid regions of the southwest is strongly shaped by urbanization.

For purposes of this article, arid watersheds are defined as those that receive less than 15 inches of rain each year. Semi-arid watersheds get between 15 and 35 inches of rainfall, and have a distinct dry season where evaporation greatly exceeds rainfall. In contrast, humid watersheds are defined as those that get at least 35 inches of rain each year, and often much more. There are many arid and semi-arid watersheds, most of which are located in fast growing regions of the western United States (Figure 1). Low annual rainfall, extensive droughts, high intensity storms and high evaporation rates are characteristic of these watersheds, and present many challenges to the stormwater manager. [Note: in some arid and semi-arid watersheds, most precipitation falls as snow and evaporation rates are much lower. These watersheds are found in portions of Alaska and at higher elevations of the Rocky Mountains and Sierra Nevada. Guidance on stormwater strategies for these dry but cold watersheds can be found in Caraco (1997)].

Soon, thousands more smaller communities will need to develop stormwater quality programs.

This article reviews strategies for managing stormwater in regions of scarce water based on an extensive survey of 30 stormwater managers from arid and semi-arid regions. Next, the article explores how source control, better site design and stormwater practices can be adapted to meet the demanding conditions posed by arid and semi-arid climates. It begins by examining the environmental factors that make stormwater management in arid and semi-arid watersheds so unique and challenging. As a consequence, stormwater strategies for the west are often fundamentally different from those originally developed for more humid regions. Some of the fundamental differences are outlined in Table 1 and are described in detail in the following text.

Figure 1. Regions of the Continental United States With Less Than 15" of Precipitation Annually

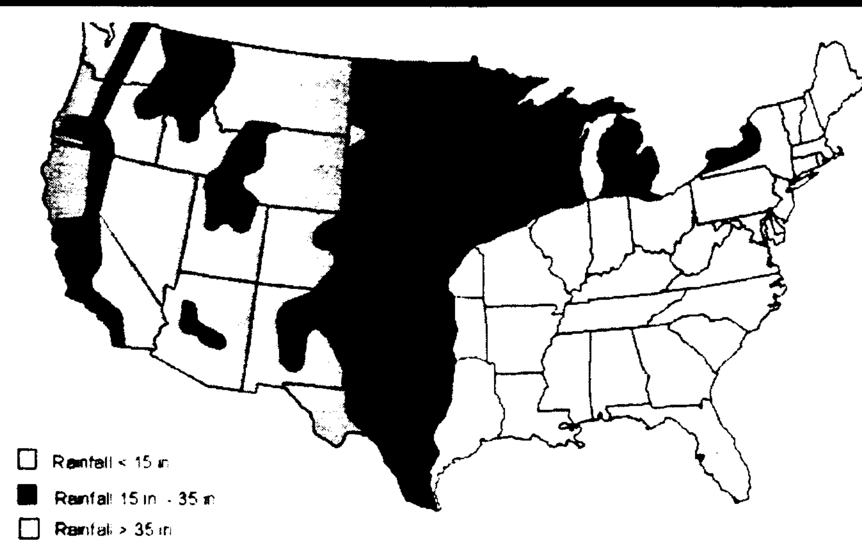


Table 1. The West Is Different: Key Considerations in Arid and Semi-Arid Watersheds
Aquatic resources and management objectives are fundamentally different
Rainfall depths are much lower
Evaporation rates are much higher
Pollutant concentrations in stormwater are much greater
Vegetative cover is sparse in the watershed
Sediment movement is great
Dry weather flow is rare, unless return flows are present

Aquatic resources and management objectives are fundamentally different

The rivers of arid regions are dramatically different from their humid counterparts. Some idea of these differences can be seen by comparing the dynamics of an arid river to a humid one (see Box 1). The differences are even more profound for the smaller urban streams in arid watersheds. In fact, it is probably appropriate to refer to them as gullies or arroyos rather than streams, since they rarely have a perennial flow of water. Many of the physical, chemical and biological indicators used to define stream quality in humid watersheds simply do not apply to the ephemeral washes and arroyos that comprise the bulk of the drainage network of arid watersheds. Without such indicators, it is difficult to define the qualities that merit protection in ephemeral streams. Clearly, the goals and purposes of stream protection need to be reinterpreted for ephemeral stream channels, and cannot be imported from humid regions.

In humid watersheds, the first objective of stormwater management is the protection of perennial streams, with goals such as maintaining pre-development flow rates, habitat conditions, water quality and biological diversity. In contrast, the objectives for stormwater management in most arid watersheds are ultimately driven either by flood control or the quality of a distant receiving water, such as a reservoir, estuary, ocean, or an underground aquifer. Witness some of the recent water quality problems in arid and semi-arid watersheds for which stormwater is suspected to be primarily responsible: beach closures along the Southern California coast, trash and floatables washed into marinas in Santa Monica, nutrient enrichment in recreational reservoirs like Cherry Creek Reservoir in Denver and Town Lake in Austin, trace metals violations in the estuarine waters of San Francisco Bay, or concerns about the quality and quantity of groundwater recharge in aquifers of San Antonio and Austin. Usually, the only local concern is preventing the loss of capacity of irrigation channels or storage reservoirs caused by sedimentation.

Groundwater is a particularly valued water resource in arid and semi-arid watersheds. Many fast-growing western communities are highly reliant on

Box 1 **An Arid River Runs Through It**

Consider, for a moment, the characteristics of the South Platte River as it runs through Denver, Colorado, as chronicled by Harris et al (1996). Flow in the South Platte river is extremely variable with a few thunderstorms and the spring snow melt causing a half dozen dramatic peaks in discharge. Normally, however, river flows quite low, falling below the average daily flow level some 354 days a year. Much of the flow in the South Platte has been spoken for: it has been estimated that river water is used and returned back to the river from three to seven times before it leaves the state (primarily due to upstream water appropriations for irrigation). Most of the time, the river's flow is sustained by municipal wastewater effluent flows, which contribute about 90% of the river's daily flow during most of the year. Indeed, without wastewater and irrigation flows, the river would frequently run dry (as it had prior to settlement). The river continues to strongly interact with groundwater, and much of the flow moves underground. The South Platte is very warm, with summer surface water temperatures exceeding 30 degrees Celsius (and fluctuating by as much as 15 degrees each day).

From a water quality standpoint, the South Platte frequently suffers from oxygen depletion, and has high concentrations of dissolved salts and nitrogen. Prior to settlement, the South Platte River was not believed to have riparian forest corridors, but in recent years, introduced species have become well established along many parts of the river. The quality of river habitat is generally regarded as poor, due to low flows, sandy, shifting substrates, and a lack of channel structure and woody debris. The river's channel continually changes in response to extreme variations in both flow and sediment supply. These extremely variable conditions are not conducive to a diverse aquatic habitat for aquatic insects or fish. For example, fewer than a dozen fish species inhabit the South Platte River, as compared to 30 or more that might be found in a humid region.

11- 301

Table 2. Rainfall Statistics for Eight U.S. Cities (all units in inches) Sources: NOAA, 1997; US DOC, 1975; CWP 1999

City	Rainfall Statistics					
	Annual Rainfall	Days of Rain per Year	90% Rainfall Event	Annual Evaporation Rate	Two Year, 24 Hour Storm	Ten Year, 24 Hour Storm
Washington, DC	38	67	1.2	48	3.2	5.2
Dallas, TX	35	32	1.1	66	4.0	6.5
Austin, TX	33	49	1.4	80	4.1	7.5
Denver, CO	15	37	0.7	60	1.2	2.5
Los Angeles, CA	12	22	1.3	60	2.5	4.0
Boise, ID	11	48	0.5	53	1.2	1.8
Phoenix, AZ	7.7	29	0.8	82	1.4	2.4
Las Vegas, NV	4	10	0.7	120	1.0	2.0

groundwater resources, and it is becoming a limiting factor for some. On a national basis, groundwater provides 39% of the public water supply. In the arid and semi-arid southwest, however, groundwater sources comprise 55% of the water supply (Maddock and Hines, 1995). Consequently, these communities have a strong interest in both the recharge and protection of groundwater on which they depend.

Rainfall Depths Are Much Smaller

Table 2 compares a series of rainfall statistics for eight arid, semi-arid and humid cities and documents that it rarely rains in arid watersheds. For example, in the fast growing Las Vegas, Nevada region, rainfalls greater than a tenth of an inch occur, on average, less than ten days a year. Not only does rain seldom fall, not much falls when it does. For example, 90% of all rainfall events in a given year are usually less than 0.50 to 0.80 inches in arid watersheds, compared to 1.0 to 1.5 inches in humid watersheds. If a "90% rule" was used in many arid regions, the water quality storm would be roughly half that of most semi-arid and humid watersheds, which would greatly reduce the size, land consumption and cost of structural practices that need to be built. In many cases, the entire water quality storm could be disposed of on-site through better site design, without the need for structural practices. It should be noted that there are some significant exceptions to this rule. Los Angeles, for example, experiences higher rainfall depths due to intense coastal storms in the winter, especially in el Nino years.

While intense storms cause the flash flooding that is so characteristic of the west, it is also important to keep in mind that the depth of rainfall in these storms is smaller than that of semi-arid and humid watersheds (Table 2). For example, the rainfall depth associated with the two-year 24-hour storm in most arid watersheds ranges from 1.0 to 1.4 inches, which is roughly equal to the typical water quality storm for a humid watershed. Similarly, the rainfall depth for the ten-year 24-hour storm in most arid watersheds ranges from two to three inches, which is roughly equivalent to the depth of a two-year storm in a semi-arid or humid watershed. Consequently, stormwater managers in arid regions can fully treat the quality and quantity of stormwater with about a third to a half of the storage needed in humid or semi-arid watersheds, with all other factors being equal.

Even though the rainfall depths in arid watersheds are lower, watershed development can greatly increase peak discharge rates during rare flood events. For example, Guay (1996) examined how development had changed the frequency of floods in arid watersheds around Riverside, California. Over two decades, impervious cover increased from 9% to 22% in these fast-growing watersheds. As a direct result, Guay determined that peak flow rate at gauged stations for the two-year storm event had climbed by more than 100%, and that the average annual stormwater runoff volume had climbed by 115% to 130% over the same time span.

Watershed development can greatly increase peak discharge rates during rare flood events.

Evaporation Rates are Greater

High evaporation rates are a great challenge in arid and semi-arid watersheds. Low rainfall combined

11-302

with high evaporation usually means that stored water will be lost water. In Las Vegas, for example, annual rainfall is a scant four inches, while pan evaporation exceeds ten feet (See Table 2). Consequently, it is virtually impossible to maintain a pond or wetland in an arid watershed without a supplemental source of water (see Saunders and Gilroy, 1997; *Technical Note* 111). Evaporation also greatly exceeds rainfall for many months of the year in semi-arid watersheds, and requires special pond design techniques.

As streams urbanize, dry weather flow can actually increase.

Pollutant Concentrations in Stormwater Are Often Higher

The pollutant concentration of stormwater runoff from arid watersheds tends to be higher than that of humid watersheds. This is evident in Table 3, which compares event mean concentrations (EMCs) from five arid or semi-arid cities to the national average for several common stormwater pollutants. As can be seen, the concentration of suspended sediment, phosphorus, nitrogen, carbon and trace metals in stormwater runoff from arid and semi-arid watersheds consistently exceeds the national average, which is heavily biased toward humid watersheds. In addition, bacteria levels are often an order of magnitude higher in arid regions (Chang, 1999).

The higher pollutant concentrations in arid watersheds can be explained by several factors. First, since rain events are so rare, pollutants have more time to build up on impervious surfaces compared to humid regions. Second, pervious areas produce high sediment and organic carbon concentrations because the sparse vegetative cover does little to prevent soil erosion in uplands and along channels when it does rain. The strong effect of upland and channel erosion can be detected when stormwater samples are taken from channels, but are less pronounced in stormwater outfall pipes.

Vegetative Cover is Sparse in the Watershed

Native vegetative cover is relatively sparse in arid and semi-arid watersheds, and offers little protection against soil erosion. Irrigation is required to establish dense and vigorous cover, which may not be sensible or economical given scarce water resources. In addition, high flows released from storm drains frequently accelerate downstream erosion since channels are also sparsely vegetated. Finally, many stormwater practices require dense vegetative cover to perform properly (e.g., grass swales are often not practical in arid watersheds, given the difficulty to establish and maintain turf).

Sediment Movement Is Greater

Stream channels in arid and semi-arid watersheds move a lot of sediment when they flow. For example, Trimble (1997) found that stream channel erosion supplied more than two thirds of the annual sediment yield of an urban San Diego Creek. He concluded that the higher flows due to watershed urbanization had greatly accelerated the erosion of arroyos, over and above the increases caused by grazing, climate and riparian management. Channel erosion can be particularly severe along road ditches that experience higher stormwater flows, which not only increases sediment erosion but also creates chronic ditch maintenance problems.

Dry Weather Flows Are Rare, Unless Supplemented by Return Water

Most small streams in arid watersheds are gullies or arroyos that only flow during and shortly after infrequent storm events. As streams urbanize, however, dry weather flow can actually increase. Human sources of dry weather flow include return flows from lawn and landscape watering, car washing, and surface discharges of treated wastewater. For example,

Figure 2: Arial Photograph from Boise, Idaho

11-303

Mizell and French (1995) found that excess water from residential and commercial landscape irrigation and construction site dewatering greatly increased rate and duration of dry weather flow in a Las Vegas Creek, and was sufficiently reliable to be the primary irrigation source for a downstream golf course.

Stormwater Strategies for Arid and Semi-Arid Watersheds

Watershed managers need to carefully choose stormwater practices that can meet the demanding climatic conditions and water resource objectives of arid and semi-arid watersheds. Communities can employ three broad strategies: aggressive source control, better site design, and application of "western" stormwater practices. Some of the key trends in each of these areas are described below.

Aggressive Source Control

The term "source control" encompasses a series of practices to prevent pollutants from getting into the storm drain system in the first place. The practices include pollution prevention, street sweeping, and more frequent clean outs of storm drain inlets. Each practice acts to reduce the accumulation of pollutants on impervious surfaces or within the storm drain system during dry weather, thereby reducing the supply of pollutants available for wash off when it rains.

Pollution prevention. Pollution prevention seeks to change behaviors at residential, commercial and industrial sites to reduce exposure of pollutants to rainfall. Almost all arid stormwater managers considered pollution prevention measures to be an integral element of their stormwater management program, on par with the use of structural stormwater practices (Caraco, 1997). Indeed, many western communities have pioneered innovative pollution prevention programs (see *On Watershed Education*, this issue). These programs focus on educating homeowners and businesses on how they can reduce or prevent pollutants from entering the storm drain system when it's not raining.

In recent years, western communities have been targeting their educational message to more specific groups and populations (see *On Watershed Education*, this issue). For example, Los Angeles County has identified seven priority categories for intensive employee training in industrial pollution prevention — auto scrap yards, auto repair, metal fabrication, motor freight, chemical manufacturing, car dealers, and gas stations— on the basis of their hotspot potential and their numerical dominance (Swammikannu, 1998). In the Santa Clara Valley of California, the three key priorities for intensive commercial pollution prevention training are car repair, construction, and landscaping services. Targeting is also used to reach homeowners with specific water conservation, car washing, fertilization and pesticide messages (see *On Watershed Education*).

Street sweeping. Street sweeping seeks to remove the buildup of pollutants that have been deposited along the street or curb, using vacuum assisted sweeper trucks. The pollutant removal performance of a new generation of street sweeper was recently reviewed in *Technical Note* 103. While researchers continue to debate whether street sweepers can achieve optimal performance under real-world street conditions, most concede that street sweeping should be more effective in areas that have distinct wet and dry seasons (CDM, 1993), which is a defining characteristic of arid and semi-arid watersheds.

> Better site design presents a great opportunity to minimize impervious cover and stormwater impacts in the west.

Storm drain inlet clean outs. One of the last lines of defense to prevent pollutants from entering the storm drain system is to catch them in the storm drain inlet. Mineart and Singh (1994) reported that monthly or even quarterly clean outs of sediment in storm drain inlets could reduce stormwater pollutant loads to the San Francisco Bay by 5% to 10%. Currently, few communities clean out their storm drain inlets more than once a year, but a more aggressive effort by public works to clean out storm drains prior to the onset of the wet season could be a viable strategy in some communities.

Better Site Design

Better site design clearly presents great opportunities to reduce impervious cover and stormwater impacts in the west, but has not been widely implemented to date. Indeed, the "California" development style, with its wide streets, massive driveways, and huge cul-de-sacs has been copied in many western communities and arguably produces more impervious cover per home or business than any other part of the country (Figure 2). While the popularity of the California development style reflects the importance of the car in shaping communities, it is also a strong reaction against the arid and semi-arid landscape. The brown landscape is not green or pastoral, and many residents consider concrete and turf to be a more pleasing and functional land cover than the dirt and shrubs they replace.

While the techniques and benefits of better site design have been extensively profiled in the last issue of *Techniques* (3:2), it is worth discussing how these techniques can be adapted for western developments.

11-304

A key adaptation is to incorporate the concept of "stormwater harvesting" into residential and commercial development design (COT, 1996). Water harvesting is an ancient concept that involves capturing runoff from rooftops and other impervious surfaces and using it for drinking water or to irrigate plants (e.g., the cistern). In a more modern version, rooftop runoff is spread over landscaping areas or the yard, with the goal for complete disposal of runoff on the property for storm events up to the two-year storm (which ranges from one to two inches in most arid and semi-arid climates. For example, the City of Tucson recommends 55 gallons of storage per 300 to 600 square feet of rooftop for residential bioretention areas (COT, 1996). In higher density settings, it may be more practical to store water in a rain barrel or cistern for irrigation use during dry periods.

When water harvesting is aggressively pursued, stormwater runoff is produced only from the impervious surfaces that are directly connected to the roadway system. Denver has utilized a similar strategy program to disconnect impervious areas and reduce the amount of stormwater pollution (DUDFC, 1992). A useful guide on these techniques has also been produced for the San Francisco Bay area (BASMAA, 1997). Water harvesting may also prove to be a useful stormwater retrofitting strategy, particularly in regions where water conservation is also a high priority.

Better site design principles also need to be adapted for fire safety in Western communities adjacent to chaparral vegetation that are prone to periodic wildfires. In some case, vegetation setbacks must be increased in these habitats to protect developments from dangerous wildfires (CWP, 1998).

Developing Western Stormwater Practices

Given the many challenges and constraints that arid and semi-arid watersheds impose, managers need to adapt and modify stormwater practices that were originally developed in humid watersheds. In our stormwater managers survey, four recurring principles emerged on how to design "western" stormwater practices that are suited to the challenging climate and water resource problems of arid and semi-arid watersheds:

1. Carefully select and adapt stormwater practices for arid watersheds
2. Minimize irrigation needs for stormwater practices
3. Protect groundwater resources and encourage recharge

Table 3. Stormwater Pollutant Event Mean Concentrations in Arid and Semi-Arid Regions (Units: mg/l, except for metals which are in ug/l)

Pollutant	National	Phoenix, AZ	Boise, Idaho	Denver, Colorado	San Jose, California	Dallas, Texas
Source	(1)	(2)	(3)	(4)	(5)	(6)
Rainfall		7.1 inches	12 inches	13 inches	14 inches	28 inches
N	2-3000	40	15	35	67	32
TSS	78.4	227	116 *	384	258	663
BOD	14.1	109	89	nd	12.3	12
COD	52.8	239	261	227	nd	106
Total N	2.39	3.26	4.13	4.80	nd	2.70
Total P	0.32	0.41	0.75	0.80	0.83 #	0.78
Soluble P	0.13	0.17	0.47	nd	nd	nd
Copper	14	47	34	60	58	40
Lead	68	72	46	250	105	330
Zinc	162	204	342	350	500	540

References: (1): Smullen and Cave, 1998, (2) Lopes et al, 1995 (3) Kjelstrom, 1995 (computed) (4) DRCOG, 1983, (5) WCC, 1992 (computed) (6) Brush et al, 1995.
Notes: nd= no data, # = small sample size * = outfall pipe samples

11-305

R0073047

4. Reduce downstream channel erosion and protect from upland sediment

1. Carefully select and adapt stormwater practices for arid watersheds

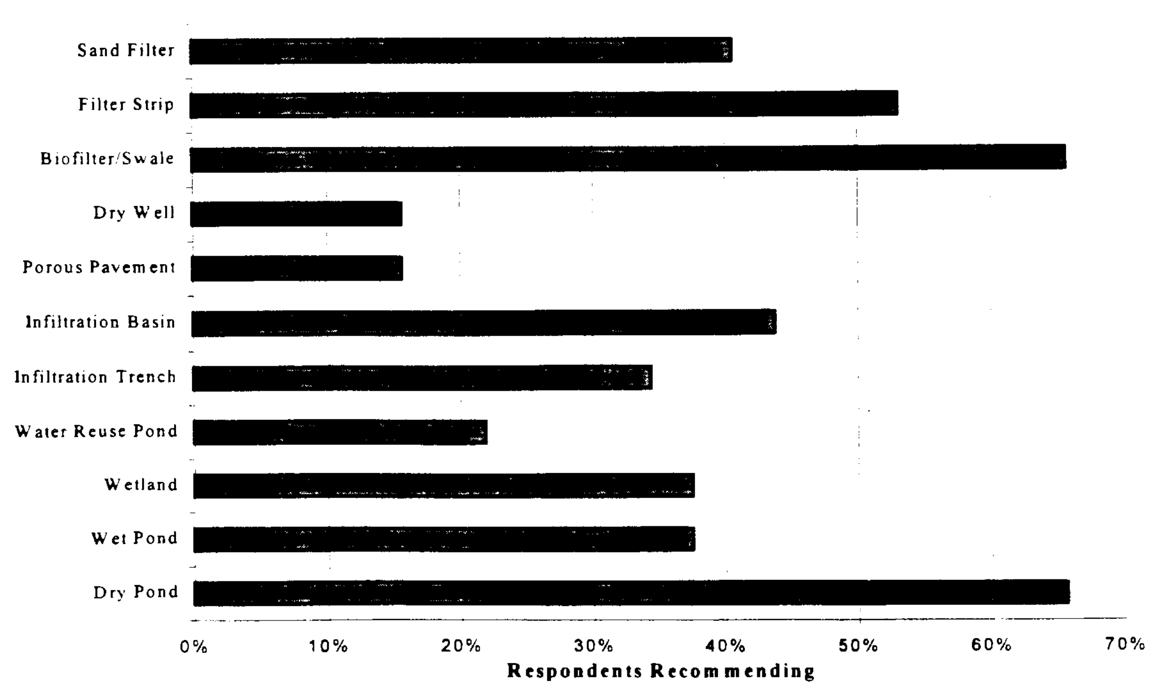
Some stormwater practices developed in humid watersheds are simply not applicable to arid watersheds, and most others require major modifications to be effective (Table 4). Even in semi-arid watersheds, design criteria for most stormwater practices need to be revised to meet performance and maintenance objectives. The following section highlights some of the major design and performance differences to consider for major stormwater practices.

Extended Detention (ED) Dry Ponds. The most widely utilized stormwater practices in arid and semi-arid watersheds were dry ponds, according to the Center's survey (Figure 3). Most were designed exclusively for flood control, but can be easily modified to provide greater treatment of stormwater quality. While dry ED ponds are not noted for their ability to remove soluble pollutants, they are reasonably effective in removing sediment and other pollutants associated with particulate matter (see *Technical Note* 95). In addition, ED ponds can play a key role in downstream channel protection, if the appropriate design storm is selected, and adequate upstream pretreatment is incorporated. Dry extended detention is the most feasible pond practice in arid watersheds, since they do not require a permanent pool of water.

Wet Ponds. Wet ponds are often impractical in arid watersheds since it is not possible to maintain a permanent pool without supplemental water, and the ponds become stagnant between storms. Wet ponds are feasible in some semi-arid watersheds, on the other hand, when carefully designed. Performance monitoring studies have demonstrated that wet ponds exhibit greater pollutant removal than other stormwater practices in Austin, Texas, at a lower cost per volume treated (COA, 1998, and *Technical Note* XX). In arid and semi-arid climates, wet ponds can require supplemental water to maintain a stable pool elevation. Saunders and Gilroy (1997) reported that 2.6 acre-feet per year of supplemental water were needed to maintain a permanent pool of only 0.29 acre-feet. Generally speaking, stormwater designers working in semi-arid watersheds should design for a variable pool level that can have as much as a three-foot draw down during the dry season. The use of wetland plants along the pond's shoreline margin can help conceal the drop in water level, but managers will need to reconcile themselves to chronic algal blooms, high densities of aquatic plants and occasional odor problems. The City of Austin has prepared useful wet pond design criteria to address these issues (COA, 1997).

Stormwater Wetlands. Few communities recommend the use of stormwater wetlands in either arid or semi-arid watersheds. Once again, the draw down rates caused by evaporation make it difficult to impossible to maintain standing water that can sustain emergent wetland plants, unless copious subsidies of supplemental water

Figure 3: BMP Preferences in Arid Climates



II-306

are supplied. One interesting exception was a gravel-based wetland that treated parking lot runoff in Phoenix, Arizona (Wass and Fox, 1995). While the wetland did require some supplemental water, evaporation was reduced by the overlying gravel bed, and the wetland achieved relatively high removal rates of oil and grease.

Sand Filters. Sand filters continue to be one of the most common practices used to treat the quality of stormwater in both arid and semi-arid watersheds. Sand filters require no supplemental water and can be used with almost any soil type. Still, the basic sand filter design continues to evolve to counter the tough design conditions found in these regions. For example, Urbonas (1997) evaluated sand filter performance in Denver, Colorado, and concluded that designs need to be modified to account for the greater sediment buildup in arid regions (*Technical Note* 100). Urbonas found that the

Table 4. Design Modifications for Stormwater Practices in Arid and Semi-Arid Watersheds

Stormwater Practice	Arid Watersheds	Semi-Arid Watersheds
ED Dry Ponds	PREFERRED multiple storm ED stable pilot channels "dry" forebay	ACCEPTABLE dry or wet forebay needed
Wet Ponds	NOT RECOMMENDED evaporation rates are too high to maintain a normal pool without extensive use of scarce water	LIMITED USE liners to prevent water loss require water balance analysis design for a variable rather than permanent normal pool use water sources such as AC condensate for pool aeration unit to prevent stagnation
Stormwater Wetlands	NOT RECOMMENDED evaporation rates too great to maintain wetland plants	LIMITED USE require supplemental water submerged gravel wetlands can help reduce water loss
Sand Filters	PREFERRED requires greater pretreatment exclude pervious areas	PREFERRED refer to COA, 1997 for design criteria
Bioretention	MAJOR MODIFICATION no irrigation better pretreatment treat no pervious area xeriscape plants or no plants replace mulch with gravel	MAJOR MODIFICATION use runoff to supplement irrigation use xeriscaping plants avoid trees replace mulch with gravel
Rooftop Infiltration	PREFERRED dry well design for recharge of residential rooftops	PREFERRED recharge rooftop runoff on-site unless the land use is a hotspot
Infiltration	MAJOR MODIFICATION no recharge for hotspot land uses treat no pervious area multiple pretreatment soil limitations	MAJOR MODIFICATION no recharge for hotspot land uses treat no pervious area multiple pretreatment
Swales	NOT RECOMMENDED not recommended for pollutant removal, but rock berms and grade control needed for open channels to prevent channel erosion	LIMITED USE limited use unless irrigated rock berms and grade control essential to prevent erosion in open channels

11-307

R0073049

test sand filter quickly became clogged with sediment after just a few storms, and recommended that sand filters include a more frequent sediment clean out regime, an increase in the filter bed size, and upstream detention to provide greater sediment pretreatment. Some additional research on the performance and longevity of sand filters in the semi-arid climate of Austin, Texas can be found in *Technical Notes* 111 and 112 (this issue).

Bioretention. The use of bioretention as a stormwater treatment practice is not very common in many western communities at the present time. Clearly, this practice will require extensive modification to work in arid watersheds. This might entail xeriscape plantings, use of gravel instead of mulch as ground cover, and better pretreatment. Sprinkler irrigation of bioretention areas should be avoided.

Infiltration Practices. While a number of communities allowed the use of infiltration in arid and semi-arid watersheds, few encouraged its use. Two concerns were frequently cited as the reason for lack of enthusiasm for structural infiltration. The first concern was that infiltration practices are too susceptible to rapid clogging, given the high erosion rates that are customary in arid and semi-arid watersheds. The second concern was that untreated stormwater could potentially contaminate the aquifers that are used for groundwater recharge.

Swales. The use of grass swales for stormwater treatment was rarely reported for arid watersheds, but was much more common in semi-arid conditions. Grass swales are widely used as a stormwater practice in residential developments in Boise, Idaho, but the dense turf can only be maintained in these arid conditions through the use of sprinkler irrigation systems. The pollutant removal performance of swales in arid and semi-arid watersheds appears to be mixed (Table 5). Poor to negative pollutant removal performance was reported in a Denver swale that was not irrigated (Urbonas, 1999 -personal communication). In the semi-arid climate of Austin, Texas, Barret et al (1998) reported excellent pollutant removal in two highway swales that were vegetated but not irrigated. Similar performance was also noted in a non-irrigated swale monitored by the City of Austin (COA, 1997).

2. Minimize irrigation needs for stormwater practices

In arid climates, all sources of water, including stormwater runoff, need to be viewed as a resource. It seems senseless, therefore, to irrigate a practice with 50 inches of scarce water a year so that it can be ready to treat the stormwater runoff produced from 10 inches of rain a year. Still, irrigation of stormwater practices the 183 and Walnut Creek sites. In our survey of stormwater managers, 65% reported that irrigation was commonly used to establish and maintain vegetated cover for most stormwater practices.

Irrigation should be limited to practices that meet some other landscaping or recreational need in a community and would be irrigated anyway, such as landscaping islands in commercial areas and road rights of way. Irrigation may also be a useful strategy for dry ED ponds that are designed for dual use, i.e., facilities that serve as a ballfield or community park during the dry season. Even when irrigation is used, practices should be designed to "harvest" stormwater, and therefore reduce irrigation needs. Landscapers should also consider planting native drought resistant plant material to

Table 5. Performance of Vegetated Swales in Semiarid Climates
Source: Barret et al, 1997, and COA, 1998

	Highway 183 median	**Walnut Creek**	**City of Austin Swale**
Parameter	Mass Load Reduction (%)		
TSS	89	87	68
COD	68	69	33
TP	55	45	43
TKN	46	54	32
Nitrate	59	36	(-2)
Zinc	93	79	ns
Lead	52	31	ns

ns = not sampled. Fecal coliform and fecal strep removals were negative at the 183 and Walnut Creek sites.

11-308

reduce water consumption.

3. Protect groundwater resources and encourage recharge

In many arid communities, protection of groundwater resources is the primary driving force behind stormwater treatment. Ironically, early efforts to use stormwater to recharge groundwater have resulted in some groundwater quality concerns. In Arizona, for example, stormwater was traditionally injected into 10 to 40 foot deep dry wells to provide for groundwater recharge. Concerns were raised that deep injection could increase the risk of localized groundwater contamination, since untreated stormwater can be a source of pollutants, particularly if the proposed land use is classified as a stormwater hotspot.

Wilson et al (1990) evaluated the risk of dry well stormwater contamination in Pima County, Arizona, and determined that dry wells had elevated pollutant concentrations in local groundwater. The build up of pollutant levels that had occurred over several decades tended to be localized, and did not exceed drinking water standards. Still, it is important to keep in mind that dry wells and other injection recharge methods should only be used to infiltrate relatively "clean" runoff, such as residential roofs. Other surface infiltration practices, such as trenches and basins, can also potentially contaminate groundwater unless they are carefully designed for runoff pretreatment, provide a significant soil separation distance to the aquifer, and are not used on "hot spot" runoff sites.

In many arid communities, protection of groundwater ,sources is the primary driving force behind stormwater treatment.

4. Design to reduce channel erosion

Above all, the western stormwater practice must be designed to reduce *downstream* erosion in ephemeral channels, while at the same time protecting itself from sediment deposition from *upstream* sources. This is a daunting challenge for any engineer, but the following ideas can help.

With respect to *downstream channel erosion*, designers will need to clamp down on the storm events that produce active erosion in channels. This might entail the design of ponds or basins that can provide 12 hours of extended detention for the one-year return interval storm event (which is usually no more than an inch or two in most arid and semi-arid watersheds). Local geomorphic assessment will probably be needed to set channel protection criteria, and these hydraulic studies are probably the most critical research priority in both arid and semi-arid watersheds today. Without ED channel protection, designers must rely on clumsy and localized engineering techniques to protect ditches and channels from eroding, such as grade control, rock berms, rip-rap, or even concrete lined channels. Bioengineering options to stabilize downstream channels in arid watersheds are limited, and often require erosion control blankets to retain moisture and seeds, as well as extensive irrigation.

Upstream erosion quickly reduces the capacity of any stormwater practice in an arid or semi-arid watershed, due to sparse vegetation cover and erosion from upstream gullies, ditches, or channels. Designers have several options to deal with this problem. The most effective option is to locate the practice so that it can only accept runoff from impervious areas, particularly for infiltration, sand filters and bioretention. Even then, the practice will still be subject to sediment transported by the wind.

All stormwater practices in arid and semi-arid watersheds require greater pretreatment *than in humid watersheds.* Seventy percent of the arid stormwater managers surveys reported that sediment clogging and deposition problems were a major design and maintenance problem for nearly all of their stormwater practices.

Even though not all upstream erosion can be prevented, designers can compensate for sediment buildup within the stormwater practice itself. Pretreatment and over-sizing can prevent the loss of storage or clogging associated with sediment deposition. As noted in *Technical Note* 112, rock berms or vertical gravel filters are ideally suited as a pretreatment device.

Most stormwater managers surveyed indicated that sediment cleanout regimes for stormwater practices need to be more frequent in arid and semi-arid watersheds, with removal after major storms and at a minimum, once a year. Lastly, stormwater managers consistently emphasized the need for better upland erosion control during construction. A full 65% of the managers reported that upstream erosion and sediment control was a major emphasis during their stormwater plan review.

Summary

It is clear that stormwater managers in arid and semi-arid climates cannot simply import the stormwater programs and practices that were originally developed for humid watersheds. Instead, they will need to develop stormwater solutions that combine aggressive source control, better site design and stormwater practices in a distinctly western context. Regulators, in turn, need to recognize that western climates, terrain and water resource objectives are different, and be flexible and willing to experiment with new approaches in municipal stormwater programs. Lastly, stormwater managers from arid and semi-arid watersheds must work more closely together to share experiences about the stormwater solutions that work and fail. It is only through this dialogue that western communities can gradually engineer stormwater practices that are rugged enough to withstand the demanding challenges of the arid and semi-arid west.

References

Barret, M., M. Keblin, P. Walsh. , J. Malina and R. Charbeneau. 1998. *Evaluation of the performance of permanent runoff controls: summary and conclusions.* Center for Transportation Research. Texas Dept of Transportation. University of Texas. Austin, TX. 37 pp.

Brush, S, M. Jennings, J. Young, and H. Mcreath. 1995. *NPDES monitoring–Dallas/Forth Worth Texas area.* pp. 115-143. In *Stormwater NPDES Monitoring Needs.* American Society of Civil Engineers.

Camp Dresser and McKee (CDM), Larry Walker Associates, and Uribe and Associates, and Resources Planning Associates. 1993. *California stormwater best management practices handbook.* Prepared for: California Water Quality Control Board. Sacramento, CA

Caraco, D. 1997. *BMP supplement for cold climates.* U.S. Environmental Protection Agency. Center for Watershed Protection. Ellicott City, MD. 112 pp.

Center for Watershed Protection (CWP). 1997. *Survey of stormwater managers in arid and semi-arid climates.* Ellicott City, MD, Unpublished data.

City of Austin (COA). 1994. *Environmental criteria manual: guidelines for BMP design.* City of Austin Drainage Utility. Austin, TX.

City of Austin, (COA) 1997. Wet Ponds. Section 1.6.6.C of *Environmental Criteria Manual.* City of Austin, TX Drainage Utility.

City of Tucson (COT) Stormwater Quality Program. 1996. *Water harvesting fact sheets.* Tucson, AZ.

Claytor, R. and T. Schueler. 1997. *Design of stormwater filtering systems.* Prepared for: Chesapeake Research Consortium. Center for Watershed Protection. Ellicott City, MD.

Denver Regional Council of Governments (DRCOG). 1983. *Urban runoff quality in the Denver region.* Prepared for US EPA NURP Program. Denver, CO. 240 pp.

Glick, R., G. Chang and M. Barret. 1998. *Monitoring and evaluation of stormwater quality control basins.* Water Environment Federation Speciality Conference. Proceedings Watershed Management: Moving from Theory to Implementation. Denver, CO. May 3-6, 1998.

Guay, J. 1996. *Effects of increased urbanization from 1970's to 1990's on storm runoff characteristics in Perris Valley, California.* USGS Water Resources Investigations Report. 95-4273.

Harris, T., J. Saunders, and. W. Lewis. 1997. *Urban rivers in arid environments–unique ecosystems.* Pp. 421-438 In *Effects of Watershed Development and Management of Aquatic Ecosystems.* L. Roesner, editor. American Society of Civil Engineers. New York, NY.

Kjelstrom, L. 1995. *Data for and adjusted regional regression models of volume and quality of urban stormwater runoff in Boise and Garden City, Idaho, 1993-94.* United States Geological Survey Water Resources Investigations Report 95-4228.

Lopes, T, K. Fossum, J. Phillips and J. Marical. 1995. *Statistical summary of selected physical, chemical, and microbial contaminants and estimates of constituent loads in urban stormwater in Maricopa County, Arizona.* USGS Water Resources Investigations Report 94-4240.

Maddock, T. and W. Hines. 1995. *Meeting future public water supply needs: a Southwest perspective.* Water Resources Bulletin, 31(2): 317-329

Mizell, S. and R. French. 1995. *Beneficial use of dry weather flow in the Las Vegas Valley, Nevada. Water Resources Bulletin.* 31(3): 447-461.

National Oceanographic and Atmospheric Administration (NOAA). 1997. *NCDC Summary of the day weather records.* Silver Spring, MD.

Saunders and Gilroy. 1997. *Treatment of nonpoint source pollution with wetland/aquatic ecosystem best management practices.* Texas Water Development Board. Lower Colorado River Authority. Austin, TX

Smullen, J, and K. Cave. 1998. *Updating the U.S. nationwide urban runoff quality database pp 202-218 in Conference Proceedings.* Third International Conference on Diffuse Pollution. International Association of Water Quality. Edinburgh, Scotland.

11-310

Better Site Design

I. An Introduction to Better Site Design

Few watershed management practices simultaneously reduce pollutant loads, conserve natural areas, save money, and increase property values. Indeed, if such "wonder practices" were ever developed, they would certainly spread quickly across the nation. As it turns out, these practices have existed for years. Collectively called "better site design," the techniques employ a variety of methods to reduce total paved area, distribute and diffuse stormwater, and conserve natural habitats. Despite their proven benefits and successful local application, better site design techniques often fail to earn the endorsement of local communities. In fact, many communities simply prohibit their use.

"Better site design" is a fundamentally different approach to residential and commercial development. It seeks to accomplish three goals at every development site: to reduce the amount of impervious cover, to increase natural lands set aside for conservation, and to use pervious areas for more effective stormwater treatment. To meet these goals, designers must scrutinize every aspect of a site plan—its streets, parking spaces, setbacks, lot sizes, driveways, and sidewalks— to see if any of these elements can be reduced in scale. At the same time, creative grading and drainage techniques reduce stormwater runoff and encourage more infiltration.

Why is it so difficult to implement better site design in so many communities? The primary reason is the outdated development rules that collectively govern the development process: a bewildering mix of subdivision codes, zoning regulations, parking and street standards, and drainage regulations that often work at cross-purposes with better site design. Few developers are willing to take risks to bend these rules with site plans that may take years to approve or that may never be approved at all.

In 1997, a national site planning roundtable was convened to address ways to encourage better site design techniques in more communities. The participants represented the diverse mix of organizations that affect the development process (listed in Table 1) and provided the technical and real world experience to make better site design happen. After two years of discussion, the roundtable endorsed 22 better site design techniques that offer specific guidance that can help achieve one of the basic better site design goals. These techniques are organized into three areas:

1. Residential Streets and Parking Lots
2. Lot Development
3. Conservation of Natural Areas

These techniques are not intended to be strict guidelines, and their actual application should be based on local conditions. The remainder of this article introduces each of the better site design techniques, describes some of the barriers to their wider use, and suggests ways to overcome these impediments.

Residential Streets and Parking Lots

As much as 65% of the total impervious cover in the landscape can be classified as "habitat for cars," which includes streets, parking lots, driveways, and other surfaces designed for the car. Consequently, 10 better site design techniques address ways to reduce car habitat in new developments.

Figure 1: A Neotraditional Community in Gaithersburg, MD
Better site design techniques have been successfully applied in a growing number of communities like the Kentlands

Table 1: Organizations Represented at the National Site Planning Roundtable (Source: CWP,1998b)

The following organizations participated in a two-year long process to craft and refine the 22 model development principles. For a full look at the national consensus agreement, consult our web site at www.cwp.org.

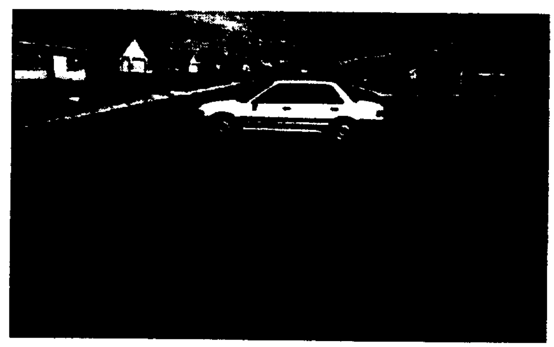
American Association of State Highway Transportation Officials	Land Trust Alliance
American Forest Association	Linowes & Blocher
American Institute of Architects	Loiederman Associates, Inc.
American Planning Association	Michael T. Rose Company
American Public Works Association	Montgomery County Council
American Rivers	Natelli Communities
American Society of Civil Engineers	National Association of Home Builders
American Society of Landscape Architects	National Realty Committee
Chesapeake Bay Program	Natural Resources Defense Council
Community Associations Inc.	Prince Georges County Department of Environmental Resources
The Conservation Fund	U.S. EPA Office of Sustainable Ecosystems and Communities
Office of Comprehensive Planning, County of Fairfax, VA	U.S. Fire Administration
Howard Research and Development Corporation an affiliate of the Rouse Company	Urban Land Institute
Institute of Transportation Engineers	Urban Wildlife Resources
International City/ County Management Association	

Design residential streets for the minimum required pavement width needed to support travel lanes, on-street parking, and emergency, maintenance, and service vehicle access. Street widths should be based on traffic volume.

In some communities, residential streets can be 32, 36, and even 40 feet wide, despite the fact that they only serve a few dozen homes. These wide streets are the greatest source of impervious cover in most subdivisions. Wide residential streets are created by blanket applications of high volume and high speed design criteria, the perception that on-street parking is needed on both sides of the street, and the perception that they provide unobstructed access for emergency vehicles.

Communities have a significant opportunity to reduce impervious cover by revising their street standards to widths of smaller residential access streets. Residential streets widths should be designed to handle expected traffic volumes, provide adequate parking, and ensure access for service, maintenance, and emergency vehicles. Two strategies can help to narrow streets: using queuing streets (see Figure 2) and critically evaluating the need for on-street parking on both sides of the street. Several national engineering organizations have recommended residential streets as narrow as 22 feet in width (ASSHTO, 1994 and ASCE, 1990).

Conventional Street



Queuing Street

(photos by Randall Arendt)

Figure 2: Queuing Streets as a Technique for Minimizing Street Width
While traditional streets are composed of two travel lanes and parking on either side of the road, queuing streets have one designated travel lane and two queuing lanes that can be used for travel or parking.

R0073054

Reduce the total length of residential streets by examining alternative street layouts to determine the best option for increasing the number of homes per unit length.

It stands to reason that a longer street network produces more impervious cover and greater development costs than a shorter one, yet most communities do not even consider whether a shorter street network can serve individual lots on residential streets. It is generally assumed that the cost of constructing roads is sufficient incentive to assure short street networks. Streets are designed to accommodate rapid, smooth traffic flow, and consequently, total street length is rarely the most important design consideration.

There is no one street layout guaranteed to minimize total street length in residential developments. Instead, site designers are encouraged to analyze different layouts to see if they can reduce street length.

Wherever possible, residential street right-of-way widths should reflect the minimum required to accommodate the travel-way, the sidewalk, and vegetated open channels. Utilities and storm drains should be located within the pavement section of the right-of-way wherever feasible.

In many communities, a single right-of-way width of 50 feet or more is applied to all residential street categories. While a wide right-of-way does not necessarily create more impervious cover, it requires more clearing and consumes land that could be used for achieving a more compact site design. By redesigning each of the main components of the right-of-way (ROW), the total width of the ROW can be sharply reduced. Techniques include reducing street width, narrowing sidewalks or restricting them to one side, narrowing the distance between street and sidewalk, and installing utilities beneath street pavement. Combined, these techniques narrow the ROW by 10 to 25 feet.

Minimize the number of residential street cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.

Many communities require the end of cul-de-sacs to be 50 to 60 feet in radius, creating large circles of needless impervious cover. There are several different options to reduce the impervious cover created by traditional cul-de-sacs. One option is to reduce the radius of the turnaround bulb. Several communities have implemented this successfully and the smaller radii can range from 33 to 45 feet. Since vehicles only use the outside of a cul-de-sac when turning, a second option is to create a pervious island in the middle of the cul-de-sac, creating a donut-like effect. A third option is to replace cul-de-sacs with loop roads and hammerheads (see Figure 3).

Where density, topography, soils, and slope permit, vegetated open channels should be used in the street right-of-way to convey and treat stormwater runoff.

Communities often require that curbs and gutters be installed along residential streets, which quickly convey stormwater runoff and associated pollutant loads directly into the stream. In contrast, open channels can remove pollutants by infiltration and filtering, and are also often less expensive than curb and gutter systems.

New engineering techniques have greatly improved the performance of conventional roadside ditches, which have traditionally suffered from erosion, standing water and increased pavement maintenance. One alternative is dry swales, which are designed both to convey the 10 year storm and treat a water quality stream through a sandy loam filter along the roadway (see Figure 4).

Engineering techniques have improved the performance of conventional roadside ditches.

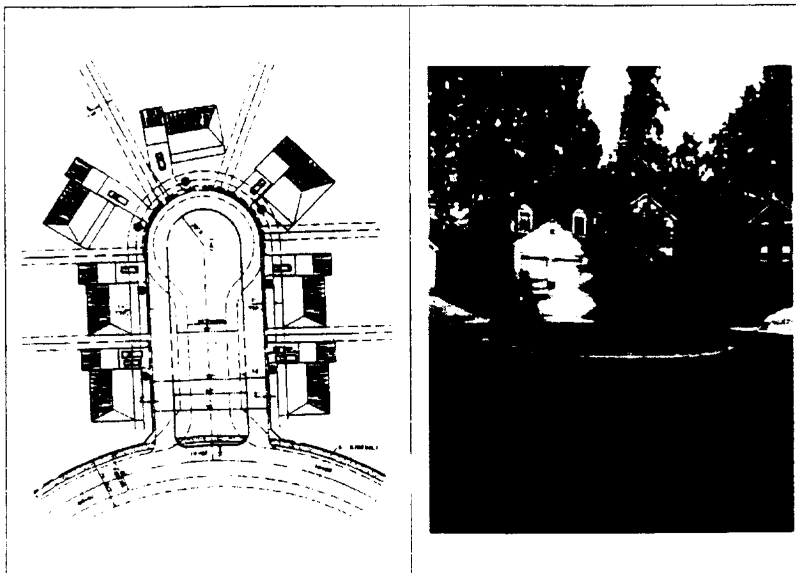


Figure 3: Two Alternatives to the Traditional Cul-de-Sac
A loop road or a pervious island in the middle are two alternatives that can significantly reduce impervious cover.

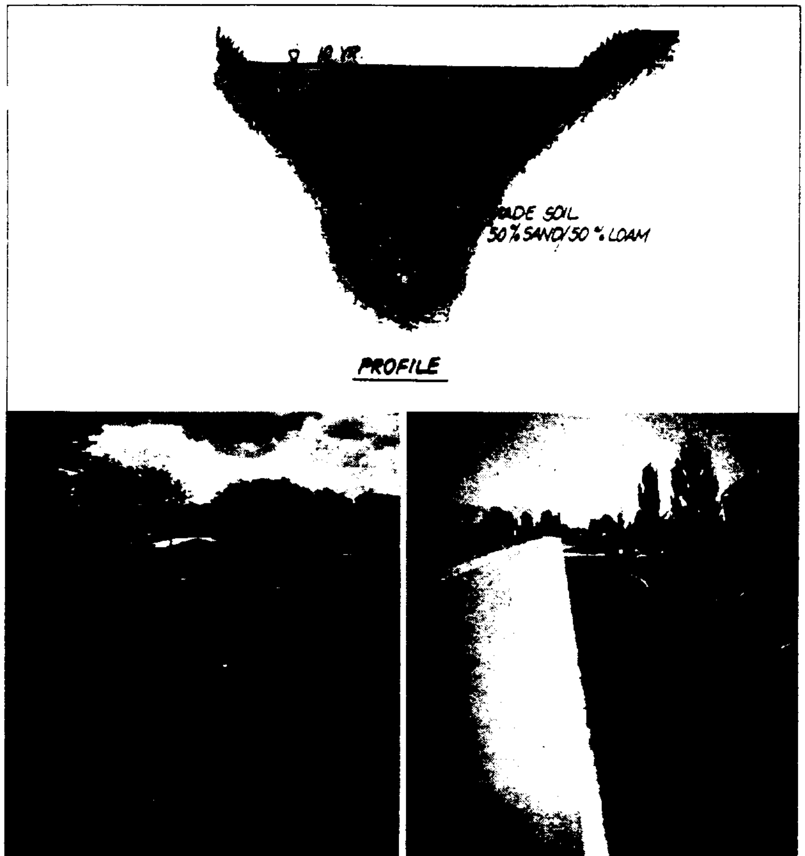


Figure 4: Profile and Two Examples of Open Vegetated Channels
Open vegetated channels allow for infiltration and treatment of stormwater on-site. A dry swale is typically designed to convey the 10 year storm, while treating smaller events with a subsurface composed of a sand and loam filler that treats the runoff before it enters a stream.

The required parking ratio governing a particular land use or activity should be enforced as both a maximum and a minimum in order to curb excess parking space construction. Existing parking ratios should be reviewed for conformance, taking into account local and national experience to see if lower ratios are warranted and feasible.

Many communities routinely build more parking spaces than are needed to meet actual parking demands. This is a result of using outdated or overly generous local parking codes to determine minimum parking ratios.

Communities should check their local codes to ensure that both a minimum and a maximum number of parking spaces are set for each building project (see Table 2 for recommended maximum parking spaces). By referring to national, regional and/or local studies, communities can evaluate their parking needs more accurately, thereby reducing the creation of unnecessary parking spaces. Even small reductions in parking can reduce construction and stormwater management costs. As it turns out, shrinking parking lots is critical in reducing the impact of commercial development (see next Feature Article).

Parking codes should be revised to lower parking requirements where mass transit is available or enforceable shared parking arrangements are made.

Despite the fact that parking lot size can shrink dramatically if credits for shared parking or mass transit are provided, only a handful of communities require or encourage developers to use these tools. Shared parking allows adjacent land uses to share parking lots if peak parking demands occur during different times of the week. Mass transit can reduce the number of vehicle trips, which translates directly into smaller parking lots.

Despite challenges, several communities have successfully provided parking credits for shared parking for reducing the total number of parking spaces created. One such example is Oakland, California, where a thorough study of short and long term parking demand was conducted. By taking an inventory of existing land uses, parking, and occupancy; and by considering vacancy factors, mass transit access, low auto ownership, and operations of special use facilities, the study concluded that parking rate for office space could be reduced from three spaces to 1.44 spaces per 1,000 gross square feet (ITE, 1995).

Reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in the spillover parking areas where possible.

Reducing the size of parking stall dimensions represents another opportunity to reduce impervious cover. The length and often the width of a typical parking stall can often be reduced by a foot or more.

Table 2: Recommended Parking Demand Ratios for Selected Land Uses
(Source CWP 1998b)

Land Use	Better Site Design Parking Ratios
Single Family Homes	2 spaces or less per dwelling unit*
Professional Offices	3.0 spaces or less per 1000 ft^2
Retail	4.0 to 4.5 spaces or less per 1000 ft^2

* can be accommodated in driveway

R0073056

Parking codes can also be amended to require a fixed percentage of smaller stalls for compact cars. Lastly, while permeable parking surfaces can be more expensive to install and maintain, the use of these materials in the 10-20% of the lot that will be used for spillover parking can reduce stormwater treatment costs.

Provide meaningful incentives to encourage structured and shared parking to make it more economically viable.

The type of parking facility in a development site is usually determined by the cost of land balanced against the cost of constructing parking. In suburban and rural areas, the low cost of land makes surface parking more cost-effective than building a garage. In highly urban areas, garages may be a more economical option, since land costs are at a premium.

Vertical parking structures can significantly reduce impervious cover by reducing acreage converted to parking. However, given the economics of surface parking versus garages, it is unlikely that garages will become the norm without incentives. Incentives for defraying some of the costs of parking garages could include tax credits, stormwater waivers or bonuses for density, floor area or building height. A simple way to save on the cost of garages is to incorporate them below or on the first floor of buildings, thereby reducing the structural cost for parking.

Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips, and/or other practices that can be integrated into required landscaping areas and traffic islands.

Although parking lots are a significant source of stormwater pollution, many communities do not require developers to provide stormwater quality control. In other communities, opportunities to minimize and treat stormwater runoff at the parking lot are often overlooked. Parking lots can be made more attractive at the same time they treat stormwater. Bioretention areas, dry swales, perimeter sand filters, and filter strips are all effective at treating stormwater within the parking lot. Figure 5 provides a schematic diagram and example of a bioretention facility.

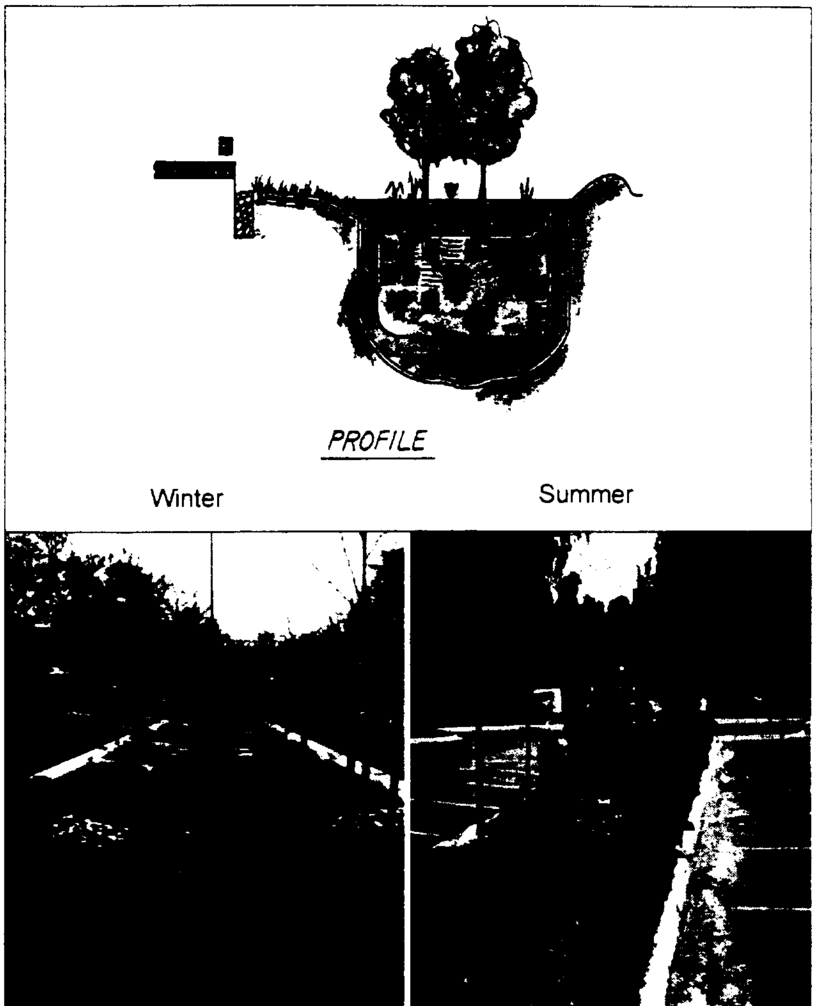


Figure 5: Profile of Parking Lot Bioretention Facilities
Bioretention areas can be designed for parking lots or on-site residential stormwater treatment, and can be an attractive landscaping feature in all seasons.

Lot Development

Many opportunities exist to reduce impervious cover in residential developments by modifying the shape, size, and layout of residential lots. Perhaps the greatest opportunity is to shift from conventional subdivisions to open space or cluster subdivisions.

Advocate open space design subdivisions incorporating smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection.

Open space subdivisions cluster houses into a smaller portion of the development site, leaving more of the site as natural open space. Figure 6 illustrates the differences between a conventional and an open space subdivision. Open space subdivisions have been documented to reduce impervious cover, stormwater runoff, and construction costs (see the second feature article in this issue for more details). While open space subdivisions are not always feasible in dense residential zones (more than six dwelling units per acre), communities that can utilize this technique should consider making open space subdivisions a by-right development option.

Conventional Subdivision | Open Space Subdivision

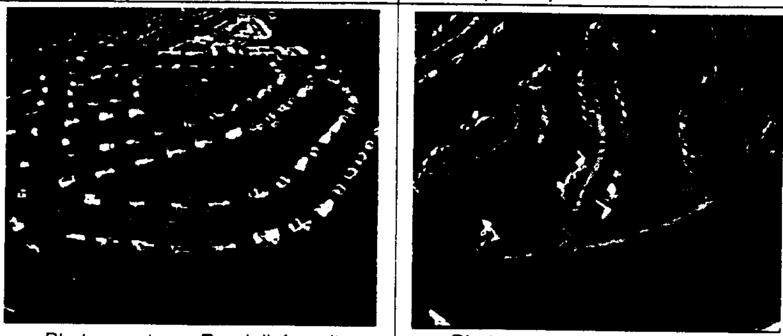


Photo courtesy: Randall Arendt | Photo courtesy: Randall Arendt

Figure 6: Examples of Conventional and Open Space Site Designs
Many conventional developments are designed using a cookie-cutter approach. Open space site designs preserve more of the existing vegetation and reduce the amount of land that is cleared and graded for individual lots.

Long Front Setback | Reduced Front Setback

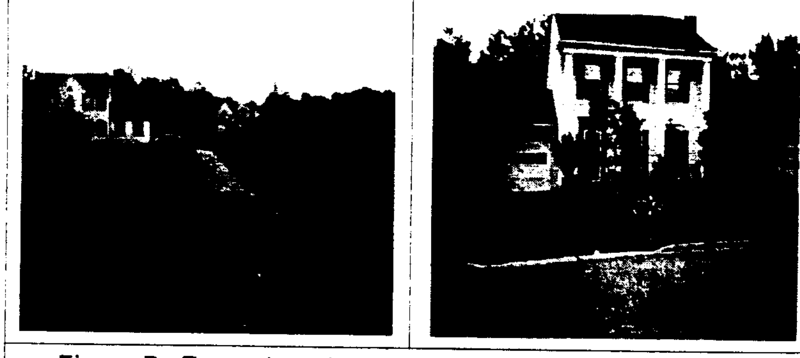


Figure 7: Examples of Long and Reduced Front Setbacks
Smaller front setbacks can reduce site impervious cover, but many current subdivision codes have strict requirements that govern setbacks.

Although open space subdivisions (also known as cluster design) have been advocated by planners for many years, they are often prohibited or severely restricted by local zoning regulations. In 95% of communities surveyed by Heraty (1992), clustering is a voluntary, rather than a mandatory, development option. In addition, open space subdivisions often require a special exception or zoning variance (i.e. they are not a by-right form of development) which requires more review time. Consequently, open space designs are not always widely exercised by developers.

Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce overall lot imperviousness.

Many current subdivision codes have very strict requirements that govern lot geometry, including setbacks and lot shape. These criteria constrain site planners from designing open space or cluster developments that can reduce impervious cover. Smaller front and side setbacks, often essential for open space designs, are typically not allowed or require a zoning variance that may be difficult to obtain.

Relaxing setback requirements allows developers to create attractive, compact lots that are marketable and livable (see Figure 7). For example, side yard setbacks can be as close as five feet from detached housing without specific fire protection measures. Often, fears about fire safety, noise, parking capacity and sight distance impairment are cited as impediments to shorter setbacks, but the reality is that these concerns can be overcome with careful design.

Promote more flexible design standards for residential subdivision sidewalks. Where practical, consider locating sidewalks on only one side of the street and providing common walkways linking pedestrian areas.

Most subdivision codes require sidewalks on both sides of residential streets, constructed of impervious concrete or asphalt, 4-6 feet wide, and 2-10 feet from the street. While these codes are intended to promote pedestrian safety, sidewalks should not be designed so rigidly. Instead, the general goal should be to improve pedestrian movement by diverting it away from street traffic. Often, a sidewalk on one side of the street is sufficient. In fact, in a study of pedestrian accidents associated with sidewalks, there was a negligible difference in accident rates when sidewalks were reported on just one side of the street versus sidewalks on both sides of the street (NHI, 1996).

Communities should also consider reducing the sidewalk width of sidewalks to 3-4 feet and placing them further from the street. Sidewalk design should emphasize the connections between neighborhoods, schools, and shops, instead of merely following the road layout (Figure 8). In addition, sidewalks should be graded to drain to front yards rather than the street. These alternatives reduce impervious cover and provide practical, safe, and attractive travel paths.

Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.

Most local subdivision codes are not very explicit as to how driveways should be designed. Most simply require a standard apron to connect the street to the driveway but do not specify width or surface material for driveways. Typical residential driveways are 12 feet wide for one car driveways and 20 feet wide for two. Shared driveways are discouraged or prohibited by many communities.

Shared driveways can reduce impervious cover, and can work when maintenance agreements and easements can be enforced. By specifying narrower driveways, promoting permeable paving materials, and allowing two-track driveways or gravel and grass surfaces, communities can sharply reduce the typical 400 to 800 square feet of impervious cover created by each driveway (see Figure 9).

Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space.

Open space subdivisions encourage the preservation of common areas that must be effectively managed. Surveys of local open space regulations, however, revealed that open space was poorly defined in most communities (Heraty, 1992). Less than a third required that open space be consolidated. Only 10% required that a portion of open space be maintained as natural cover, and few specified which uses were allowed or excluded in the open space areas. Some communities are wary of open space because they feel that community associations may lack financial, legal, or technical resources to effectively maintain their common areas.

In reality, open space maintained in a natural condition costs up to five times less to maintain than lawns. Communities should explore more reliable methods to assure that responsibility is taken for open space management. Effective methods include creating a community association, or shifting responsibility to a land trust or park through a conservation easement.

Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system.

Often, local codes discourage the storage and treatment of rooftop runoff on individual lots, thus bypassing opportunities to promote filtering or infiltration in the front or back yard. Most subdivision codes require that yards have a minimum slope to ensure drainage away from homes. The slope helps move runoff away from the home to prevent nuisance ponding, basement flooding, or ice formation on driveways or sidewalks. However, these concerns are only significant within 10 or 15 feet from the home foundation.

Sending rooftop runoff over a pervious surface before it reaches an impervious one can decrease the annual runoff volume from residential development sites by as much as 50%. Techniques to treat rooftop runoff in the yard include directing flow into small bioretention areas that encourage sheet flow across vegetated areas (see Figure 10) or infiltrate runoff in trenches, dry wells, or french drains.

Conservation of Natural Areas

Conservation of natural areas is integral to better site design, and the last six techniques deal with conserving and managing natural areas at the development site. These techniques include stream buffers, clearing and grading, tree conservation and stormwater treatment. To fully utilize these techniques, communities may need to offer developers both flexibility and incentives.

Create a variable width, naturally vegetated buffer system along all perennial streams that also encompasses critical environmental features such as the 100-year floodplain, steep slopes and freshwater wetlands.

This technique establishes a three-zone buffer system to protect streams, shorelines and wetlands at the development site (Figure 11). These three zones

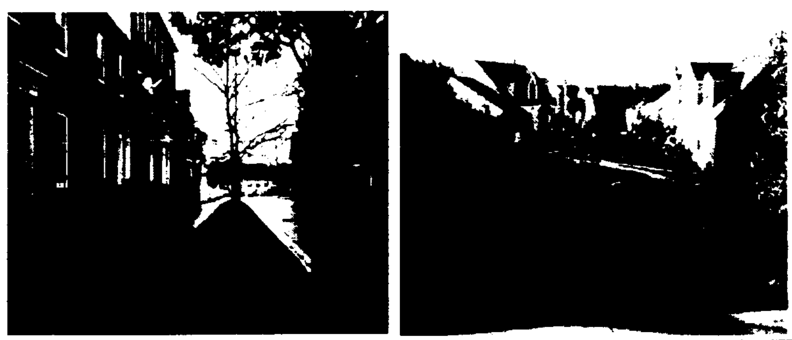


Figure 8: Using Flexible Design Standards for Sidewalks
Creating sensible pathways can produce safe, pedestrian friendly communities.

Figure 9: Examples of Different Types of Shared Driveways
Shared driveways can help reduce the amount of impervious cover created for parking.

R0073059

Figure 10: Alternative Runoff Management
Two alternatives for managing rooftop runoff are bioretention areas and rain barrels.

Shoreline Buffer	A Forested Buffer

Figure 11: Development vs. Buffer
A buffer is more than a setback from the stream or shoreline. Native vegetation cover should be retained within part of the buffer to protect the water quality, treat stormwater, and enhance natural beauty.

are distinguished by the types of allowable uses unique to each zone. In addition, the buffer should incorporate the 100-year floodplain, steep slopes, and freshwater wetlands to fully protect the water quality of streams, help treat stormwater, and enhance the quality of life for residents (Schueler, 1995).

Buffers are noted for their economic benefits as well, including include increased property values, reduced flood damages, and sediment removal costs savings. A model stream buffer ordinance and regional samples can be downloaded from our website at www.cwp.org.

The riparian stream buffer should be preserved or restored with native vegetation. The buffer system should be maintained through the plan review delineation, construction, and post-development stages.

While establishing a buffer is paramount to better site design, assuring that the forest buffer is safeguarded from clear cutting is just as essential. Many communities have stream buffer ordinances, but a line drawn on a map is virtually invisible to contractors and landowners. Few communities require that buffer lines be marked. A strong buffer ordinance should outline the legal rights and responsibilities for management and maintenance during construction and for the long term. An effective buffer program should also indicate who is responsible for these issues and address measures to reestablish buffers using native vegetation. Figure 12 illustrates two techniques for preserving and maintaining natural areas and buffers.

Clearing and grading of forests and native vegetation at a site should be limited to the minimum amount needed to build lots, allow access, and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner.

Most communities allow the entire development site to be cleared and graded, with a few exceptions in specially regulated areas such as jurisdictional wetlands, steep slopes, and floodplains. Since areas that are conserved in their natural state retain their natural hydrology and are not exposed to erosion during construction, it is desirable to conserve as much original soil at the site as possible. Clearing should be limited to the minimum area required for building footprints, construction access, and safety setbacks. Existing tools that could be adapted to limit clearing include erosion and sediment control ordinances, grading ordinances, forest conservation or tree protection ordinances, and open space development. One study has shown that providing grassed lots can add $750 to the value of a lot as compared to bare lots (Harbor and Herzog, 1999). For more information on clearing and grading, see Technical Notes 80, 81, 107 and 108.

Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and conserving native vegetation. Wherever practical, incorporate trees into community open space, street rights-of-way, parking lot islands, and other landscaped areas.

Few communities require that a percentage of trees and native vegetation be conserved during the development process. In fact, many communities promote the use of lawns instead of native vegetation. However, native trees, shrubs, and grasses contribute to the quality of the environment, create a sense of place, and increase property values. Tools that can be used for tree conservation include adopting forest conservation ordinances, encouraging open space design, planting street trees in the rights-of-way,

R0073060

adopting clearing and grading restrictions to preserve trees and native vegetation, and adding landscaping requirements for parking lots.

Incentives and flexibility should be encouraged to promote conservation of stream buffers, forests, meadows, and other areas of environmental value. In addition, off-site mitigation should be encouraged where it is consistent with locally adopted watershed plans.

A small number of communities require conservation of non-regulated areas such as stream buffers, forests, and meadows. Even fewer provide meaningful incentives for developers to conserve more natural areas than they are required to. To combat this problem, communities may want to offer increased flexibility and incentives to reward developers for conserving natural areas.

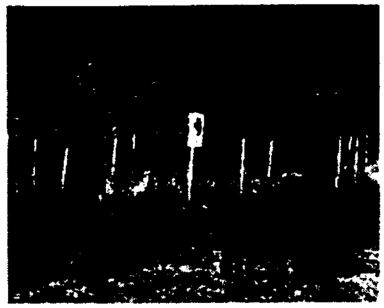
Methods to encourage conservation include by-right open space development, buffer flexibility, property tax credits, density bonuses, transferrable development rights, and providing credits for reduced stormwater management requirements. Stormwater credits exist for natural area conservation, disconnecting rooftop runoff, and routing sheetflow to buffers (MDE, 2000).

New stormwater outfalls should not discharge unmanaged stormwater into jurisdictional wetlands, sole-source aquifers, or sensitive areas.

Stormwater runoff generated from impervious cover can represent a significant threat to the quality of wetlands, surface water and groundwater. While many communities are beginning to require stormwater quality practices, they are often poorly matched to site conditions and watershed objectives.

Stormwater practices can be designed to be effective, attractive and relatively easy to maintain. A well-designed stormwater practice should add value to a community while meeting stormwater management objectives. For new criteria on the design of stormwater practices, refer to the Maryland Stormwater Manual available online: http://www.mde.state.md.us/ environment/wma/

Buffer Reforestation



Tree Conservation Area

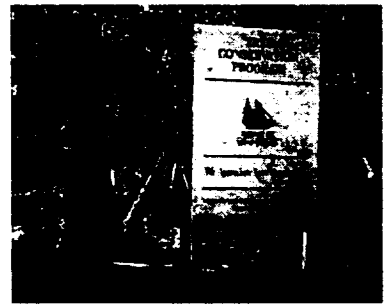


Figure 12: Two Techniques for Natural Areas and Buffers
Buffer reforestation and tree conservation are two important techniques for maintaining natural areas, including buffers. Buffer lines should be clearly marked to protect from clearing and grading both during and after construction.

Summary

For many communities, implementing better site design may require that development rules be changed, and this process is not an easy one. Advocates of better site design are likely to have to answer some difficult questions from fire chiefs, lawyers, traffic engineers, developers, and many others in the community. Will a proposed change make it more difficult to park? Lengthen response times for emergency vehicles? Increase risks to community residents and children? Progress toward better site design will require more local governments to examine their current practices in the context of a broad range of concerns, such as how the changes will affect development costs, local liability, property values, public safety, and a host of other factors.

Subsequent articles in this special issue of *Techniques* supply more background on the benefits of better site design and how it can be implemented in your community. In the next article, *The Benefits of Better Site Design in Residential Subdivisions*, we document how open space subdivisions can reduce runoff, pollutant export and development costs when compared to conventional subdivisions. The third article, *The Benefits of Better Site Design at Commercial Developments*, examines strategies to shrink the parking lots that comprise more than half of the area of new commercial developments and help mitigate the harmful impact parking lots have on the environment. The last article, *Changing Development Rules in Your Community*, describes a process for making better site design happen in your community. Finally, our *Resources* section profiles more than a dozen useful better site design references.

Better site design has considerable potential to reduce the environmental impacts of new development sites, and when adapted properly, of redevelopment sites as well. Better site design is a particularly useful strategy in watersheds where future development is projected to approach or slightly exceed impervious cover thresholds. It should be kept in mind, however, that better site design alone cannot adequately protect most watersheds. It must be combined and integrated with other watershed protection tools, such as watershed planning, land conservation, erosion and sediment control and the rest. These caveats notwithstanding, better site design is the one of the few watershed protection tools that simultaneously provides dividends for watershed advocates, developers and the community as a whole. Consequently, communities are encouraged to invest in the local site planning roundtable process that can make it happen. *–HYK*

Better site design alone cannot adequately protect most watersheds.

Editor's Note: We are currently working on techniques for infill and redevelopment. Beginning later this year, we will begin a national roundtable consensus process focusing on topics, challenges, and concerns. Refer to our website (www.cwp.org) for updates on this project.

References

American Association of State Highway and Transportation Officials (AASHTO). 1994. *A Policy on Geometric Design of Highways and Streets.* AASHTO, Washington, DC. No. 33.

American Society of Civil Engineers (ASCE). 1990. *Residential Streets*, 2nd edition. Co-authors: National Association of Home Builders and Urban Land Institute. Published by the Urban Land Institute, Washington, D.C.

Center for Watershed Protection (CWP). 1998a. *A Consensus Agreement on Model Development Principles.* Ellicott City, MD.

Center for Watershed Protection (CWP). 1998b. *Better Site Design: A Handbook for Changing Development Rules in Your Community.* Ellicott City, MD.

Harbor, Jon and Herzog, Martha. 1999. *Green Subdivision Lots Put Green in Developers' Pockets.* Earth and Atmospheric Sciences, Purdue University. West Lafayette, IN.

Heraty, Maureen. 1992. *An Assessment of the Applicability of Cluster Development Regulations as a Nonpoint Source Pollution Best Management Practice.* Metropolitan Washington Council of Governments. Produced for U.S. EPA Office of Wetlands, Oceans and Watersheds. Washington, D.C.

Institute of Transportation Engineers (ITE). 1995. *Shared Parking Guidelines.* Institute of Transportation Engineers. Washington D.C.

Maryland Department of Environment (MDE). 2000. *Maryland Stormwater Design Manual*, Vol. 1. Center for Watershed Protection. Baltimore, MD.

National Highway Institute (NHI). 1996. *Pedestrian and Bicycle Safety and Accommodations.* U.S. Department of Transportation, Federal Highway Administration, National Highway Traffic Safety Administration, McLean, VA. Publication # HWA-HI96-029. NHI Course No. 38061.

Schueler, Thomas. R. 1995. *Site Planning for Urban Stream Protection.* Center for Watershed Protection. Ellicott City, MD. Prepared for the Metropolitan Washington Council of Governments. Washington, D.C.

R0073062

Better Site Design

II. The Benefits of Better Site Design in Residential Subdivisions

Though they may not realize it, site planners have an excellent opportunity to reduce storm water runoff and pollutant export simply by changing the way they lay out new residential subdivisions. Planners that employ open space design techniques can collectively reduce the amount of impervious cover, increase the amount of natural land conserved, and improve the performance of stormwater treatment practices at new residential developments.

Simply put, open space designs concentrate density on one portion of a site in order to conserve open space elsewhere by relaxing lot sizes, frontages, road sections, and other subdivision geometry. While site designs that employ these techniques go by many different names, such as clustering or conservation design, they all incorporate some or all of the following better site design techniques:

- Using narrower, shorter streets and rights-of-way
- Applying smaller lots and setbacks and narrow frontages to preserve significant open space
- Reducing the amount of site area devoted to residential lawns
- Spreading stormwater runoff over pervious surfaces
- Using open channels rather than curb and gutter
- Protecting stream buffers
- Enhancing the performance of septic systems, when applicable

In this article, we examine some of the benefits of employing better site design techniques as they apply to residential subdivisions. The analysis utilizes a simple spreadsheet computer model to compare actual residential sites constructed in the 1990s using conventional design techniques with the same sites "redesigned" utilizing better site design techniques. For each development scenario, site characteristics such as total impervious and vegetative cover, infrastructure quantities, and type of stormwater management practice are estimated.

The Simplified Urban Nutrient Output Model (SUNOM) was used to perform a comparative analysis for two subdivisions that span a wide range of residential density (see box on page 645). The first is a large-lot subdivision known as Duck Crossing, and the second is a medium-density subdivision known as Stonehill Estates. In each case, the model was used to simulate five different development scenarios:

- Pre-developed conditions
- Conventional design without stormwater practices
- Conventional design with stormwater practices
- Open space design without stormwater practices
- Open space design with stormwater practices

Open space design concentrates density on one portion of a site in order to conserve open space elsewhere.

This article compares the hydrology, nutrient export, and development cost for these sites under both conventional and open space design, and with and without stormwater treatment. The article also summarizes other research on the benefits of open space design and discusses the implications it can have for the watershed manager.

R0073063

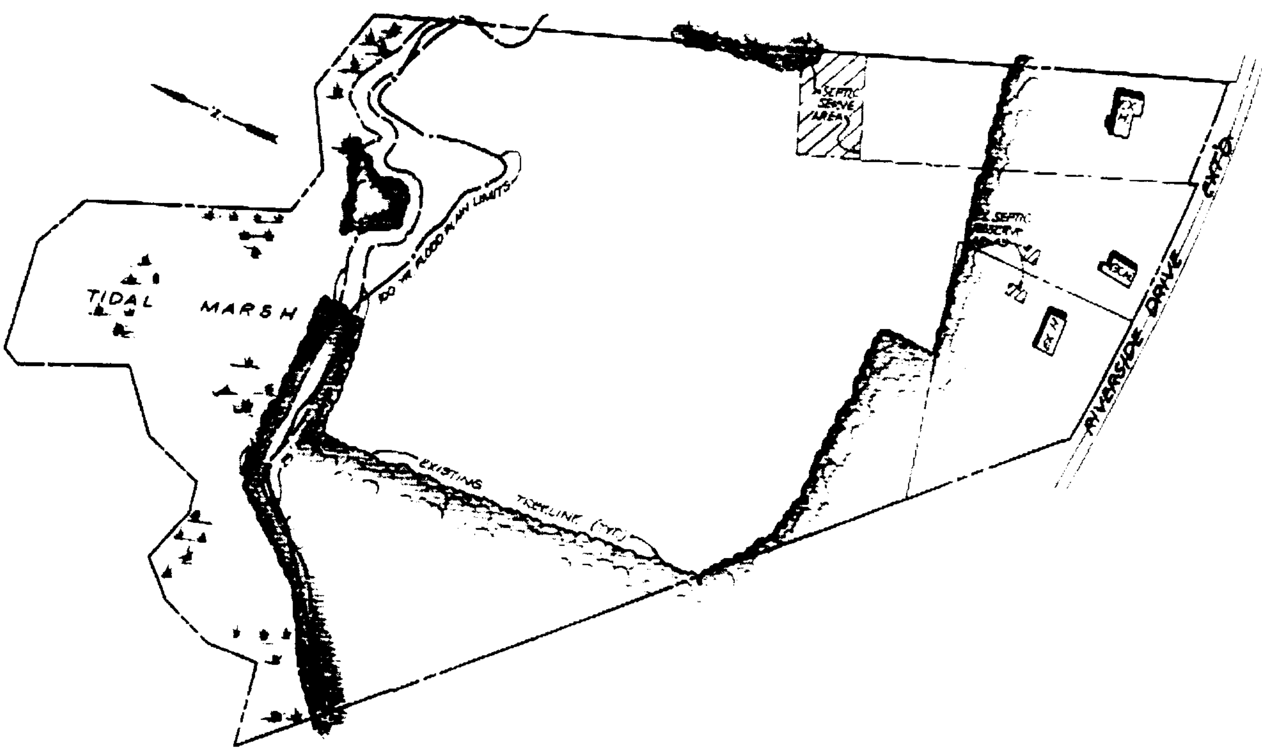


Figure 1: Predevelopment Conditions at the Duck Crossing Site

Duck Crossing - A Low-Density Residential Subdivision

Duck Crossing is a large-lot residential development located in Wicomico County on Maryland's Eastern Shore. Prior to development, the low gradient coastal plain site contained a mix of tidal and non-tidal wetlands, natural forest, and meadow (Figure 1). Its sandy soils were highly permeable (hydrologic soil group A). Three existing homes were located on the parcel, which relied on septic systems for on-site sewage disposal. The existing septic systems discharged a considerable nutrient load to shallow groundwater.

A conventional large-lot subdivision of eight single family homes was constructed on the 24-acre site in the early 1990s. The subdivision is reasonably typical of rural residential development along the Chesapeake Bay waterfront during this era (Figure 2). Each new lot ranged from three to five acres in size, and was set back several hundred feet from an access road. The access road was 30 feet wide and terminated in a large diameter cul-de-sac. Sidewalks were located on both sides of the street. Each lot was served by a conventional septic system with a primary and reserve field of about 10,000 square feet. Stormwater management consisted of curb and gutters that conveyed runoff into a storm drain system that, in turn, discharged to a small dry pond (designed for the water quality volume, only).

The entire site was privately owned, with the exception of the tidal marsh, which was protected under state and federal wetland laws and represented the only common open space on the site. As a result of construction, the existing meadow was entirely converted to lawn, and the impervious cover for the site increased to slightly over 8%.

Open Space Design for Duck Crossing

The critical ingredient of the open space redesign was a reduction in lot size from several acres to about 30,000 square feet. This enabled about 74% of the site to be protected and managed as common open space, which included most of the existing forest, wetlands and meadow (Figure 3). Consequently, only 19% of the site was managed as turf, nearly all of which was located on the private lots.

The open space redesign at Duck Crossing also incorporated a narrower access road (20 feet wide) along with shorter, shared driveways that served six of the eight lots. The road turnaround was designed as a loop rather than a cul-de-sac bulb. Also, a wood chip trail system was provided through the open space

R0073064

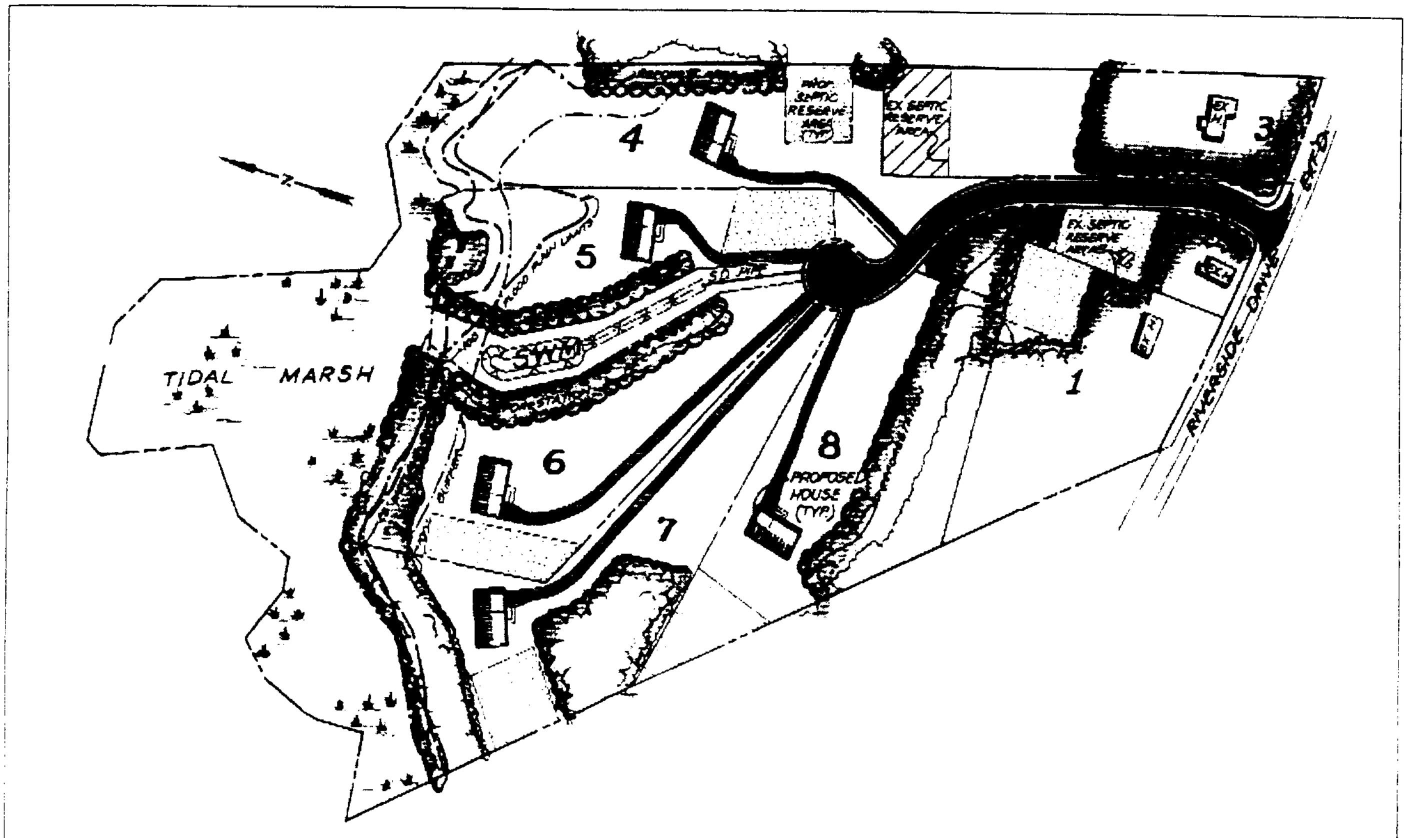


Figure 2: The Low-Density Conventional Subdivision Built at Duck Crossing (eight lots)

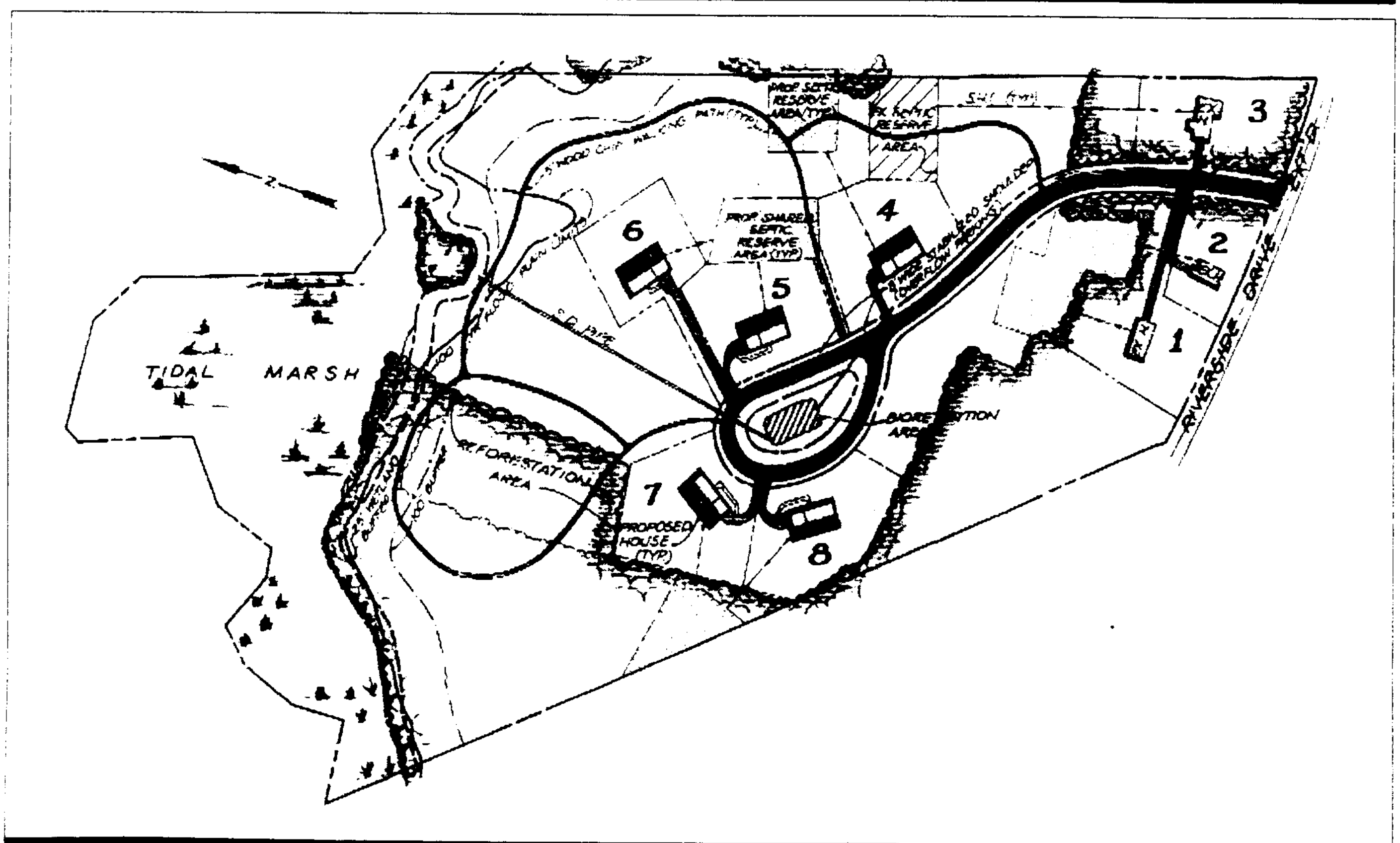


Figure 3: The Open Space Subdivision That Could Have Been Built at Duck Crossing (eight lots)

R0073065

instead of sidewalks along the road. Each home site was carefully located away from sensitive natural areas and the 100-year flood plain. Taken together, these better site design techniques reduced impervious cover for the site by about a third compared to the conventional design (from 8% to 5%).

The redesigned stormwater conveyance system utilized dry swales rather than a curb and gutter system, and featured the use of bioretention areas in the roadway loop to treat stormwater quality. This combination of stormwater practices provided greater pollutant removal through filtration and infiltration.

One of the most important objectives in the redesign strategy was to improve the location and performance of the septic systems that dispose of wastewater at the site. Home sites were oriented to be near soils that were most suitable for septic system treatment. In addition, six homes shared three common septic fields located within open space rather than on individual private lots. Lastly, given the permeability of the soils, advanced re-circulating sand filters were installed to provide better nutrient removal than could be achieved by conventional septic systems.

Comparative Hydrology for Duck Crossing

Given its low impervious cover and permeable soils, the water balance at Duck Crossing was dominated by infiltration, even after development. The comparative hydrology under the five development scenarios is presented in Table 1. As might be expected, the conventional design yielded the greatest volume of surface runoff and the least amount of infiltration. The open space design produced about 25% less annual surface runoff and 12% more infiltration than the conventional design, but did not come close to replicating pre-development conditions. The use of stormwater practices did not materially change the water balance under either the conventional or open space design at Duck Crossing (see Table 1).

The open space design sharply reduced nutrient export.

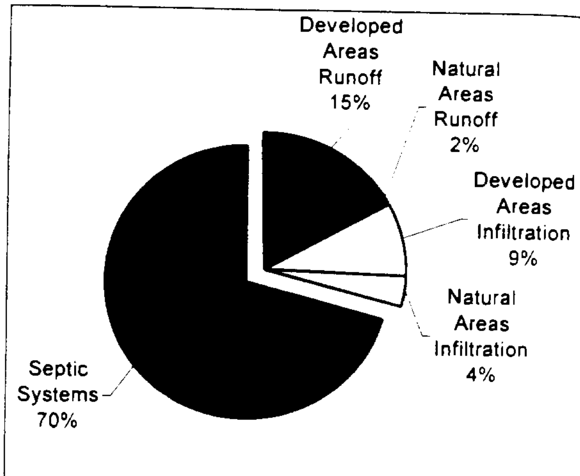


Figure 4: Nitrogen Load Distribution From the Conventional Design of Duck Crossing, Without Stormwater Practices

Comparative Nutrient Output at Duck Crossing

Nutrient export at Duck Crossing was dominated more by subsurface water movement than by surface runoff. Indeed, stormwater runoff seldom comprised more than 15% of the annual nitrogen or phosphorus load from this lightly developed site. The SUNOM model indicated that the major source of nutrients was subsurface discharges from septic systems, which typically accounted for 60 to 80% of the total load in every development scenario (see Figure 4).

The open space design sharply reduced nutrient export, primarily because re-circulating sand filters were used in the shared septic systems and helped to reduce (but not eliminate) subsurface nutrient discharge. The other elements of the open space design (reduced impervious cover, reduced lawn cover, and multiple stormwater practices) also helped to reduce nutrient export, but by a much smaller amount. The comparative nutrient export from each Duck Crossing development scenario is detailed in Figure 5.

R0073066

Table 1: Annual Water Budget of Duck Crossing

		Pre-Developed	Conventional Design	Open Space Design
Runoff (inches/year)	no practice	2.3	4.8	3.9
	practices	--	4.8	3.7
Infiltration (inches/year)	no practice	18.2	15.3	17.0
	practices	--	15.3	17.2

Comparative Cost of Development

The cost to build infrastructure for the open space design was estimated to be 25% less than the conventional design at Duck Crossing, due primarily to the necessity for less road paving, sidewalks, and curbs and gutters. Even when higher costs were factored in for the more sophisticated stormwater and on-site wastewater treatment used in the open space design, the total cost was still 12% lower than the conventional design. In addition, the open space design had seven fewer acres that needed to be cleared and graded, or served by erosion and sediment controls, compared to the conventional design (these costs are not currently evaluated by the SUNOM model). Overall, the SUNOM model estimated that the conventional design at Duck Crossing had a total infrastructure cost of $143,600, compared to $126,400 for the open space design.

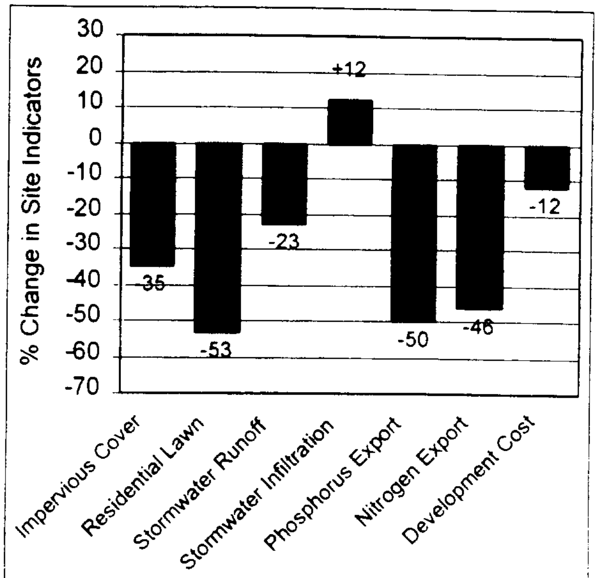


Figure 6: Percentage Change in Key Site Conditions From a Conventional Design to an Open Space Design, Both With Stormwater Practices

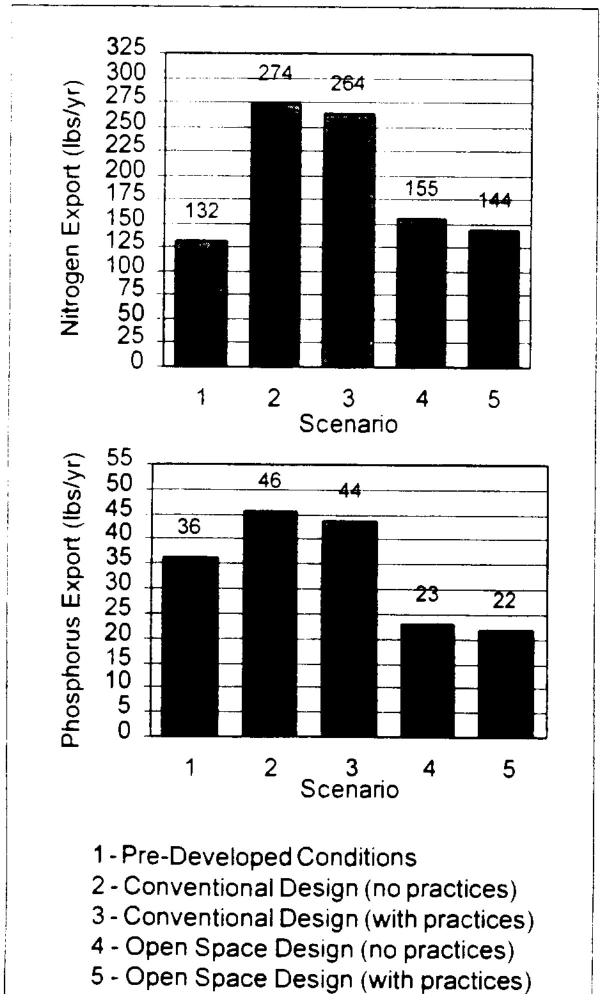


Figure 5: Annual Nitrogen and Phosphorus Loads for Each Development Scenario at Duck Crossing

Summary

The comparative results for the Duck Crossing redesign analysis are summarized in Figure 6. The open space design increased natural area conservation and reduced impervious cover, stormwater runoff, nutrient export, and development costs compared to the conventional subdivision design.

R0073067

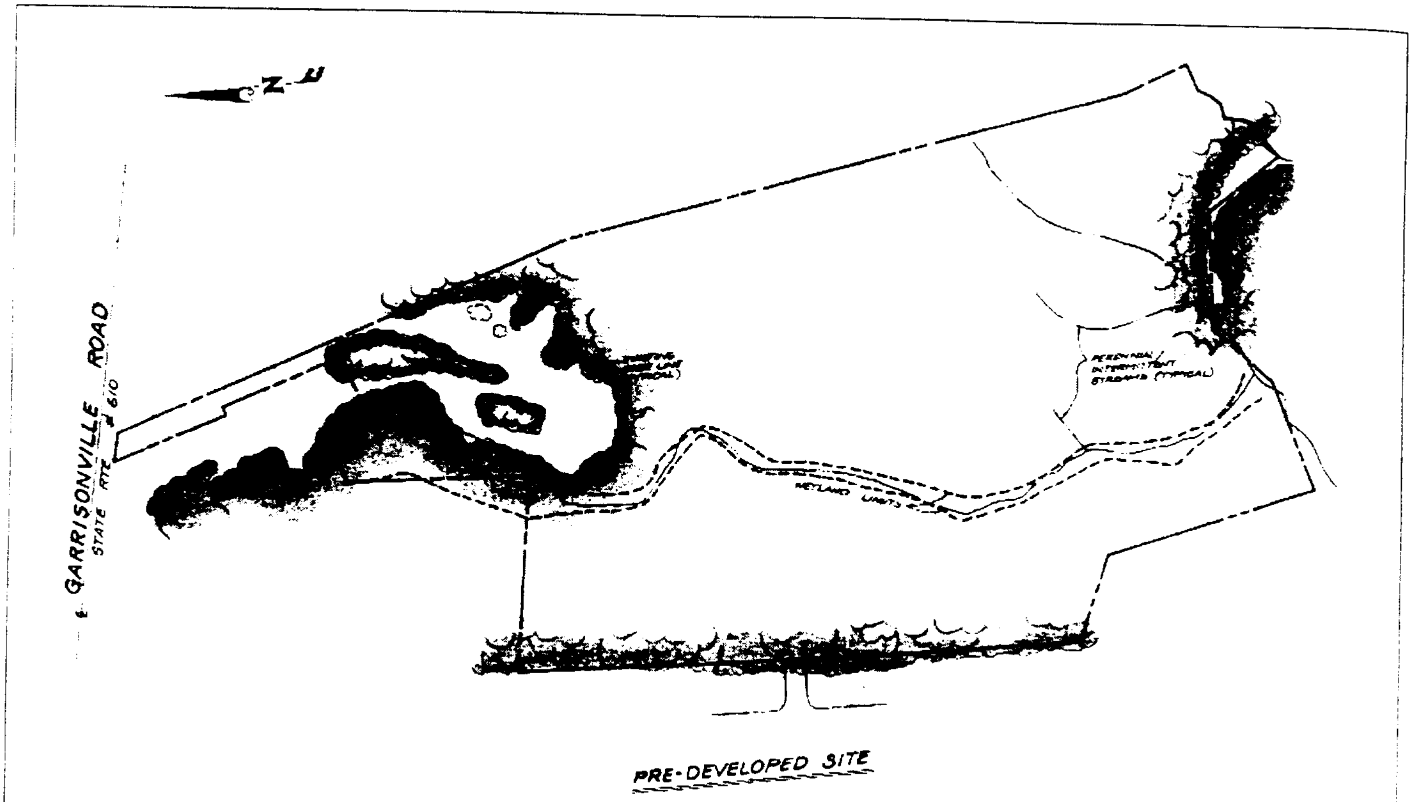


Figure 7: Predevelopment Conditions at the Stonehill Estates Site

Stonehill Estates - A Medium-Density Residential Subdivision

Stonehill Estates, located near Fredericksburg, Virginia, is situated in the rolling terrain of the Piedmont. The undeveloped parcel was 45 acres in size, nearly all of which was mature hardwood forest (Figure 7). An intermittent stream bisected the site, discharging into a perennial stream near the southern edge of the parcel. Roughly 3.6 acres of forested wetlands were found along the stream corridors, and an extensive floodplain was located along the perennial stream. Soils at the site were primarily silt loams and were moderately permeable (hydrologic soil groups C and D).

The site was highly attractive for development, given the excellent access provided by two existing roads, both of which had public water and sewer lines that could be easily tapped to serve the new subdivision. The conventional design was zoned for three dwelling units per acre. After unbuildable lands were excluded, the parcel yielded a total of 108 house lots, each of which was about 9,000 square feet in size (Figure 8). The subdivision design typifies medium-density residential subdivisions developed in the last two decades in the Mid-Atlantic region, where lots sizes were uniform in size and shape and homes were set back a generous and fixed distance from the street. The design utilized a mix of wide and moderate street sections (34 feet and 26 feet), and included six large diameter cul-de-sacs for turn-arounds. Sidewalks were generally installed on both sides of the street.

The stormwater management system for the conventional design represents the typical "pipe and pond" approach utilized in many medium-density residential subdivisions. Street runoff was conveyed by curbs and gutters into a storm drain system that discharged into the intermittent stream channel, and then traveled downstream to a dry extended detention pond. The pond was primarily designed to control flooding, but also provided some limited removal of stormwater pollutants.

Interestingly, about 25% of the site was reserved as open space in the conventional design at Stonehill Estates. Nearly all of these lands were unbuildable because of environmental and site constraints (e.g., floodplains, steep slopes, wetlands, and stormwater facilities), and the resulting open space was highly fragmented. Even so, about a fourth of the forested wetlands were impacted by two roads crossing over the intermittent stream. Almost 90% of the original forest cover was cleared as a result of the conventional design, and was replaced by lawns and impervious cover. Overall, about 60% of the site was converted to lawns, and another 27% was converted to impervious cover.

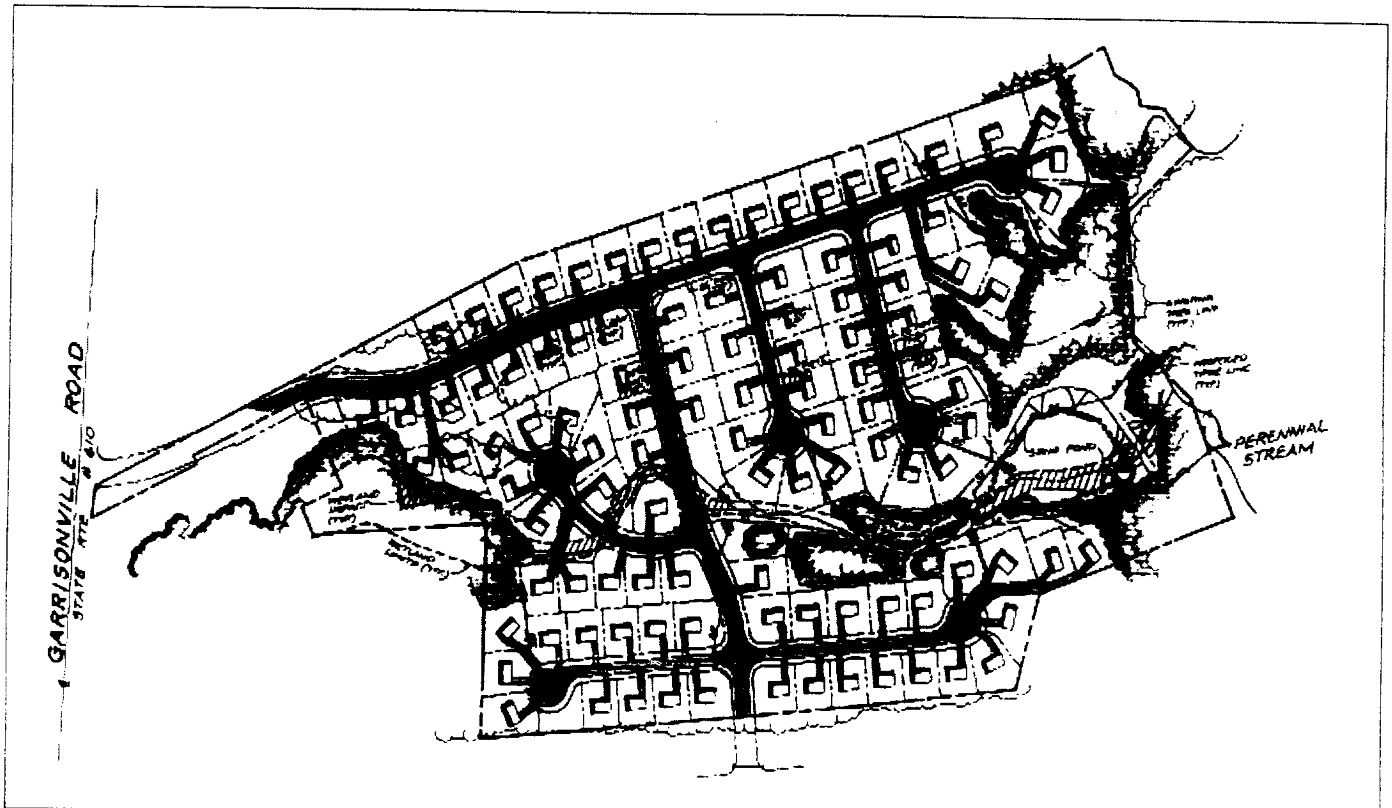


Figure 8: The Conventional Subdivision Design That Was Built at Stonehill Estates (108 lots)

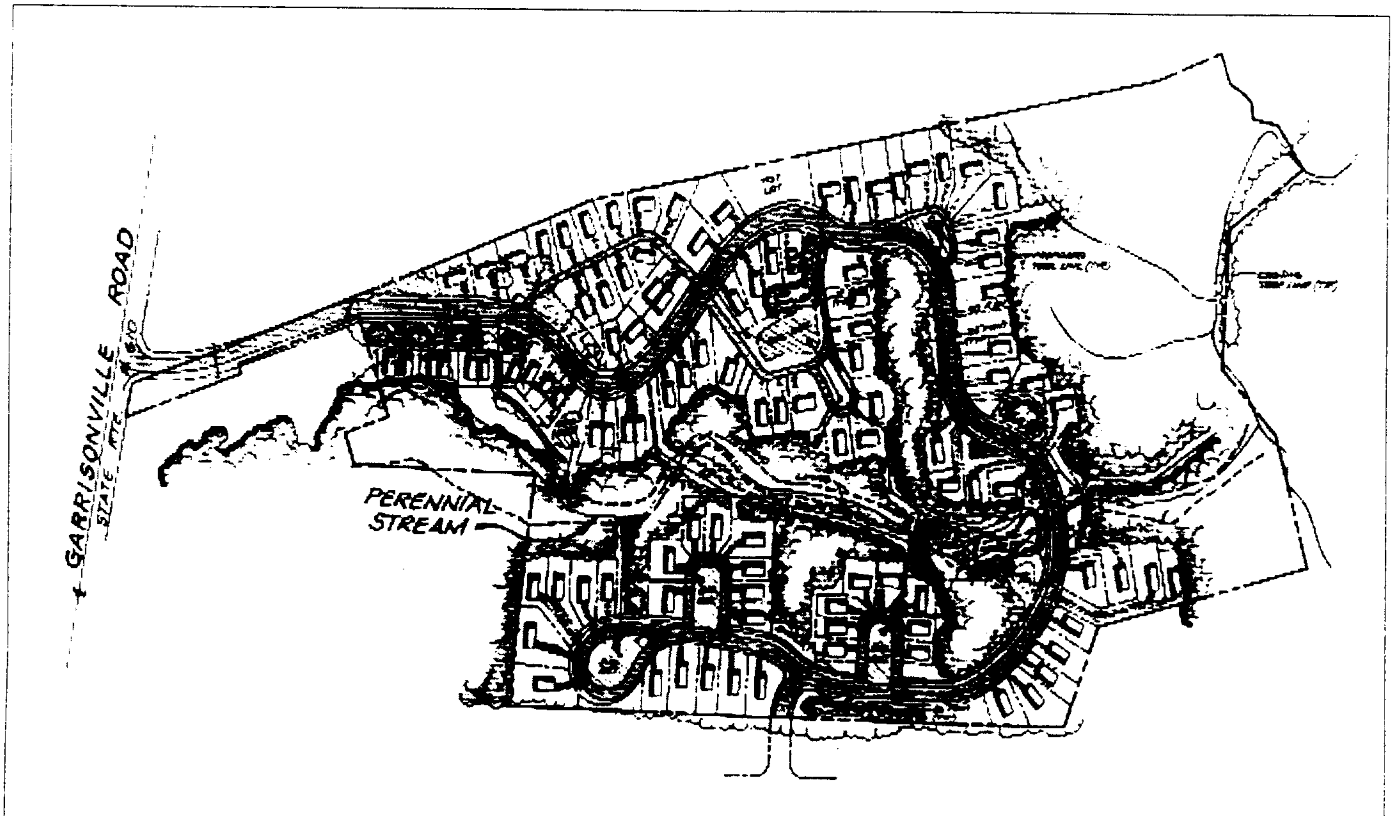


Figure 9: The Open Space Subdivision That Could Have Been Built at Stonehill Estates (108 lots)

Open Space Design for Stonehill Estates

In the redesign analysis, Stonehill Estates was designed to incorporate many of the open space design techniques advocated by Arendt (1994). The resulting design retained the same number of lots as the conventional design, but had a much different layout (Figure 9). The average lot size declined from about 9,000 square feet in the conventional design to 6,300 square feet in the open space design. This reduced lot size allowed about 44% of the site to be protected as open space, most of which was managed as a single unit that included an extensive natural buffer along the perennial and intermittent stream corridor.

The basic open space layout was augmented by several other better site design practices, including narrower streets, shorter driveways, and fewer sidewalks. Loop roads were used as an alternative to cul-de-sacs. In some portions of the site, irregularly shaped lots and shared driveways were used to reduce overall road length. Each individual lot was located adjacent to open space, so that the more compact open space lots would not feel as crowded. As a result of these techniques, the open space design for Stonehill Estates reduced impervious cover from 27% to 20%. In addition, lawn cover declined from 60% to 30% of the total site area.

The innovative stormwater collection system utilized dry swales rather than storm drains in gently sloping portions of the site. The dry swales and several bioretention areas located in loop turnarounds were used to initially treat stormwater quality. Each of these practices then discharged to a small micro-pool detention pond, whose embankment was created by the single road crossing over the intermittent stream.

Comparative Hydrology

Prior to its development, the highly wooded site produced very little surface runoff, but because of relatively tight soils, generated only a modest amount of infiltration. However, after the site was converted into the conventional subdivision, surface runoff increased by a factor of five, and infiltration was reduced by about 40% (Table 2). In contrast, the open space design worked to reduce stormwater runoff and increase stormwater infiltration compared to the conventional design, although it did not come close to replicating the original hydrology of the forested site (Table 2).

Comparative Nutrient Output

As might be expected, the conversion of the forest into a conventional subdivision greatly increased nutrient export from the site; the model indicated that annual phosphorus and nitrogen export would increase by a factor of seven and nine, respectively, after development (see Figure 10). Unlike Duck Crossing, nutrient export at Stonehill Estates was dominated by stormwater runoff after development. The SUNOM model indicated that stormwater runoff contributed about 94% of the annual nutrient export from the site,

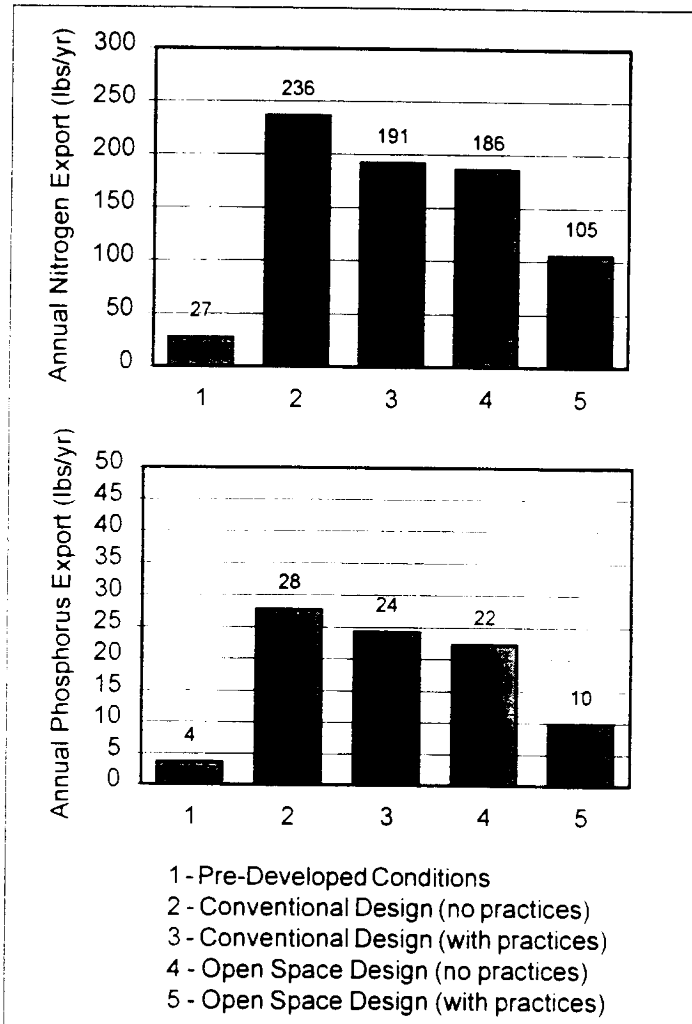


Figure 10: Annual Nitrogen and Phosphorus Loads for Each Stonehill Estates Development Scenario

Table 2: Comparative Hydrology of Stonehill Estates

		Pre-Developed	Conventional Design	Open Space Design
Runoff (inches/year)	no practice	2.1	10.6	8.8
	practices	n/a	10.6	8.0
Infiltration (inches/year)	no practice	4.9	3.1	4.0
	practices	n/a	3.1	4.8

Table 3: Redesign Analyses Comparing Impervious Cover and Stormwater Runoff from Conventional and Open Space Subdivisions					
Residential Subdivision	Original Zoning for Subdivision	Impervious Cover at the Site			Reduction in Stormwater Runoff (%)
		Conventional Design	Open Space Design	Net Change	
Remlik Hall [1]	5 acre lots	5.4 %	3.7%	- 31%	20%
Tharpe Knoll [2]	1 acre lots	13%	7%	- 46%	44%
Chapel Run [2]	½ acre lots	29%	17%	- 41%	31%
Pleasant Hill [2]	½ acre lots	26%	11%	- 58%	54%
Prairie Crossing [3]	½ to 1/3 acre lots	20%	18%	- 20%	66%
Buckingham Greene [2]	1/8 acre lots	23%	21%	- 7%	8%
Belle-Hall [4]	High Density	35%	20%	- 43%	31%

Sources: [1] Maurer, 1996; [2] DE DNREC, 1997; [3] Dreher, 1994; and [4] SCCCL, 1995.

with subsurface water movement adding only 6% to the total export. Nutrient loads were not greatly reduced by the dry extended detention pond installed at the conventional subdivision; the model indicated that nutrient export from the conventional design would still be six to seven times greater than the predevelopment condition even with this stormwater treatment practice.

In contrast, the open space design resulted in greater nutrient reduction (Figure 10). For example, the open space design scenario *without* stormwater practices produced a lower nutrient load than the conventional design scenario *with* stormwater practices. This was primarily due to lower impervious cover associated with the open space design. When the open space design was combined with more sophisticated stormwater practices (i.e., bioretention, dry swales and wet ponds), nutrient export was half that of the conventional design. It is interesting to note, however, that even when the most innovative site design and stormwater techniques were applied to the site, nutrient export was still three to four times greater than that produced by the forest prior to development.

Infrastructure Costs

The total cost to build infrastructure at Stonehill Estates was about 20% less for the open space design than for the conventional design. Considerable savings were realized in the form of less road paving and shorter lengths of sidewalks, water and sewer lines and curbs and gutters. The cost difference between the open space and conventional designs would have been greater were it not for the fact that higher costs were incurred for the more sophisticated stormwater practices used in the open space design. It was estimated that the infrastructure cost for the conventional design was $1.54 million, compared to $1.24 million for the open space design.

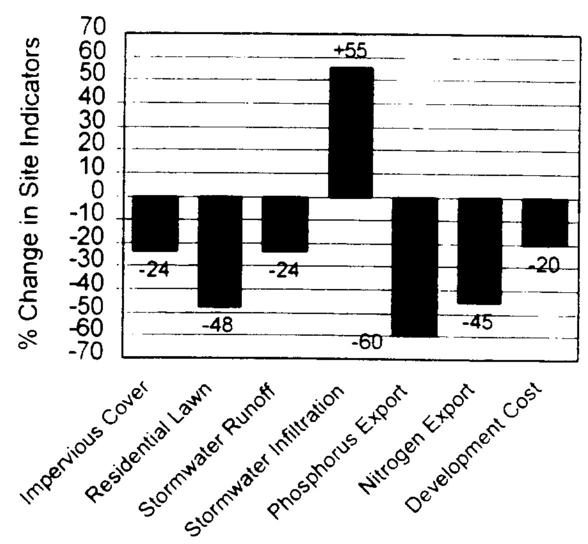


Figure 11: Change in Site From a Conventional Design to an Open Space Design, Both With Stormwater Practices

Table 4: Projected Construction Cost Savings for Open Space Designs from Redesign Analyses		
Residential Development	Construction Savings	Notes
Remlik Hall[1]	52%	Includes costs for engineering, road construction, and obtaining water and sewer permits
Tharpe Knoll [2]	56%	Includes roads and stormwater management
Chapel Run [2]	64%	Includes roads, stormwater management and reforestation
Pleasant Hill [2]	43%	Includes roads, stormwater management, and reforestation
Buckingham Greene [2]	63%	Includes roads and stormwater management
Sources:[1] Maurer, 1996; [2] DE DNREC, 1997		

Summary

The comparative results for the Stonehill Estates redesign analysis are summarized in Figure 11. The open space design reduced impervious cover, natural area conversion, stormwater runoff, nutrient export and development costs compared to the conventional subdivision design.

Other Redesign Research

Several other researchers have employed redesign comparisons to demonstrate the benefits of open space subdivisions, over a wide range of base lot sizes. The results are shown in Table 3. It should be recognized that each study used slightly different models and assumptions, and as such, strict comparisons should be avoided. The redesign comparisons clearly show that open space designs can sharply reduce impervious cover and storm water runoff while accommodating the same number of dwelling units, at least to base lot sizes of an eighth of an acre. The reductions in impervious cover and runoff range from 7 to 65%. The ability of open space design to reduce impervious cover starts to diminish for residential zones that exceed densities of four dwelling units per acre.

Other studies reinforce the conclusion that open space designs are less expensive to build than conventional subdivisions.

These studies reinforce the conclusion that open space designs are usually less expensive to build than conventional subdivisions. The projected construction cost savings associated with open space designs ranged from 40 to 66% (Table 4). Most of the cost savings were due to reduced need for road building and stormwater conveyance. In another study, Liptan and Brown (1996) reported that open space design produced infrastructure construction costs savings of $800 per home in a California subdivision.

Numerous economic studies have shown that well-designed and marketed open space designs are very desirable to home buyers and very profitable for developers. Strong evidence indicates that open space subdivisions sell faster, produce better cashflow, yield a higher return on investment and appreciate faster than their traditional counterparts (Arendt *et al.*, 1994, Ewing, 1996, NAHB, 1997, ULI, 1988. CWP, 1998a, and Porter, 1988). While open space designs are often perceived as applying only to upscale and affluent consumers, several successful open space subdivisions have been built for moderate to lower income buyers. Both ULI (1988) and Ewing (1996) report that open space designs can be an effective tool to promote affordable housing within local communities.

The relatively high demand for open space designs reflects two important economic trends. The first trend is that the tastes and preferences of many new home buyers are gradually changing. Recent market surveys indicate that home buyers increasingly desire natural areas, smaller lawns, better pedestrian access, wildlife habitat and open space in the communities they choose to live in. The second trend is that open space developments that can provide these amenities seldom comprise more than 5% of the new housing offered in most communities. Consequently, there appears to be a large and relatively untapped potential demand for more open space developments. Other compelling benefits of open space design are detailed in CWP (1998a) and Schueler (1995).

R0073072

Table 5: Sample Evaluation Criteria for the Quantity and Quality of Open Space Development (Adapted from Conservation Fund, 1999)

Points Achieved by the Development	Percent of Open Space Achieved for Different Residential Zones				
	More than 4 units per acre	From 2 to 4 units per acre	From 1 to 2 units per acre	From 0.5 to 1 unit per acre	less than ½ unit per acre
-2	0 to 9%	less than 15%	15 to 24%	25 to 34%	less than 40%
-1	10 to 14%	15 to 24%	25 to 34%	35 to 49%	less than 50%
0	15 to 24%	25 to 34%	35 to 49%	50 to 59%	less than 60%
+1	25 to 30%	35 to 40%	50 to 55%	60 to 70%	less than 70%
+2	more than 30%	more than 40%	more than 55%	more than 70%	more than 80%

The total open space achieved by the site is computed using the following formula:

$$\frac{A(0.2) + B(0.2) + C(0.5) + D}{E} \times 100$$

A = open space acres in managed landscape
B = open space acres in annual crops
C = open space acres in perennial crops
D = open space acres in native vegetation
E = total undeveloped acres in open space

Evaluating the Quality of Individual Open Space Developments

In the real world, site designers must satisfy a wide range of economic objectives, and water quality or resource protection is usually not on the top of the list. It is certainly possible to design a lousy open space design, and communities should expect a wide range in the quality of open space designs they review. How can a community objectively evaluate the quality of individual open space design proposals, and differentiate poor or mediocre projects from the good and outstanding ones?

Nerenberg and Freil (1999) have recently developed a simple rating system to evaluate the quality of individual open space design proposals. The rating system, known as the Conservation Development Evaluation System (CeDES), was developed in consultation with a host of planning agencies and organizations. The CeDES employs 10 core criteria to test how well a proposed open space design reduces impervious cover, minimizes grading, prevents soil loss, reduces and treats stormwater, manages open space, protects sensitive areas, and conserves trees or native vegetation. Each of the 10 core criteria has a quantitative benchmark for comparison. An example of one benchmark that rates the quantity and quality of open space is provided in Table 5. A full description of the CeDES rating can be found in Conservation Fund (1999).

Based on the total score achieved under the 10 core criteria, an open space design project can earn anywhere from zero "oak leaves" up to four "oak leaves." The more oak leaves earned, the better the quality of the proposed project. Based on initial testing, the CeDES seems to do a good job of sorting the poor projects from the outstanding ones. While the CeDES is intended for use as a tool for local development review, it can also be used as a marketing tool to let home buyers know how green their new subdivision actually is.

Implications for the Watershed Manager

The redesign comparisons have several implications for the watershed manager. First, they offer compelling quantitative evidence that open space design can sharply reduce stormwater and nutrient export from new development, and as such, can serve as an effective tool for watershed protection. It is interesting to note that open space design, by itself, produced nutrient reductions roughly equivalent to those achieved by structural stormwater practices. In other words, nutrient export from open space designs *without* stormwater treatment was comparable to the conventional designs *with* stormwater treatment. When open space design were combined with effective stormwater treatment, nutrient loads were sharply reduced, but were still greater than pre-development conditions.

> Despite its economic and environmental benefits, open space design is not a development option in many communities.

A second, more troubling implication is that it may well be impossible to achieve a strict goal of no increase in nutrient load for new development, even when the best site design and most sophisticated stormwater practices are applied. A handful of communities have adopted stormwater criteria that mandate that no

R0073073

net increase in phosphorus load occur as a result of development, but as the redesign comparisons in this article show, such criteria are not likely to be actually achieved. Thus, if nutrient loads are capped in a watershed, managers may need to remove pollutants at existing developments with stormwater retrofits in order to offset increases in nutrient loads produced by new development.

The redesign research also has some implications for watershed-based zoning. Quite simply, a shift from conventional to open space design can reduce the impervious cover of many residential zoning categories by as much as 30 to 40%. In some watersheds, an aggressive shift to open space design in new residential zones is an essential strategy to meet an impervious cover cap for protecting sensitive or impacted streams.

Another notable finding is that large lot subdivisions have the potential to generate the same unit area nutrient export as higher density subdivisions. The high nutrient loading from large lot developments in un-sewered areas is attributed to subsurface discharges from septic systems. From a nutrient management standpoint, it may be more cost effective to regulate septic system performance than stormwater performance in very low density residential subdivisions located on permeable soils.

Lastly, watershed managers have only a few tools at their disposal that offer developers a real chance to save money. The economic evidence clearly suggests that open space design is such a tool, and has potential to either reduce the cost of development, or at least offset the cost of other watershed protection measures. However, despite its economic and environmental benefits, open space design is not a development option in many communities, nor is it widely used by most developers even when available. Many communities will need to fundamentally change their local development rules in order to make open space design an attractive development option.

Site planning roundtables that involve the local players that shape new residential development, described later in this issue, are an effective way to bring this change about. The ultimate goal is to make open space design a "by-right" form of development, so that its design, review and approval are just as easy and certain as a conventional subdivision. Who knows, the day may come when a special exception or permit is needed to build a conventional subdivision. *- JAZ*

Editor's Note: Some useful model ordinances for open space design can be found at www.cwp.org. Also, check the Resources section in this issue for some great references on how to make open space design work in your community.

References

Arendt, Randall. 1994. *Designing Open Space Subdivisions: A Practical Step-by-Step Approach.* Natural Lands Trust. Media, PA. 96 pp.

Center for Watershed Protection (CWP). 1998a. *Better Site Design: A Handbook for Changing Development Rules in Your Community.* Ellicott City, Maryland. 202 pp.

CWP, 1998b. *Nutrient Loading From Conventional and Innovative Site Development.* Prepared for Chesapeake Research Consortium. Ellicott City, Maryland. 96 pp.

Conservation Fund. 1999. *Pilot Conservation Development Evaluation System.* Great Lakes Office. [available at www.conservation fund.org/conservation/sustain/gloindex.html].

Delaware Dept. of Natural Resources and Environmental Conservation (DE DNREC). 1997. *Conservation Design for Stormwater Management.* Dover, DE.

Dreher, D. and T. Price. 1994. *Reducing the Impact of Urban Runoff: The Advantages of Alternative Site Design Approaches.* Northeastern Illinois Planning Commission. Chicago, IL.

Ewing, R. 1996. *Best Development Practices: Doing the Right Thing and Making Money at the Same Time.* American Planning Association. Chicago, IL.

Liptan, T. and C. Brown. 1996. *A Cost Comparison of Conventional and Water Quality-based Stormwater Designs.* City of Portland, Portland OR.

Maurer, G. 1996. *A Better Way to Grow: For More Livable Communities and a Healthier Chesapeake Bay.* Chesapeake Bay Foundation. Annapolis, MD. 24 pp.

National Association of Homebuilders. 1986. *Cost Effective Site Planning.* Washington DC.

Nerenberg, S. and K. Freil. 1999. *The Conservation Development Evaluation System (CeDES): Evaluating Environmentally Friendly Developments.* Land Development. Fall, 1999. pp. 22 -28

Porter, D., P. Phillips, and T. Lassar. 1988. *Flexible Zoning: How it Works.* Urban Land Institute, Washington, DC. 200 pp.

Schueler, T. 1995. *Site Planning for Stream Protection.* Center for Watershed Protection. Ellicott City, MD. 220 pp.

Urban Land Institute. 1988. *Density by Design.* J. Wetling and L. Bookout, editors. Urban Land Institute, Washington, D.C.

R0073074

Description of the Simplified Urban Nutrient Output Model

The basic tool used in the redesign analysis was a spreadsheet model known as the Simplified Urban Nutrient Output Model (SUNOM). The SUNOM model computes the annual hydrologic budget, nutrient export and infrastructure cost for individual development sites, using simple input variables that can be easily derived or measured from any site engineering plan.

The first step in applying the SUNOM model is to measure the fraction of the site in each of six categories of surface cover: impervious surfaces, lawns, forests/wetlands, meadow, open water, and stormwater treatment areas. In the next step, the user measures key infrastructure variables from the site plan including the length of roads, sidewalks, water and sewer utilities, curb and gutter, and storm drain pipes (in some cases, widths or diameters are needed as well). Basic soil type data is then collected, in order to classify soils according to the hydrologic soil group(s) present on the pervious surfaces of the site. Lastly, basic data is assembled on the size and type of stormwater practices and septic systems, when present. Depending on the size and complexity of the plan, it typically takes about a day to derive all the necessary inputs to operate the model.

Estimating Hydrology for the Site

SUNOM operates based on a simplified water balance. Rainfall can take several different pathways once it reaches the ground surface. A fraction of the rainfall leaves the site directly as stormwater runoff, while the remainder infiltrates into the subsurface soils (storage in surface depressions or interception by the tree canopy interception is ignored in the model, since they are a small and often temporary component of the annual water balance). Once water infiltrates into the soil, much of it returns to the atmosphere through evapotranspiration. The remainder moves to shallow ground water, is transported as interflow, or recharges deeper groundwater. The SUNOM model does not differentiate between these three final destinations, but simply computes the total volume of subsurface infiltration. The water budget can be adjusted further if lawn irrigation or septic system effluent is expected to contribute "outside" water to the development site.

Surface runoff from all surfaces is calculated using a volumetric runoff coefficient that is closely related to impervious cover. Resulting runoff quantities are normalized to runoff inches over the entire site (Schueler, 1987). Surface runoff from natural cover and turf are computed assuming that these areas are one percent impervious (NVPDC, 1980), but these values can be changed to reflect the prevailing soil type or soil compaction (see Technical Note 107).

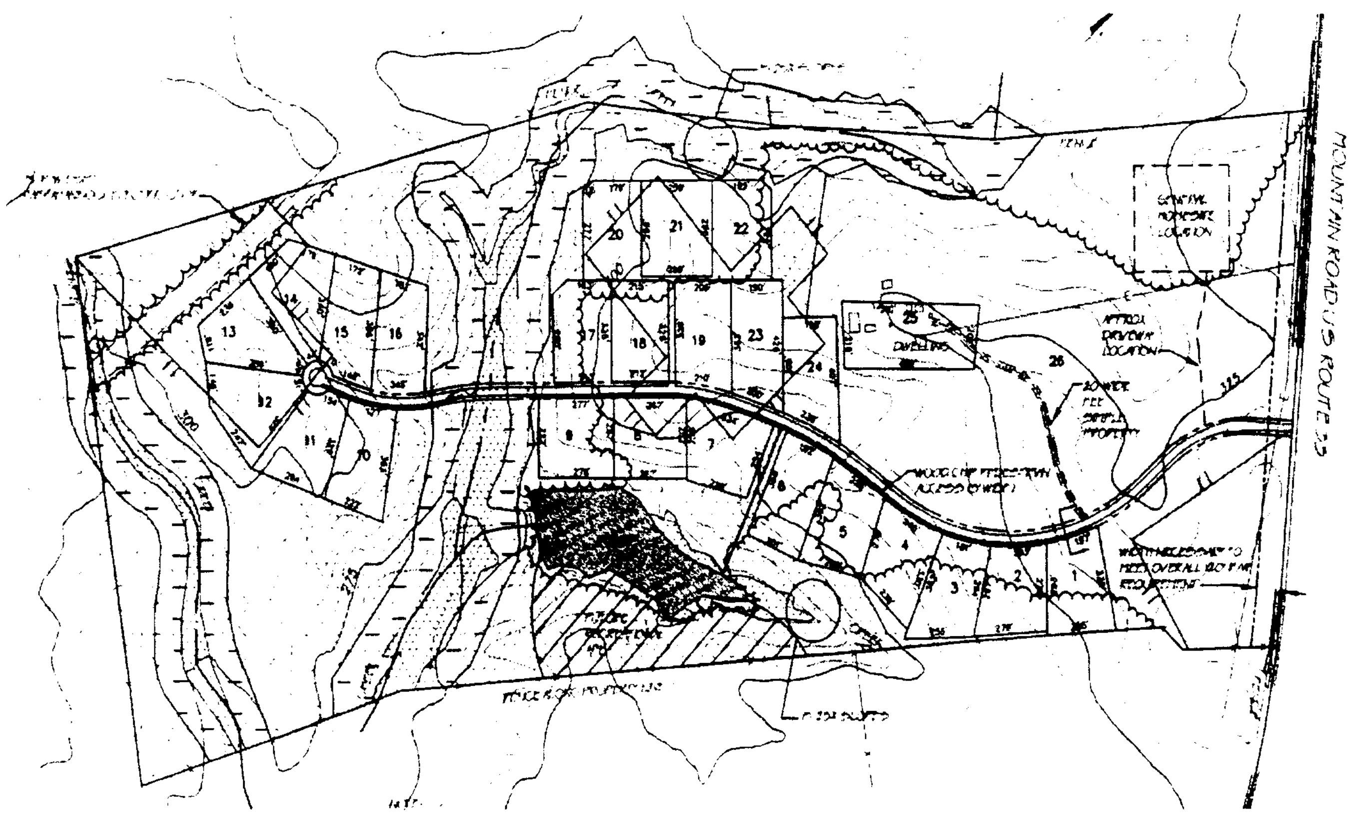


Figure 1: The SUNOM Model Operates Using Basic Site Variables That Can Be Easily Derived From Most Site Plan Submittals

Estimating infiltration is a somewhat trickier affair. For the purposes of the model, total infiltration is defined as the sum of subsurface infiltration plus septic infiltration. Subsurface infiltration is estimated based on annual infiltration volume for the prevailing hydrologic soil group of the pervious area, which can be adjusted for soil compaction. The annual volume of subsurface infiltration is calculated without estimating its final destination (i.e., quick interflow, deep recharge, shallow groundwater). Once annual stormwater runoff and subsurface infiltration volumes are calculated, they can be checked against an annual evapotranspiration volume to ensure that the overall water balance is reasonable.

Annual septic system infiltration is calculated under the assumption that entire wastewater flow into a septic system infiltrates to the subsurface. The volume of this wastewater flow, in site-inches, is derived as a function of the number of individuals using each septic system multiplied by their per capita annual water use. Some stormwater practices can take surface runoff and convert it into subsurface infiltration. The model accounts for this by deducting the fraction of treated runoff volume that is infiltrated back into the soil from the annual stormwater runoff volume and adding it to the infiltration volume.

Calculation of Nutrient Loads

This module computes nutrient loads for each of the types of surface cover present at a site by multiplying its computed stormwater runoff and subsurface infiltration volume by a median nutrient concentration. For stormwater flows, the mean concentrations are derived based on national stormwater monitoring data or single land use or source area marketing data. Subsurface nutrient concentrations for natural areas are estimated based on measured baseflow concentrations from adjacent undeveloped receiving waters. Median nutrient concentrations from published sources were used to characterize the subsurface concentrations from turf areas. In the case of septic systems, typical per capita septic loads, along with septic efficiencies, were used to characterize this nutrient loading source.

The total annual nutrient load for a development site is then computed as the sum of the stormwater runoff load, and the subsurface infiltration load from natural areas, turf, and septic systems. Surface stormwater loads are adjusted to reflect pollutant reduction by stormwater practices if they are present. The spreadsheet contains typical nutrient removal rates for many common stormwater practices (see Technical Note 95). Subsurface infiltration loads can also be adjusted to reflect the use of innovative septic system technology with higher nutrient removal capability. Default data are provided in the SUNOM model for all nutrient concentration and removal parameters, but the user can also supply their own estimates if better local or regional data are available.

Development Cost

The SUNOM modules computes the cost of building the infrastructure to serve a new development. The module calculates these costs based on the dimensions of the infrastructure that are specified in the development plan, and supplied as model input (e.g., length and area of roads, length and diameter of pipe). These units of infrastructure are then multiplied by unit costs that were derived for the mid-Atlantic region. The SUNOM model can estimate the following component costs: paving for roads or parking lots, curb and gutter, sidewalks, stormwater conveyance, utilities, landscaping, reforestation, septic systems and other necessary elements for site construction. Stormwater treatment costs are calculated as a function of the volume of stormwater runoff treated by the practice using predictive equations developed by the Center (see Technical Note 90). At this time, the SUNOM model does not estimate engineering or permitting costs, nor does it itemize costs related to clearing, grading and erosion and sediment control, but these enhancements can be added by the user.

Appropriate Use of the SUNOM Model

The SUNOM model is basically a simple accounting tool to track the annual runoff, nutrient loads, and total infrastructure costs from four kinds of surface cover in a development plan. The model is most appropriately used as a tool to compare how these factors change in response to different development scenarios. These "redesign" scenarios help demonstrate the costs and benefits of better site design. As with any empirical model, it is very important to make sure that parameter values are sensible and regionally appropriate. The user should always check whether default infiltration rates, nutrient concentrations, removal rates and unit costs make sense given local conditions. The SUNOM model is intended to serve as a planning model rather than an engineering model. More detailed simulation models or monitoring may be required to give the precise and accurate predictions needed for actual engineering design at a given development site. More extensive documentation on the model is contained in Appendix A of CWP, 1998. We are continually improving the SUNOM model, and the most recent version, which utilizes a Microsoft Excel spreadsheet, is available through the Center at a nominal charge.

References

Center for Watershed Protection (CWP). 1998. *Nutrient Loading From Conventional and Innovative Site Development*. Ellicott City, MD.

Northern Virginia Planning District Commission (NVPDC). 1980. *Guidebook for Screening Urban Nonpoint Pollution Management Strategies*. Metropolitan Washington Council of Governments. Falls Church, VA.

Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments. Washington, DC.

R0073076

Better Site Design

III. The Benefits of Better Site Design in Commercial Development

Modern commercial development is dominated by the parking lot. Indeed, as much as half of the entire surface area of a typical office park or shopping center is devoted to parking. No one has ever stepped up to claim that they invented the parking lot, and their reluctance is understandable: the parking lot is a prime habitat for the car and not much else.

From an environmental standpoint, parking lots rank among the most harmful land uses in any watershed. Parking lots not only collect pollutants that are deposited from the atmosphere, but also accumulate pollutants that leak, drip or wear off cars. Researchers have found that parking lot runoff can have extremely high concentrations of nutrients, trace metals and hydrocarbons (see Technical Notes 15 and 105). Parking lots also influence the local air and stream temperatures. In the summer months, pavement temperatures can exceed 120 degrees Fahrenheit, which in turn increases local air temperatures five to 10 degrees compared to a shaded forest. Parking lots can also exacerbate smog problems, as parked cars emit greater levels of smog precursors under extreme heat island conditions (Scott *et al.*, 1999).

Perhaps the greatest environmental impact of parking lots is hydrological in nature. Simply put, there is no other kind of surface in a watershed that produces more runoff and delivers it faster than a parking lot. When this runoff is discharged into a headwater stream, its great erosive power steadily degrades the quality of downstream habitats, unless exceptionally sophisticated stormwater practices are installed.

Is it possible to design a better parking lot? At first glance, there seems to be little opportunity to incorporate better site design into parking lots. However, the better site design techniques described earlier in this issue suggest a key design strategy: *work to incrementally shrink the surface area of the parking lots and then use the space saved to integrate functional landscaping and better stormwater treatment within the parking lot.* Through a series of relatively minor design adjustments, it is possible to reduce the surface area of parking lots by 5-20%. These design adjustments include curbing excess parking, incrementally reducing parking demand ratios, providing credits for mass transit, shrinking stall sizes, narrowing drive aisles, and using grid pavers for spillover parking areas.

In this article, we examine some of the benefits of employing better site design as they apply to commercial development. As with the residential redesign, this analysis also uses the Simplified Urban Nutrient Output Model (SUNOM) to compare actual commercial development sites constructed in the 1990s with the same sites redesigned utilizing better site design techniques. The two commercial developments analyzed include a retail shopping center and a commercial office park.

Our fairly conservative approach to parking lot redesign is intended to reflect realistic opportunities in a suburban setting. For example, we did not utilize shared parking, porous pavement, or structured parking in any of the redesigns, although each of these techniques is very effective. Nor did we reduce the basic footprint or size of the buildings in either scenario, although smaller "boxes" may well have been more appropriate for the zoning. Instead, our basic approach was to make a series of relatively modest changes in parking lot design to shrink parking lot area, and then implement better landscaping and stormwater treatment measures within the saved space.

> From an environmental standpoint, parking lots rank among the most harmful land uses in any watershed.

This article reports on the potential benefits of parking lot redesign in terms of reduced runoff, pollutant export and development costs. It also reviews the initial experience of communities that are experimenting with new and innovative parking lot designs, and concludes with some implications for both the engineer and watershed manager.

R0073077

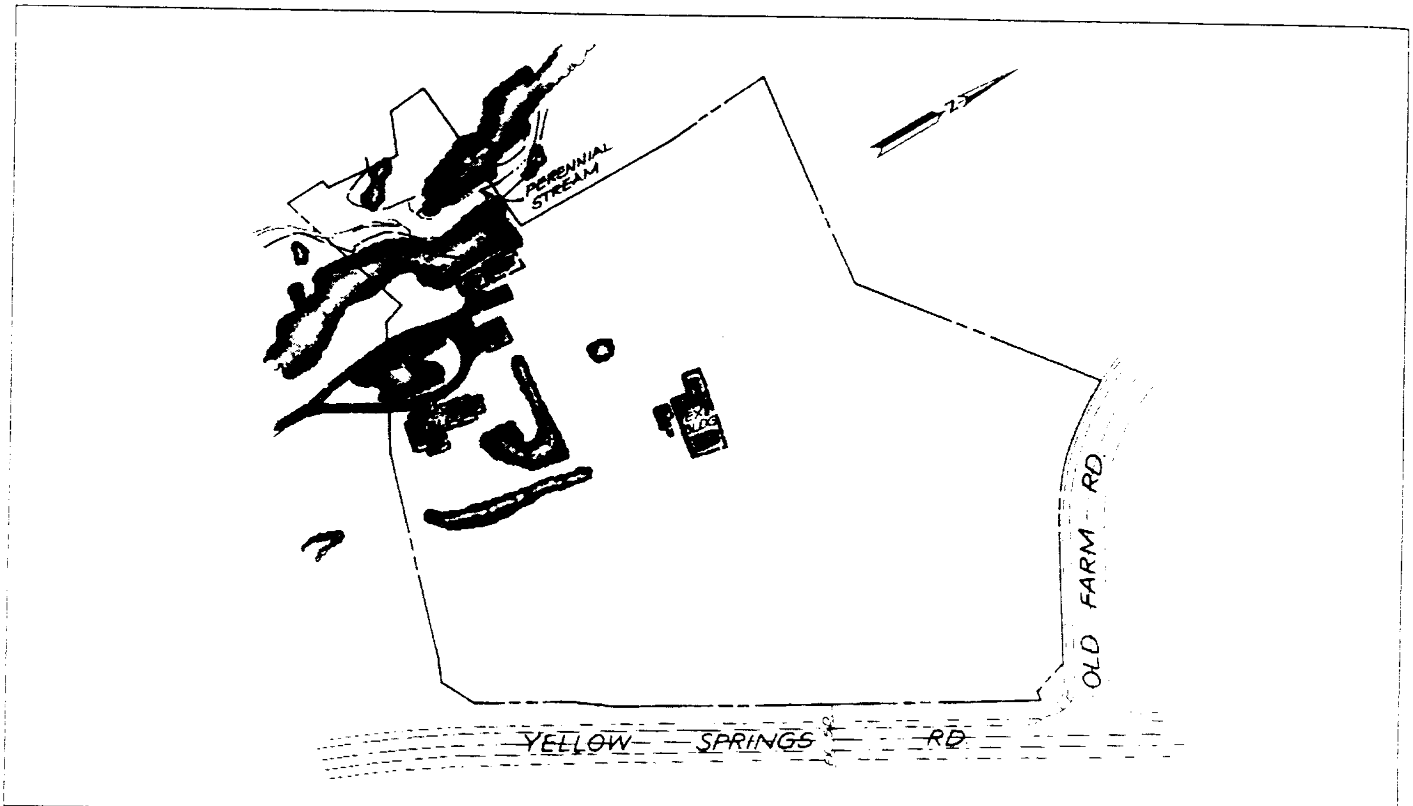


Figure 1: Predevelopment Conditions at the Old Farm Shopping Center Site

Redesign of the Old Farm Shopping Center

The undeveloped Old Farm shopping center, located in the City of Frederick, Maryland, was primarily meadow, with some shrubby forest and a few farm buildings. Bordered by two major arterial roads and served by existing public water and sewer, the site was a prime candidate for commercial development.

Construction of the shopping center site parcel commenced in 1992. The 9.3 acre site is a typical suburban "strip" shopping center with two large retail stores, other retail space, a gas station and a drive-in bank (Figure 2). In terms of surface cover, the shopping center devoted 50% of its total area for parking, as compared to 16% for the actual footprint of the retail buildings. Another 24% of the surface area was devoted to landscaping or stormwater treatment. Less than 10% natural cover was retained on the site, and part of the project encroached on the 100-year floodplain and the stream buffer. The entire site was mass graded during construction. The basic layout was designed to accommodate the car, with generous parking located in front of the stores. The parking lot design provided 5.2 full-size stalls per 1,000 square feet (sf) of retail space, which exceeded the already generous local parking requirement of five spaces per 1,000 sf. According to the most recent national parking research, only 4.0 to 4.5 spaces are needed to serve shopping centers (ULI, 1999).

The stormwater treatment system at Old Farm consisted of an infiltration basin located near the rear of the shopping center that captured runoff from about a third of the site, and three oil grit separators that provide some treatment for the remaining two-thirds of the site. After discharging from the oil/grit separators, runoff traveled through a series of storm drains that extended along the road and eventually discharged to the stream (albeit without detention of any kind). It should be noted that recent performance monitoring has shown that oil grit separators have little or no pollutant removal capability (see Technical Notes 101 and 104).

The Redesigned Old Farm Shopping Center

The Old Farm shopping center was redesigned using a "U-shaped" layout that maintained the same amount of gross floor area, but sharply reduced the site area devoted to parking (Figure 3). The new design reduced walking distances, encouraged pedestrian use, and created a more intimate shopping experience. Parking dropped from 50% of the total site area to 38%, primarily because the parking demand ratio was reduced from 5.2 spaces to 4.4 spaces per 1,000 sf of retail area.

R0073078

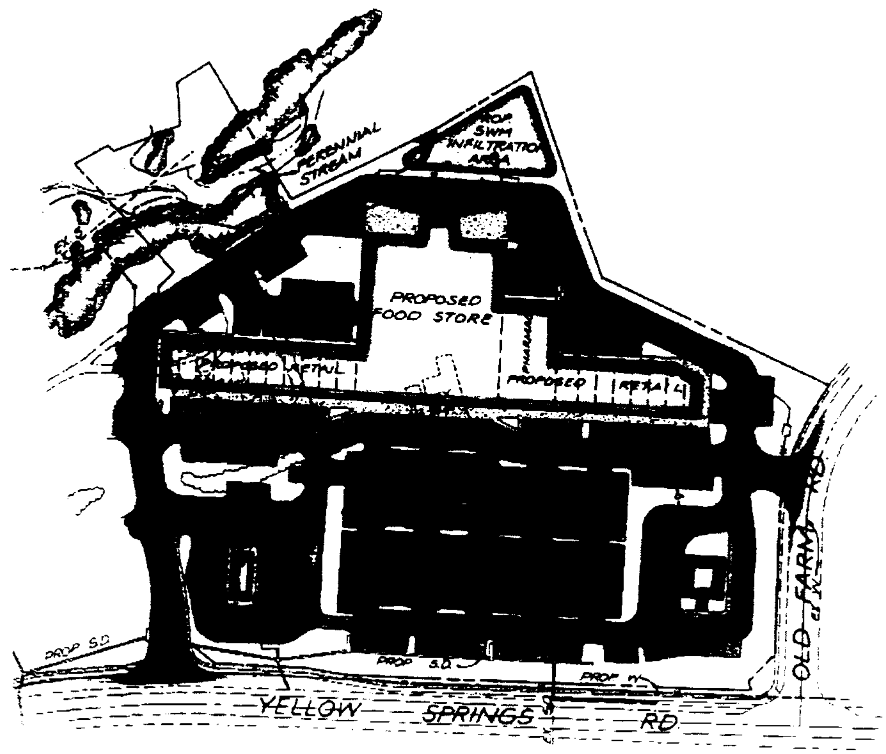


Figure 2: The Conventional Design of the Old Farm Shopping Center

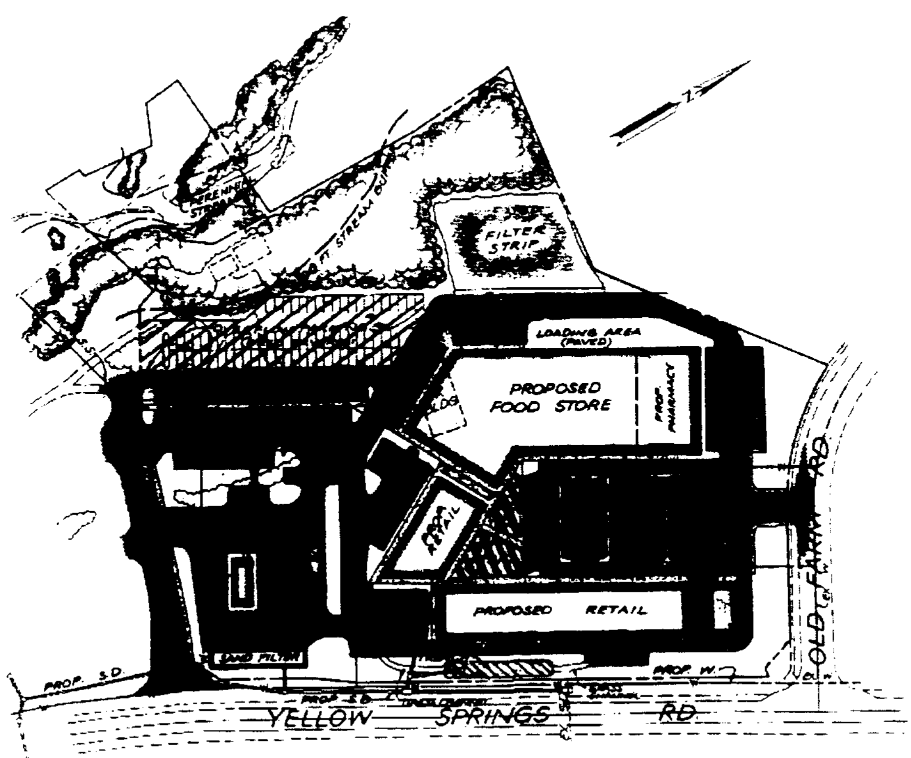


Figure 3: The Innovative Design of the Old Farm Shopping Center

R0073079

Table 1: Hydrology of the Old Farm Shopping Center Case Study				
		Pre-Developed	Conventional Parking Lot	Innovative Parking Lot
Runoff (inches/yr)	no practice	2.6	24.5	20.6
	practices		18.1	15.1
Infiltration (inches/yr)	no practice	11.8	2.7	3.4
	Practices		9.1	8.9

The rationale for the lower parking demand was justified in two ways. First, no extra parking spaces were allowed beyond those required by the locality. Second, the existing parking demand ratio was reduced by about 15% to reflect actual parking demand more accurately. As a result, the total number of parking spaces dropped from 343 to 291. In addition, 17% of the parking stalls were designed for compact cars, which require slightly smaller stalls than standard full-sized spaces. Taken together, these changes eliminated slightly more than one acre of parking area, which provided enough space to design a more effective landscaping and stormwater treatment system.

Several parking lot islands were increased in size and converted into bioretention areas to treat stormwater. Other elements of the stormwater treatment system included a sand filter, an infiltration trench, and a filter strip. Furthermore, 25% of the entire parking area was designated for "spillover parking," and grid pavers were used rather than normal paving materials. The grid pavers helped store the first few tenths of an inch of rainfall that would have otherwise run off the parking lot (ICPI, 2000). Lastly, the redesign enabled reforestation and greater protection of the buffer along the stream that runs along the edge of the property. As a result, the proportion of natural cover at the site climbed from 7% to 19% as a result of the parking lot redesign.

Comparative Hydrology at the Old Farm Shopping Center

As expected, the construction of the original shopping center dramatically changed the hydrology of the site (Table 1). The increase in impervious cover from 1% to more than 70% increased annual runoff volume by a factor of nine. The infiltration basin used in the original design helped put some runoff back into the ground, but even so, annual runoff was seven times greater than the pre-development condition. The redesigned parking lot, by virtue of its lower impervious cover and improved stormwater practices, produced about 20% less runoff than the original design. Nevertheless, the stormwater practices at the redesigned parking lot were not able to match the pre-development hydrology.

Comparative Nutrient Output from the Old Farm Shopping Center

The conversion of the meadow into a shopping center greatly increased nutrient export from the site; the SUNOM model indicated that annual phosphorus and nitrogen export would increase tenfold as a result of the development (see Figure 4). Nutrient export from the shopping center was dominated by stormwater runoff, as the model indicated that stormwater runoff contributed about 95% of the annual nutrient export from the site. Nutrient loads were not greatly reduced by the infiltration basin or oil/grit separators that were installed at the conventional parking lot. Nutrient export was still projected to be eight to ten times higher than pre-development conditions, even after these stormwater treatment practices were installed.

In contrast, the redesigned parking lot sharply reduced nutrient export (Figure 4). In fact, the redesigned parking lot *without* stormwater practices produced about the same nutrient load as the conventional parking lot *with* stormwater practices. This reduction was a direct result of the lower impervious cover associated with the redesigned parking lot. When the redesigned parking lot was combined with more sophisticated stormwater practices (i.e., bioretention, sand filter, infiltration trench and filter strip), the total nutrient export was half that of the conventional parking lot with stormwater practices. It is interesting to note, however, that this load was still about five times higher than that produced by the meadow prior to development.

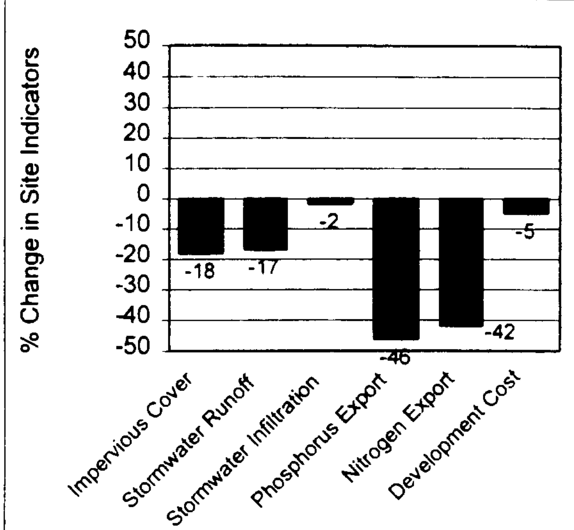


Figure 5: Percentage Change in Key Site Indicators From a Conventional Design of the Old Farm Shopping Center to an Innovative Design, Both With Stormwater Practices

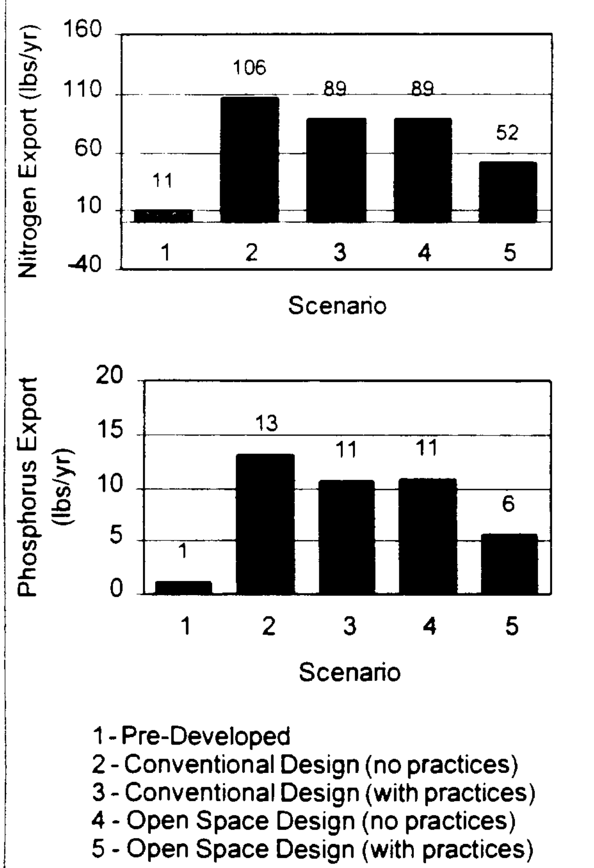


Figure 4: Annual Nitrogen and Phosphorus Export in Each Old Farm Shopping Center Development Scenario

Comparative Cost to Develop the Old Farm Shopping Center

The cost to develop the redesigned parking lot was marginally lower than the cost for the conventional parking lot — about 5%. Considerable cost savings were realized due to less paving, shorter sidewalks, and fewer curbs and gutters, but these savings were largely offset by added costs for improved stormwater practices, landscaping and grid pavers. Overall, the estimated cost to build the conventional parking lot was $782,500, compared to $746,270 for the redesigned parking lot. The extent of potential cost savings depends heavily on the level of sophistication of the original stormwater treatment system. In this case, the unsophisticated stormwater practices used in the conventional parking design were fairly inexpensive, but were also not effective in removing nutrients.

Summary

Figure 5 summarizes the redesign analysis of the Old Farm Shopping Center. The redesigned parking lot resulted in less impervious cover, stormwater runoff, and nutrient export for a slightly lower development cost than the conventional design.

R0073081

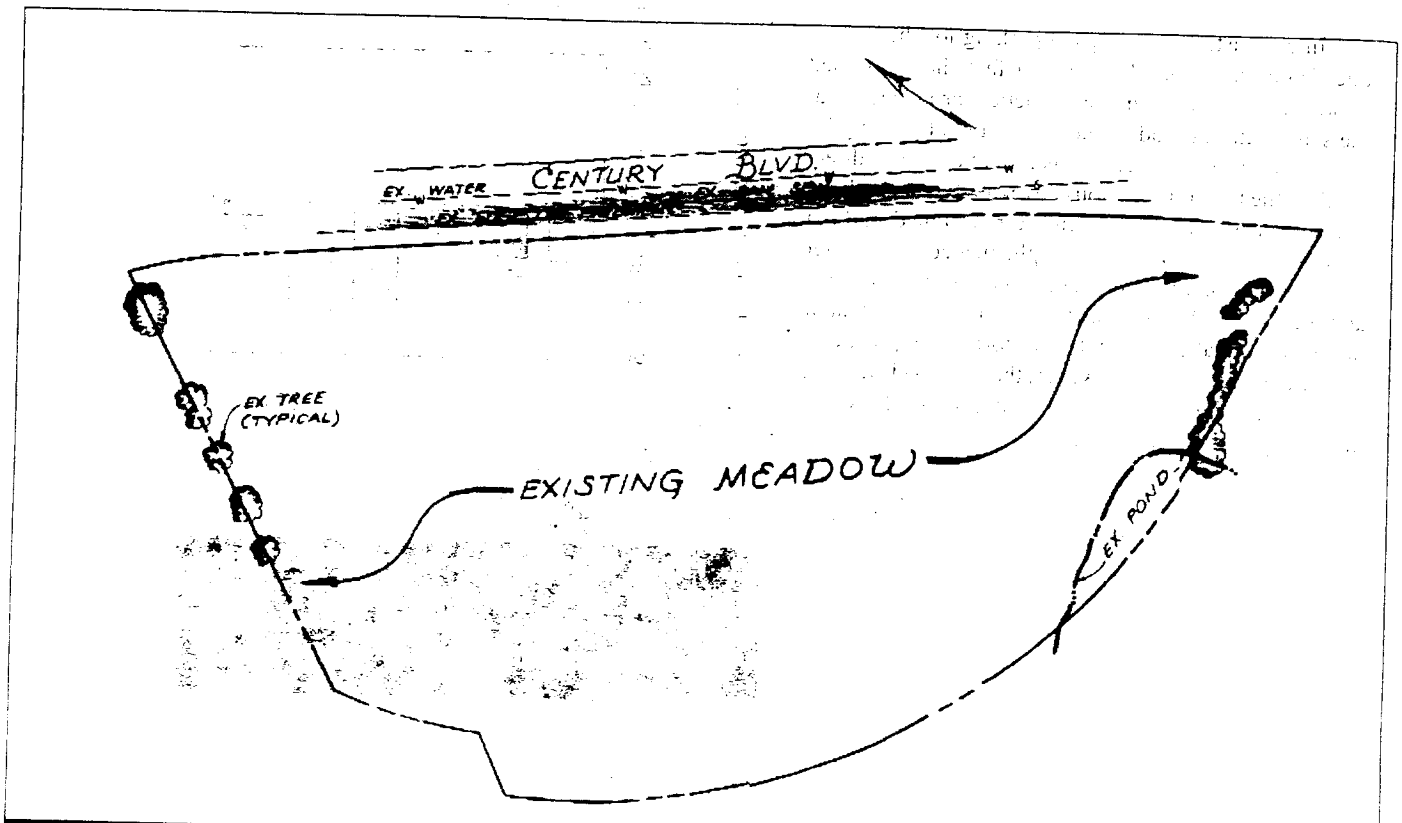


Figure 6: Predevelopment Conditions at the 270 Corporate Office Park Site

Redesigning the 270 Corporate Office Park

The second case study involved the redesign of a typical suburban office park. The 12.8 acre parcel is located in Germantown, Maryland in the mildly sloping terrain of the Piedmont (Figure 6). The existing cover at the site was almost entirely meadow, except for a few trees and an old farm pond that bisected the property boundary. No wetlands or other sensitive natural features were evident on the site. The site was zoned for office development, and existing infrastructure made it an attractive candidate for development. An existing network of public water and sewer, electric, gas, and other utilities ran along the frontage of a large arterial road.

The layout of the conventional suburban office park design is depicted in Figure 7. The project included a pair of five-story office buildings, surrounded by a sea of parking. Over half (52%) of the surface cover at the office park was devoted to parking, as compared to only 11% for actual footprint of the office building. Most of the remainder of the site was utilized for landscaping, stormwater treatment or turf. Only 2% of the natural cover was retained on the site, and nearly all of the parcel was mass graded during construction.

As with many suburban office parks, the location of the building and parking were primarily oriented toward the car. The parking lot was sized using a parking demand ratio of 3.1 spaces per 1,000 sf of building, which slightly exceeded the minimum parking requirements of the locality. As a result, the parking lot created room for 745 standard stalls, along with 33 larger stalls for vans and disabled access. The parking bays also featured roomy aisles between the stalls (24 feet wide). The design was intended to provide some amenities for the office workers, including a short path system between buildings, an ornamental stormwater pond, and some landscaping in required setbacks and parking islands.

The conventional design featured the classic "pipe and pond" approach to stormwater management. Parking lot runoff was initially collected by a curb and gutter system that sent runoff into underground storm drain pipes that, in turn, discharged into two very small wet ponds. Each pond served roughly half of the site and was expected to have a reasonably good capability to remove nutrients (see Technical Note 95).

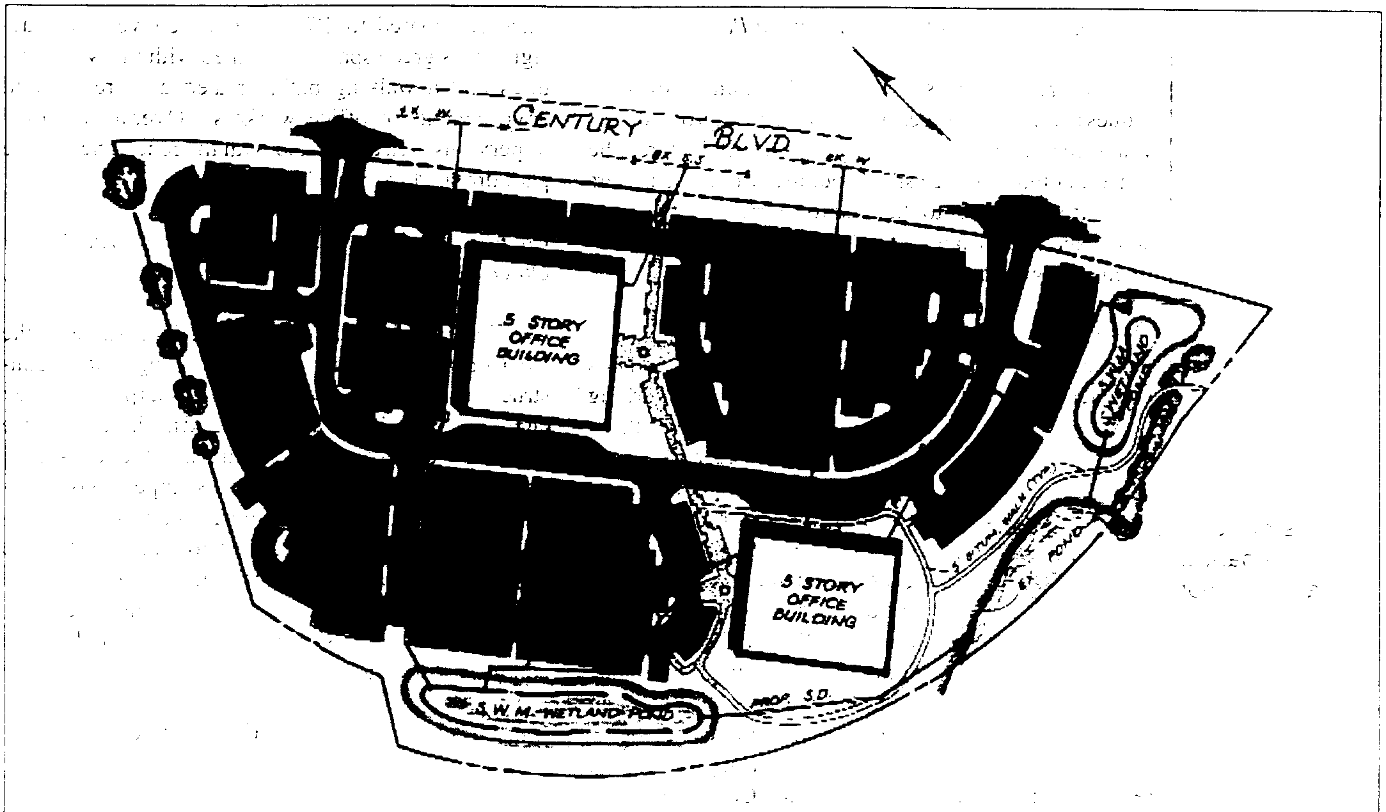


Figure 7: The Conventional Design of the 270 Corporate Office Park

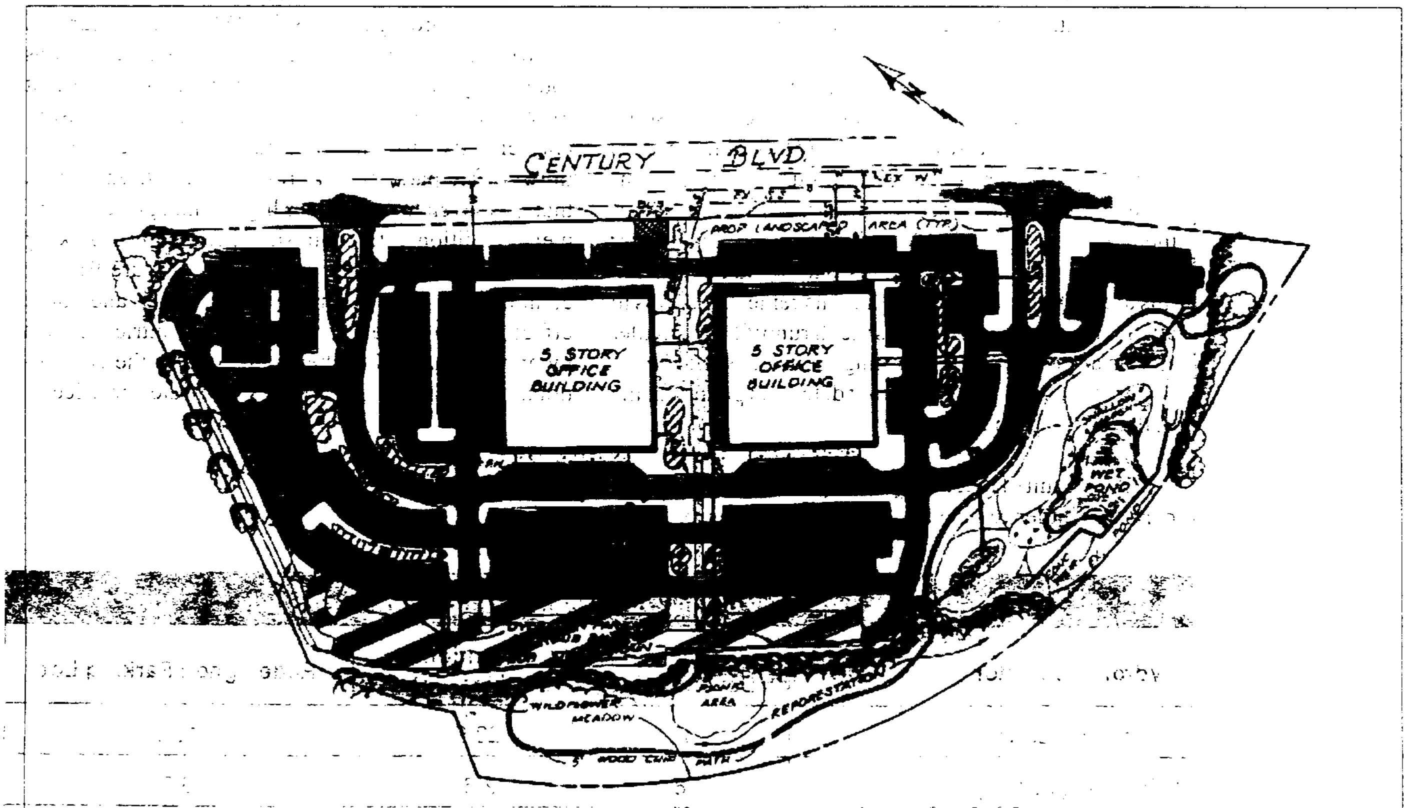


Figure 8: The Innovative Design of the 270 Corporate Office Park

R0073083

The Redesigned 270 Corporate Office Park

The redesigned site employed a number of techniques to minimize impervious cover and improve stormwater treatment (Figure 8). The office park featured the same amount of office space, but the two office towers were situated closer to the road to shorten utility extensions, and pedestrian access to a bus stop was provided to encourage the use of public transportation.

The key strategy employed in the redesign was to incrementally reduce the size of the parking lot, and this was achieved in five ways. First, no excess parking spaces were allowed over those required by the local parking demand ratio. Second, the local parking demand ratio was reduced by 8% to reflect actual parking demand. Third, the parking demand ratio was reduced by another 10% to reflect the proximity to the bus stop. Fourth, the size of approximately 20% of all parking stalls was downsized to accommodate compact cars. Lastly, drive aisles in many parking bays were reduced from 24 feet in width to 20 feet. Combined, these measures reduced the total parking lot area by nearly 30%, or about two acres. Once again, the savings in paving gave the designer more room to integrate landscaping with more effective stormwater treatment.

Construction of the conventional office park sharply increased annual runoff and decreased infiltration.

For example, larger landscaping islands were installed in the parking lot to plant shade trees, and some of these areas were also converted into bioretention areas to treat stormwater. A dry swale was used to treat stormwater within a landscaped setback area in another part of the site. About 15% of the lot was designated for spillover parking, and grid pavers were used to attenuate runoff in this area. The basic stormwater management goal was to attenuate, treat, or recharge as much runoff from smaller storms as possible in the parking lot itself. Runoff from larger storms was treated in a wet detention pond near the outlet of the property.

As a result of the redesign, roughly 14% of the office park was either retained in natural land cover or reforested (compared to 2% under the conventional design). This green space, combined with the water features and a walking path, created a more tranquil environment for office workers. Overall, the total impervious area associated with the redesigned office park dropped from 68% to 53%.

Comparative Hydrology for the 270 Corporate Center Office Park

The hydrological story was much the same for the 270 Corporate Center as for the shopping center. Construction of the conventional design sharply increased annual runoff volumes and decreased infiltration (Table 2). Runoff did not increase as much in the redesigned parking lot, primarily because its impervious cover was much lower. Annual runoff volumes were 21% lower in the redesigned parking lot compared to the conventional design, and infiltration volumes were 42% higher. Despite these improvements, the redesigned parking lot was unable to mimic the hydrologic conditions prior to development.

Nutrient Output at the 270 Corporate Center Office Park

As expected, the conversion of the meadow into an office park greatly increased nutrient export. Annual phosphorus and nitrogen export increased roughly ten-fold, according to the SUNOM model (Figure 9). As with the shopping center, stormwater runoff was found to generate about 95% of the annual nutrient export from the site. The two wet ponds were reasonably effective in removing nutrients at the conventional office park, but still resulted in nutrient export that was seven to eight times higher than pre-development conditions. In contrast, the redesigned parking lot sharply reduced nutrient export (Figure 9). The combination of lower impervious cover and more effective stormwater practices reduced nutrient export by about 40 to 50%, when compared to the conventional parking lot design *with* stormwater practices.

Table 2: Hydrology of the 270 Corporate Office Park Case Study

Hydrologic Factor	Pre-Developed	Conventional Parking Lot	Redesigned Parking Lot
Runoff (inches/yr)	2.7	23.9	18.9
Infiltration (inches/yr)	11.8	2.6	3.7

Note: no change in the annual volume of runoff or infiltration was calculated as a result of the stormwater practices installed at either the conventional or redesigned parking lots.

R0073084

Comparative Cost to Develop the 270 Corporate Office Park

The cost to develop the redesigned office park was approximately the same as the cost to develop the conventional office park, although the component costs were somewhat different. Less was spent on paving, sidewalks and utility pipes, but these savings were largely offset by higher costs for improved stormwater treatment practices, landscaping, grid pavers and curiously, curbs and gutters (the higher cost for this last item was due to the wider parking islands used for bioretention areas). Overall, the estimated cost to build the conventional parking lot was $948,900, compared to $921,200 for the redesigned parking lot.

Summary

The redesigned parking lot at the 270 Corporate Office Park resulted in less impervious cover, stormwater runoff, and nutrient export for about the same development cost as the conventional design. The results are summarized in Figure 10.

The Limits and Potential of Parking Lot Redesign

To our knowledge, no one has yet tried to quantify the potential economic and environmental benefits of better parking lot design at new commercial developments. This initial analysis provides compelling evidence that better site design is an important, if not indispensable, tool for managing the quantity and quality of stormwater runoff from parking lots.

In each of the case studies, the redesigned parking lot resulted in less impervious cover, stormwater runoff, and nutrient export for about the same or even slightly lower cost than the conventional design. Taken together, better site design techniques reduced impervious cover by at least 15% in each case. While this is an impressive reduction, about half of each site remained impervious after the redesign. Perhaps the most critical benefit of each redesign was that it created more room to locate more effective stormwater treatment practices. When smaller parking lots were combined with better stormwater practices, the resulting nutrient export was almost half that of a conventional parking lot.

In each case study, the critical ingredient was an incremental reduction in the local parking demand ratio. Without this capability to shrink the surface area devoted to parking, designers have little ability to devise the more sophisticated stormwater treatment and landscaping systems that can

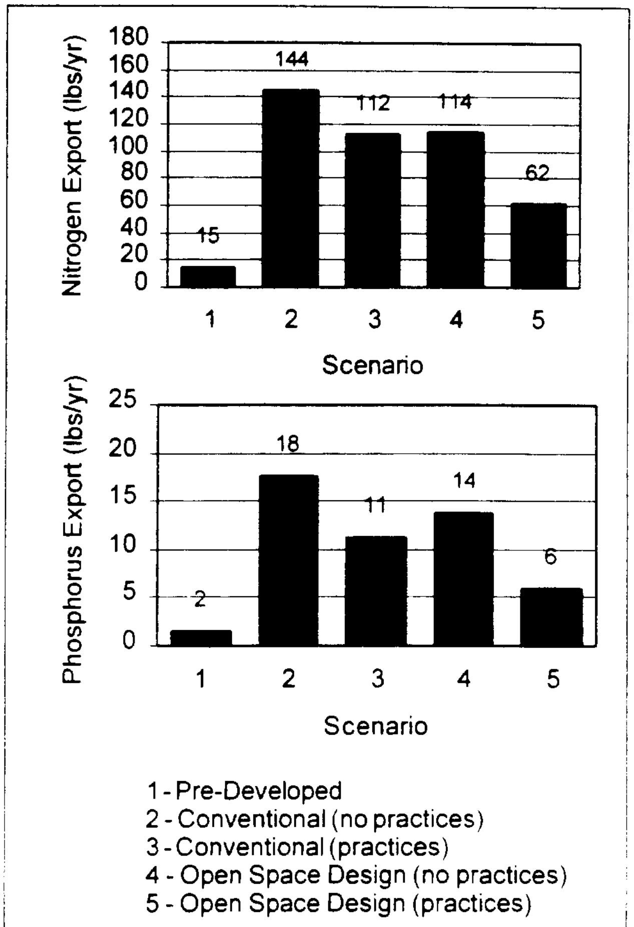


Figure 9: Annual Nitrogen and Phosphorus Load in Each 270 Corporate Office Park Development Scenario

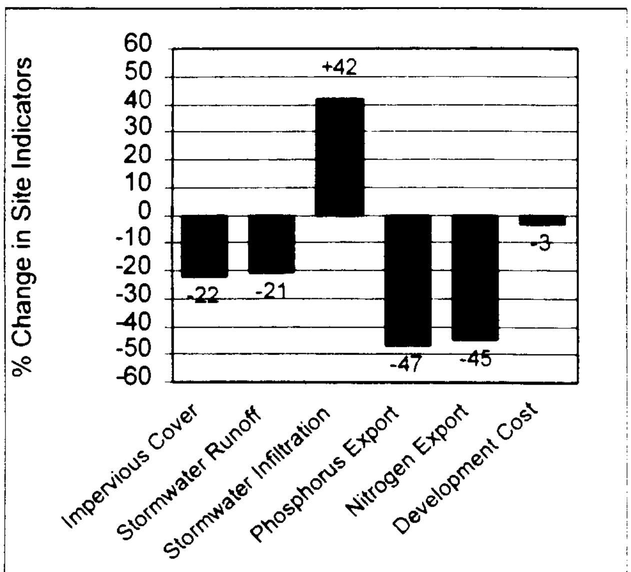


Figure 10: Percentage Change in Key Site Conditions from a Conventional Design to a Redesigned Parking lot at the 270 Corporate Office Park, Both With Stormwater Practices

R0073085

help mitigate the impact of the parking lot. Therefore, the first and most important step in implementing better site design for commercial developments *is to reduce local parking demand ratios, even if only by five or ten percent.* For many communities, however, this modest step may seem like a terrifying leap, possibly off a cliff.

Developers, bankers, retailers and drivers all have a shared interest in abundant and convenient parking, and it is hard to convince them that any attempt to downsize parking lots, however modest, will not work against this goal. This kind of thinking is quite understandable. Most people can easily recall the rare situation where parking was hard to find, but the more common situation where parking is plentiful generally escapes our everyday notice.

Small wonder, then, that so many communities are prone to inertia when it comes to changing parking codes. Perhaps the only way watershed advocates can overcome this inertia is to document the existence of excess parking capacity in each community. Indeed, it is a rather simple step for volunteers to count cars and photograph empty stalls during peak times at similar commercial land uses to demonstrate how generous local parking requirements actually are.

The most important step to implement better site design for commercial developments is to reduce local parking demand ratios.

A small but growing list of communities are now experimenting with their parking standards and parking lot designs, including cities like Scarborough, Ontario; Oakland, CA; Olympia, WA; Sacramento, CA; Bellevue, WA; Davis, CA and Prince George's County, MD. Each community has worked in different ways to redesign their parking lots, and many of their successful experiences are recounted in *Better Site Design: A Handbook for Changing Development Rules in Your Community* (CWP 1998a).

Given the prevalence of parking lots in our urban landscape and the environmental harm they cause, we need to fundamentally change the way that parking lots are sized and designed. The modest ideas presented in this article are merely an initial step in this direction. A wide range of professions collectively influence the form and function of parking lots, including engineers, hydrologists, landscape architects, urban foresters, soil scientists, developers, leasing agents, plan reviewers, transportation researchers and many, many others. Working together, these groups can move us closer toward the goal of a truly sustainable parking lot, i.e., one that not only provides car habitat, but also prevents damage to other habitats as well. **- *JAZ***

Editor's Note: Some useful benchmarks for testing how good your local parking codes can be found in the Codes and Ordinances Worksheet (see accompanying article).

References

Center for Watershed Protection. 1998a. *Better Site Design: A Handbook for Changing Development Rules in Your Community.* Site Planning Roundtable. Ellicott City, MD. 176 pp.

Center for Watershed Protection. 1998b. *Nutrient Loading From Conventional and Innovative Site Development.* Chesapeake Research Consortium. Ellicott City, MD. 56 pp.

Interlocking Concrete Pavement Institute. 2000. *Permeable Interlocking Concrete Pavements: Selection, Design, Construction and Maintenance.* Washington, DC.

Scott, Klaus I., James R. Simpson, and E. Gregory McPherson. 1999. "Effects of Tree Cover on Parking Lot Microclimate and Vehicle Emissions." *Journal of Arboriculture* 25(3):129-142.

Urban Land Institute. 1999. *Parking Requirements for Shopping Centers: Summary Recommendations and Research Study Reports.* 2nd Edition. Washington, DC. 81 pp.

R0073086

Cost and Benefits of Storm Water BMPs
Final Report 9/14/98

Prepared by:

Center for Watershed Protection

Prepared for:

Parsons Engineering Science
EPA Contract 68-C6-0001
WA 2-15
Task 6

1.0 INTRODUCTION

Storm water Best Management Practices (BMPs) are a primary tool to improve the quality of urban streams and meet the requirements of NPDES permits. They include both structural options, such as construction of storm water ponds, and non-structural ones, such as implementing a storm drain stenciling program. Using BMPs can represent a significant cost to communities, but these costs should be weighed against the benefits they provide. This report will review available data on the costs and potential benefits of both structural and non-structural BMPs designed to improve the quality of urban and urbanizing streams, and the larger water bodies to which they drain.

2.0 STRUCTURAL BMP COSTS

The term structural BMPs, often referred to as "Treatment BMPs," refers to physical structures designed to remove pollutants from storm water runoff, reduce downstream erosion, provide flood control and promote groundwater recharge. They can also have ancillary benefits and costs such as increasing or decreasing property values. In contrast with non-structural BMPs, structural measures include some engineering design and construction.

Structural BMPs include:

- Ponds and Created Wetlands
- Infiltration Practices
- Filters
- Bioretention
- Vegetative BMPs
- Other structures (not included in this analysis).

Ponds and wetlands include several designs that treat storm water through the use of some combination of a permanent pool and detention storage. Wetlands also incorporate the use of aquatic plants to aid in treatment by slowing runoff velocities and providing some pollutant uptake. Some typical pond and wetland designs are described in Table 1.

Table 1. Storm Water Pond and Wetland Designs

Design	Description
Dry Extended Detention Pond	A pond with no permanent pool of water. Detention (usually 24 or 48-hour) is the only mechanism to improve water quality.
Wet pond	A pond with a permanent pool of water but no extended detention storage. Retention and biological activity in the permanent pool are the primary mechanisms of pollutant removal.
Wet Extended Detention Pond	Wet extended detention ponds incorporate the features of wet ponds and extended ponds, with a permanent pool of water and extended detention storage above the pool.
Shallow Marsh	A shallow marsh system is a wetland with a very shallow depth, which treats runoff primarily through settling and pollutant uptake in the permanent pool.
Extended Detention Wetland	A shallow marsh system with extended detention storage above the permanent pool.
Pond/Wetland System	Use of a wetland following a wet pond. This design can achieve high pollutant removal, while consuming less space than a shallow marsh.

Infiltration BMPs have no "formal" outlet for small storms, and thus these storms are treated by filtration as they percolate through the soil into the groundwater. The two infiltration systems focused on in this report are infiltration trenches and infiltration basins (Table 2).

Table 2. Infiltration BMPs

Design	Description
Infiltration Trench	A rock-filled trench with no outlet. Storm water directed to the trench is infiltrated into the ground, and pollutant removal is achieved through filtering by the soil matrix.
Infiltration Basin	A shallow impoundment with no low flow outlet. Therefore, storm water runoff entering the basin must infiltrate through the bottom soils to exit the basin. Pollutant removal is accomplished as storm water is filtered through the soil.

Filtering systems remove pollutants by passing storm water though a filtering medium such as a sand or organic medium. Runoff is typically returned to a drainage or stream system after being treated by filters. The three filtering systems discussed in this segment, as well as bioretention, are described in Table 3. Although bioretention can serve as a filtering system or infiltration practice, it is discussed separately for the remainder of the document because it has separate cost data and design criteria.

Table 3. Filtering Practice Designs

Design	Description
Surface Sand Filter	A BMP where runoff enters a sedimentation chamber that provides pretreatment, and then flows to a sand filter, where the runoff flows through a bed of sand, receiving additional treatment. Treated runoff is collected in and underdrain system and returned to the storm drain network or stream channel.
Underground Sand Filter	Use the same pollutant removal mechanisms as surface sand, but the filter and the pretreatment storage are located in a vault underground.
Perimeter Sand Filter	Also uses the same pollutant removal mechanisms as surface sand filters. In the perimeter sand filter design, the filter typically lies parallel to the curb at the edge of a parking lot. The inlet to the system is a grated system at the edge of the lot.
Bioretention	A shallow landscaped depression that temporarily ponds 6 to 12 inches of storm water before it filters through a soil matrix. Nutrient uptake into woody plants is an additional removal mechanism.

Vegetative BMPs, sometimes called open channel BMPs, treat storm water runoff as it flows over a sloping vegetated surface. Treatment is through settling and through filtering as storm water infiltrates into the soil matrix below the vegetated surface. Some typical vegetated BMPs are described in Table 4. In this report, wet swales are assumed to have the same cost as biofilters, because there is little cost data available on this practice.

Table 4. Vegetative BMP Designs

Design	Description
Grass Channel/ Biofilter	A modified drainage channel designed with a cross-section and slope that keeps the storm water velocity low enough to allow filtering and some infiltration during small to moderate storm events.
Wet Swale	An open channel that retains the water quality volume in a series of linear cells along a channel. The channel bottom usually intersects the seasonally high groundwater table, and pollutant removal is achieved due to settling and pollutant uptake by plants in the swale.
Dry Swale	Constructed open channels designed to capture and treat a defined volume of storm water runoff by filtering it through a surface cover and a prepared soil mix.

Other BMPs include experimental and proprietary products, as well as some conventional structures such as water quality inlets. They are not included in this analysis because sufficient data are not available to support either the performance or the cost of these devices, or they have poor pollutant removal or life-long performance.

2.1 Screening Criteria

Site suitability for selecting a particular BMP strategy is key to successful performance. Most BMPs have limitations for applicability. Considerations include drainage area, soils, and long-term maintenance requirements. Tables 5 through 8 set forth common screening criteria in devising a BMP strategy to serve a site or watershed. These criteria were developed for the State of Maryland (CWP et al., 1997), and are most applicable to moderate, humid climates such as the mid-Atlantic and Pacific Northwest. In cold climates, design modifications may be needed to adjust for phenomena such as freezing and spring snowmelt (Caraco and Claytor, 1997). In arid climates, some BMPs may not be appropriate due to water requirements of the BMPs. Table 9 lists BMPs that require supplemental water, and outlines their value in arid and semi-arid climates.

Table 5. BMP Selection Matrix No. 1
PHYSICAL FEASIBILITY

CODE	BMP LIST	SOILS	WATER TABLE	DRAINAGE AREA (acres)	SITE SLOPE	HEAD (ft)	ULTRA URBAN
P-1	Micropool ED	"A" soils may require pond liner "B" soils may require testing	2 feet if hotspot or aquifer	10 min*	No more than 15%	6 to 8 ft	Not practical
P-2	Wet Pond			25 min*			
P-3	Wet ED Pond						
P-4	Multiple Pond						
P-5	Pocket Pond	OK	Below WT	5 max**		4 ft	OK
W-1	Shallow Marsh	A soils may require liner	2 feet if hotspot or aquifer	25 min	No more than 8%	3 to 5 ft	Not practical
W-2	ED Wetland						
W-3	Pond/Wetland						
W-4	Pocket Marsh	OK	Below WT	5 max		2 to 3 ft	Depends
I-1	Infiltration Trench	$f_c > 0.52$ inch/hr	4 feet (2 feet Eastern Shore)	5 max	No more than 6%	1 ft	Depends
I-2	Shallow I-Basin			10 max		3 ft	Not practical
F-1	Surface Sand Filter	OK	2 feet	10 max **	No more than 6%	5 ft	Depends
F-2	Underground SF			2 max **		5 to 7ft	OK
F-3	Perimeter SF			2 max **		2 to 3 ft	OK
F-4	Organic SF			5 max**		2 to 4 ft	OK
F-5	Pocket Sand Filter			5 max **		2 to 5 ft	OK
F-6	Bioretention	Made Soil				5 ft	OK
O-1	Dry Swale	Made Soil	2 feet	5 max	4% max	3 to 5 ft	Not practical
O-2	Wet Swale	OK	Below WT	5 max		1 ft	

Notes: OK= not restricted, WT= water table, PT = pretreatment, ED = Extended Detention, SF = Sand Filter
*** unless adequate water balance and anti-clogging device installed**
**** drainage area can be larger in some instances**

R0073092

Table 6. BMP Selection Matrix No 2
TERRAIN FACTORS

BMP GROUP	LOW RELIEF	KARST	MOUNTAINOUS
Ponds	Maximum normal pool depth of 4 feet (dugout)	• Require poly or clay liner • max ponding depth • geotechnical tests	Embankment heights restricted
Wetlands	OK	Require polyliner geotechnical testing	Embankment heights restricted
Infiltration	Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 6% Trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F-1 and F-2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Table 7. BMP Selection Matrix No. 3
SPECIAL WATERSHED DESIGN REQUIREMENTS

BMP GROUP	STREAM BUFFER	COLD-WATER	SENSITIVE STREAM	AQUIFER PROTECTION	RESERVOIR PROTECTION	SHELLFISH/ BEACH
Ponds	Drainage area may limit except for P-5 P-1 has lower removal rates	P-2, P-3, and P-4 restricted Limit ED to 12 hrs Offline design Provide shading	Require control of Cp_v, usually 1 year 24 ED	May require liner if A soils are present Pretreat hotspots 2 to 4 ft SD	Require control of Cp_v	Moderate bacteria removal, design for geese prevention Provide permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W-1, W-2 and W-3 restricted	Require control of Cp_v, usually 1 year 24 ED	May require liner if A soils are present Pretreat hotspots 2 to 4 ft SD	Require control of Cp_v	Provide 48 hr ED for max coliform dieoff
Infiltration	Often infeasible due to soils or water table in tidal area	OK, if site has right soil	Often difficult to infiltrate the Cp_v	SD from wells and water table No hotspot runoff OK to infiltrate rooftop runoff	SD from bedrock and water table Pretreat runoff prior to infiltration BMP	OK, but a min. 2 to 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Should be combined with another ED basin to provide Cp_v	OK, if designed w/ no exfiltration	May be necessary for pretreatment prior to another BMP	OK; moderate to high coliform removal
Open Channels	OK	OK	Should be linked w/ED basin to provide Cp_v	OK, but hotspot runoff must be adequately treated		Poor coliform removal for O-2

*SD = Separation Distance, Cpv = Refers to channel protection, *SD = Separation Distance
Cpv = Refers to channel protection, ED = Extended Detention

R0073094

Table 8. BMP Selection Matrix No. 4
COMMUNITY AND ENVIRONMENTAL FACTORS

CODE	BMP LIST	EASE OF MAINTENANCE	COMMUNITY ACCEPTANCE	AFFORDABILITY	HABITAT	OTHER FACTORS
P-1	Micropool ED	◗	◗	○	◗	Trash/debris
P-2	Wet Pond	○	○	○	○	High pond; possible mosquitos
P-3	Wet ED Pond	○	○	○	○	
P-4	Multiple Pond	○	○	◗	○	
P-5	Pocket Pond	●	◗	○	●	Drawdowns
W-1	Shallow Marsh	◗	○	◗	○	
W-2	ED Wetland	◗	◗	◗	○	Limit ED depth
W-3	Pond/Wetland	○	○	◗	○	
W-4	Pocket Marsh	●	●	○	◗	Drawdowns
I-1	Infiltration Trench	●	○	◗	●	Avoid large stone
I-2	Shallow I-Basin	●	●	◗	●	Frequent pooling
F-1	Surface SF	◗	◗	●	●	Minimize concrete
F-2	Underground SF	●	○	●	●	Out of sight
F-3	Perimeter SF	●	○	●	●	Traffic bearing
F-4	Organic SF	◗	○	●	●	Change compost
F-5	Pocket Sand Filter	◗	◗	◗	●	
F-6	Bioretention[1]	●	◗	◗	●	Landscaping
O-1	Dry Swale	○	○	◗	●	
O-2	Wet Swale	○	○	○	●	Possible mosquitos

○ High ● Low ◗ Medium

[1] Combination with F-2 can improve bioretention performance on these measures.
ED = Extended Detention, SF = Sand Filter

R0073095

Table 9. BMP Use in Arid and Semi-Arid Climates

BMP		Supplemental Water Required?	Use in Arid and Semi-Arid Climates
Ponds	Detention Pond	◗	• Consider alternatives to a vegetated bottom, such as sand or stones. • Always use drought tolerant vegetation • If water is required, use a non-potable water source.
	Dry ED Pond	◗	
	Wet Pond	●	• Rarely applicable in arid or semi-arid climates.
	Wet ED Pond	●	• Rarely applicable in arid climates • In semi-arid climates, may be used if the permanent pool is allowed to vary seasonally, rather than be maintained at a fixed level.
Wetlands	Shallow Marsh	●	• Rarely applicable in arid or semi-arid climates.
	ED Wetland	●	• Rarely applicable in arid climates • In semi-arid climates, may be used if the permanent pool is allowed to vary seasonally, rather than be maintained at a fixed level.
	Pond/Wetland	●	• Rarely applicable in arid or semi-arid climates.
Infiltration	Infiltration Trench	○	• Applicable in arid and semi-arid climates.
	Infiltration Basin	◗	• Consider alternatives to a vegetated bottom, such as sand or stones. • Always use drought tolerant vegetation • If water is required, use a non-potable water source
Filters	Sand or Organic Filters	○	• Applicable in arid and semi-arid climates.
Bioretention	Bioretention	◗	• Always use drought tolerant vegetation • If water is required, use a non-potable water source
Vegetative BMPs	Channels	◗	• Consider alternatives to a vegetated bottom, such as sand or stones. • Always use drought tolerant vegetation • If water is required, use a non-potable water source
	Designed Swales	◗	
	Filter Strips	◗	

ED = Extended Detention, Arid = <15" of rain per year, Semi-Arid = <30" of rain per year

● = Yes, significant amounts of water required

◗ = Yes, but only for maintenance (e.g., vegetated BMPs)

○ = No supplemental water required.

2.2 Base Capital Costs

The base capital costs refer primarily to the cost of actually constructing and building the BMP. This may include the cost of erosion and sediment control during construction. The costs of design, geotechnical testing, legal fees, and other unexpected or additional costs are not included in this estimate. The cost of constructing any BMP is variable and depends largely on site conditions and drainage area. For example, if a BMP is constructed in very rocky soils, the increased excavation costs may substantially increase the cost of construction. In addition, designs vary slightly among BMP types. A pond may be designed with or without various levels of landscaping, for example. The data in Table 10 represent typical unit costs ($/cubic foot) from various studies, and should be considered planning level. In the case of ponds, a range is used to reflect the economies of scale involved in designing this BMP.

In some ways there is no such value as the "average" construction cost for some BMPs, because many BMPs can be designed for widely varying drainage areas. However, there is some value in assessing the cost of a typical application of each BMP. The data in Table 11 reflect base capital costs for typical applications of each category of BMP. It is important to note that, since many BMPs have economies of scale, it is not practical to extrapolate these values to larger or smaller drainage areas in many cases.

Table 10. Typical Unit Base Costs for BMPs

BMP	Typical Cost ($/cf)	Notes	Source
Pond	0.50-1.00	Cost range reflects economies of scale in designing this BMP. The lowest unit cost represents approximately 150,000 cubic feet of storage, while the highest is approximately 15,000 cubic feet. Typically, dry ponds are the least expensive design options among ponds.	Adapted from Brown and Schueler (1997)
Wetland	0.60-1.25	Although little data are available to assess the cost of wetlands, it is assumed that they are approximately 25% more expensive (because of plant selection and sediment forebay requirements) than ponds.	Adapted from Brown and Schueler (1997)
Infiltration Trench	4.00	Represents typical costs for a 100-foot long trench.	Adapted from SWRPC (1991)
Infiltration Basin	1.30	Represents typical costs for a 0.25-acre infiltration basin.	Adapted from SWRPC (1991)
Sand Filter	3.00-6.00	The range in costs for sand filter construction is largely due to the different sand filter designs. Of the three most common options available, surface sand filters are the most expensive, perimeter sand filters are moderate and underground sand filters are the most expensive.	Adapted from Brown and Schueler (1997)
Bioretention	5.30	Bioretention is relatively constant in cost, because it is usually designed as a constant fraction of the total drainage area.	Adapted from Brown and Schueler (1997)
Dry Swale	4.25	Very few dry swales have been constructed, but the design is similar to a bioretention facility, with less landscaping. Thus, it is assumed that dry swales cost approximately 80% as much as bioretention.	Adapted from Brown and Schueler (1997)
Grass Channel/ Biofilters	0.50	Based on cost per square foot, and assuming 6" of storage in the filter.	Adapted from SWRPC (1991)
Filter Strip	0.00-1.30	Based on cost per square foot, and assuming 6" of storage in the filter strip. The lowest cost assumes that the buffer uses existing vegetation, and the highest cost assumes sod was used to establish the filter strip.	Adapted from SWRPC (1991)

Table 11. Base Costs of Typical Applications of Stormwater BMPs[1]

BMP	Typical Cost ($/BMP)	Application	Source
Pond	$100,000	50- Acre Residential Site (Impervious Cover = 35%)	Adapted from Brown and Schueler (1997)
Wetland	$125,000	50- Acre Residential Site (Impervious Cover = 35%)	Adapted from Brown and Schueler (1997)
Infiltration Trench	$45,000	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from SWRPC (1991)
Infiltration Basin	$15,000	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from SWRPC (1991)
Sand Filter	$35,000-$70,000[2]	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from Brown and Schueler (1997)
Bioretention	$60,000	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from Brown and Schueler (1997)
Dry Swale	$30,000	5- Acre Residential Site (Impervious Cover = 35%)	Adapted from Brown and Schueler (1997)
Grass Channel/ Biofilters	$3,500	5- Acre Residential Site (Impervious Cover = 35%)	Adapted from SWRPC (1991)
Filter Strip	$0-$9,000	5- Acre Residential Site (Impervious Cover = 35%)	Adapted from SWRPC (1991)

1: Total captial costs can typically be determined by increasing these costs by approximately 30%.
2: A range is given to account for design variations.

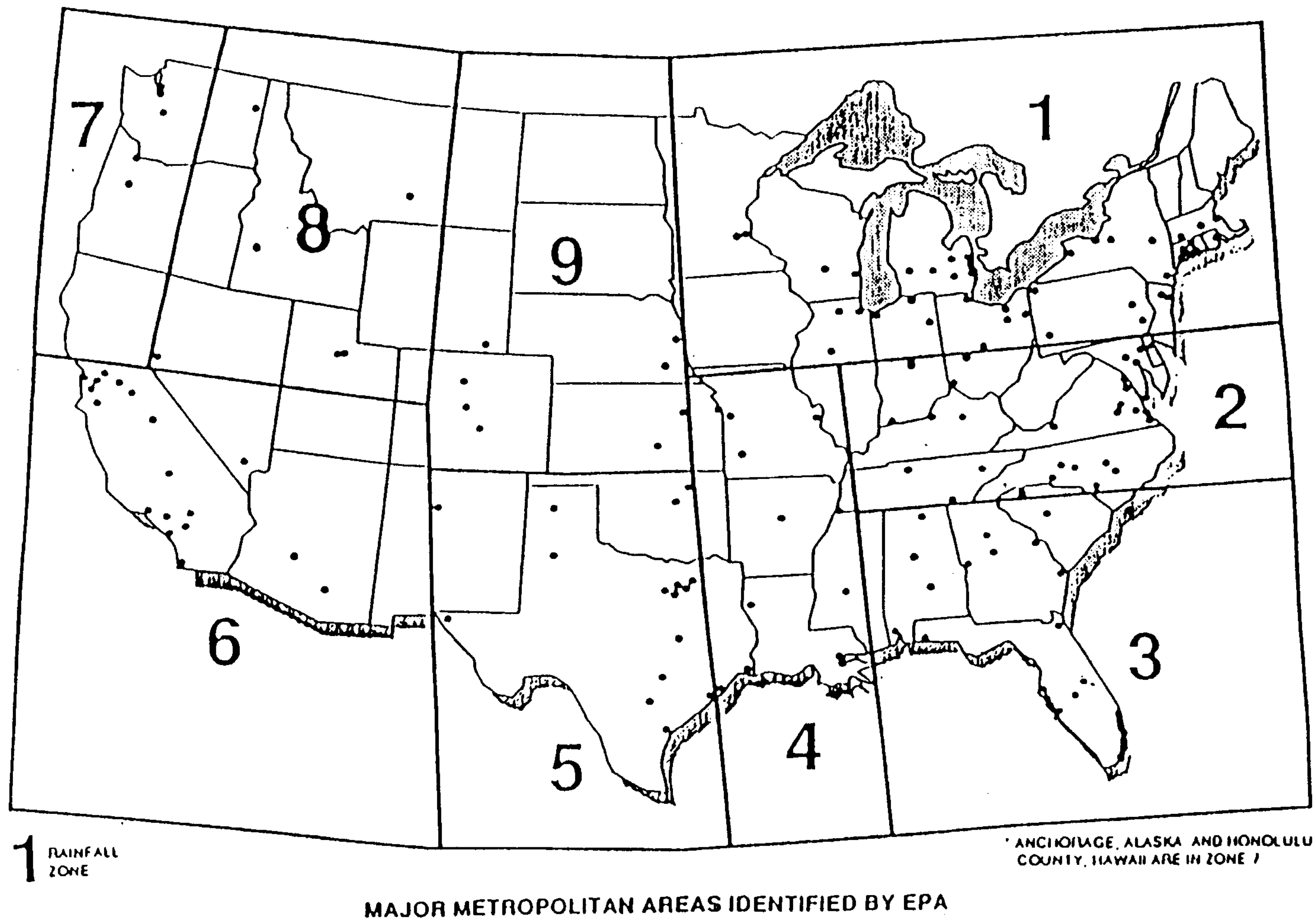
Although various manuals report construction cost estimates for storm water ponds, only three studies, to our knowledge, have systematically evaluated the construction costs associated with structural BMPs since 1985. The three studies used slightly different estimation procedures. Two of these studies were conducted in the Washington, DC region and used a similar methodology (Wiegand et al., 1986; Brown and Schueler, 1997). In both studies, the costs were determined based on engineering estimates of construction costs from actual BMPs throughout the region. In the third study, conducted in Southeastern Wisconsin, costs were determined using standardized cost data for different elements of the BMP, and assumptions of BMP design (SWRPC, 1991).

Any costs reported in the literature need to be adjusted for inflation and regionally. All costs reported in this report assume a 3% annual inflation rate. In addition, studies are adjusted to the "twenty cities average" construction cost index, to adjust for regional biases, based on a methodology followed by the American Public Works Association (APWA, 1992). Using the EPA's rainfall regions (See Figure 1), a cost adjustment factor is assigned to each region (Table 12). For example, rainfall region 1 has a factor of 1.12. Thus, all studies in the Northeastern United States are divided by 1.12 in order to adjust for this bias.

Table 12. Cost Adjustment Factors
Source: Modified from APWA, 1992

Rainfall Region	1	2	3	4	5	6	7	8	9
Adjustment Factor	1.12	0.90	0.67	0.92	0.67	1.24	1.04	1.04	0.76

Figure 1. US EPA Rainfall Zones
Source: APWA, 1992



2.1.1 Ponds and Wetlands

Total pond volume is generally a strong predictor of cost (Table 11). There are some economies of scale associated with constructing ponds, as evidenced by the slope of the volume equations derived. This is largely because of the costs of inlet and outlet design, and mobilization of heavy equipment that are relatively similar regardless of pond size.

Erosion and sediment control represents only about 5% of the construction cost of ponds and wetlands (Brown and Schueler, 1997). Thus, the construction cost estimates presented in Table 13 are comparable. The cost of building storm water ponds has increased since 1986 (Figure 2), even after adjusting for inflation. Part of the reason for this increase is thought to be attributable to the improved design of storm water ponds to enhance water quality and to the more complex regulatory and review environment (Brown, 1997). The cost estimations made by SWRPC (1991) were generally a mid-range between the earlier and more recent studies.

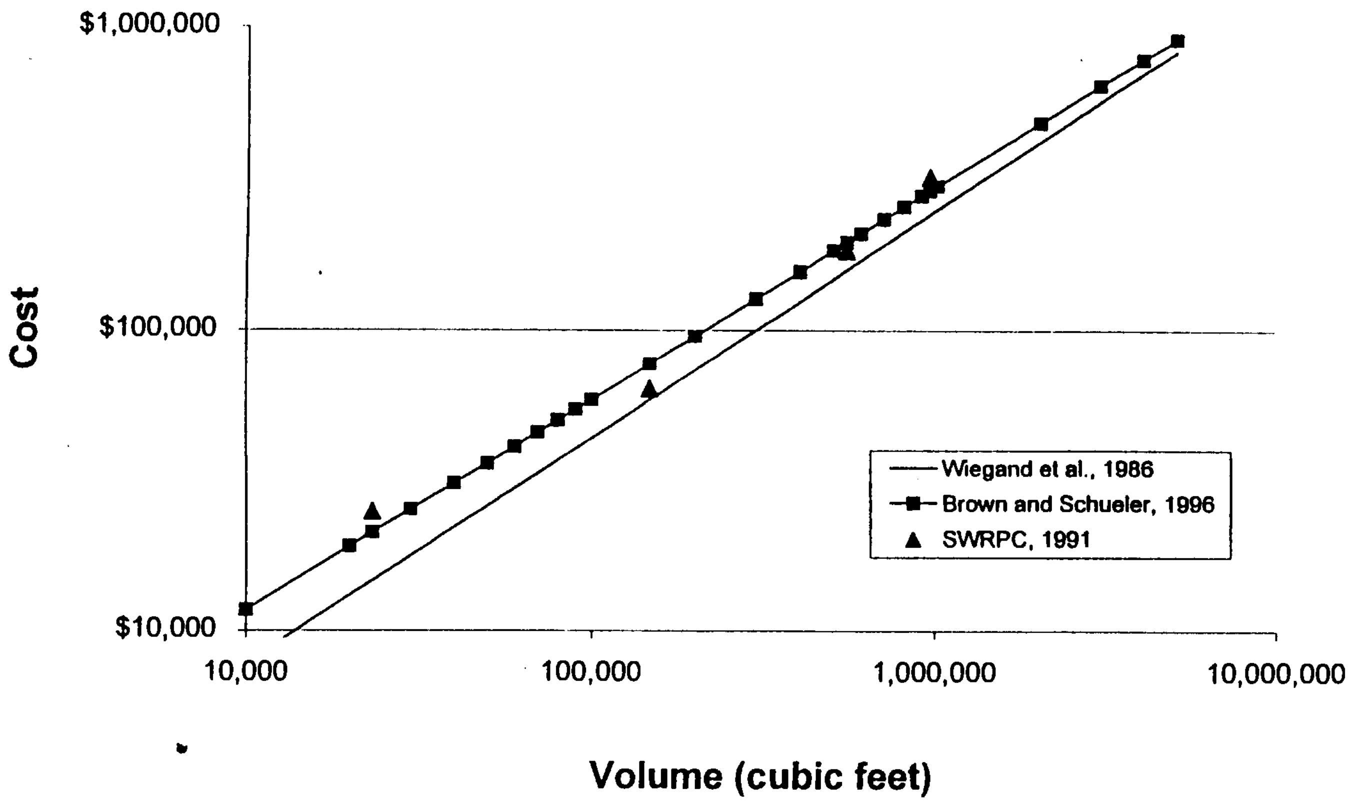
Table 13. Base Capital Costs for Storm Water Ponds and Wetlands

BMP	Cost Equation or Estimate[1,2]	Costs Included: Construction	Costs Included: E&S Control	Source
All Ponds and Wetlands	$7.75V^{0.75}$	✔	✔	Wiegand et al.. 1986
All Ponds and Wetlands	$18.5V^{0.70}$	✔		Brown and Schueler, 1997
Dry Ponds	$7.47V^{0.78}$	✔	✔	Brown and Schueler, 1997
Wet Ponds	1.06V: 0.25 acre wet detention basin (23,300 cubic feet)	✔		SWRPC, 1991
	0.43V: 1.0 acre wet detention basin (148,000 cubic feet)			
	0.33V: 3.0 acre wet detention basin (547,000 cubic feet)			
	0.31V: 5.0 acre wet detention basin (952,000 cubic feet)			

1: V refers to the total pond volume in cubic feet
2: Costs presented from SWRPC (1991) are "moderate" costs reported in that study.

R0073103

Figure 2. Pond Construction Cost



2.1.2 Infiltration Practices

Costs for infiltration BMPs are highly variable from site to site, depending on soils and other geotechnical information. Perhaps because of this variability, cost estimates for infiltration trenches have been widely different (Table 14; Figure 3). Brown and Schueler (1997) concluded that the Wiegand (1986) equation underestimated cost, partially because of the lack of pretreatment in earlier designs, although they were unable to develop a consistent equation due to a small sample size.

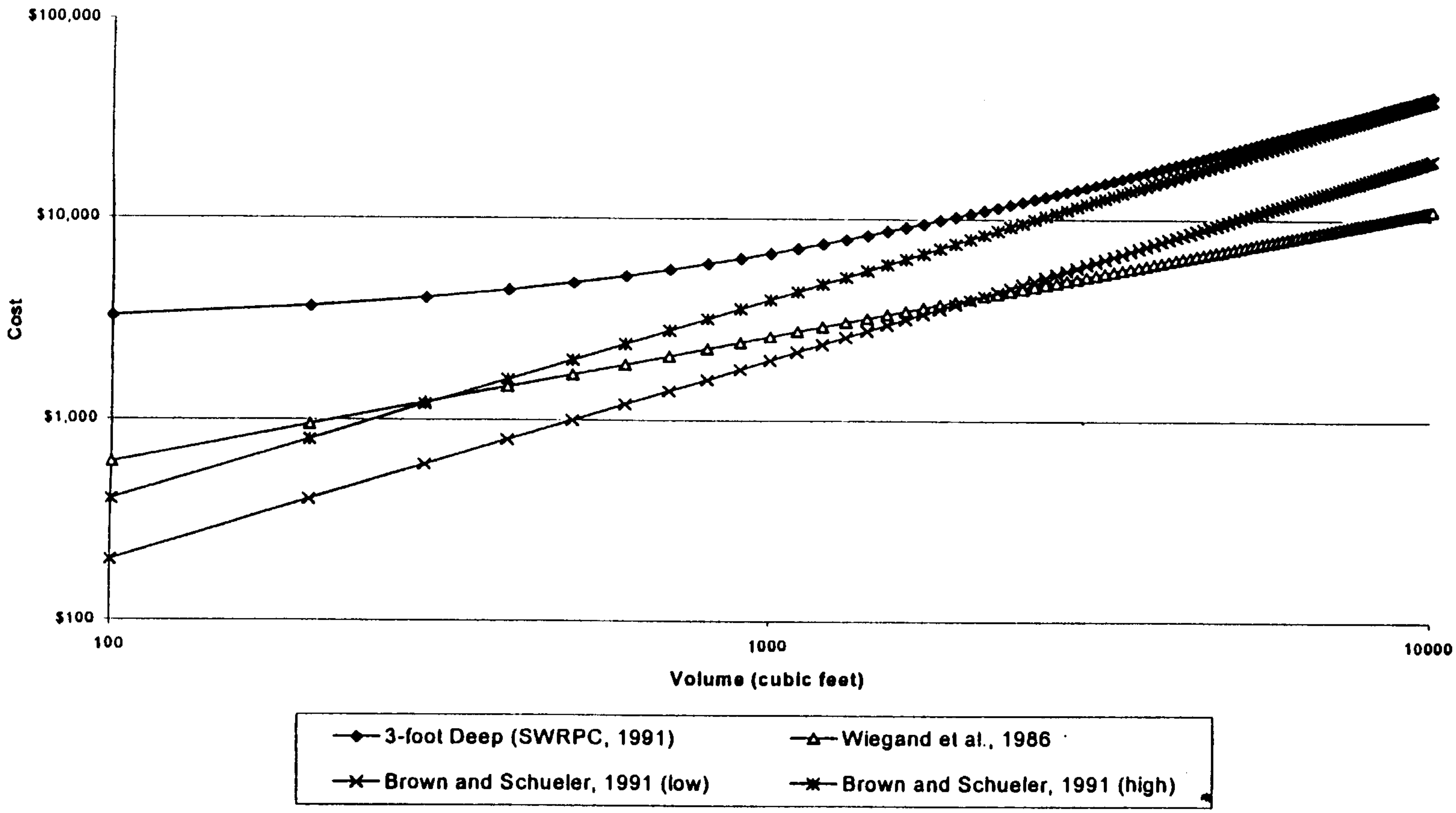
It is difficult to estimate the cost of infiltration basins, particularly since there have been very few constructed within the last several years. The costs estimates for SWRPC are dramatically higher than those estimated by Schueler, 1987 (Figure 4). This is largely because the SWRPC document assumes that 50% additional volume is excavated for the spillway, while Schueler, 1987 uses a wet pond cost equation.

Table 14. Base Capital Costs for Infiltration Practices

BMP	Cost Equation or Estimate[4]	Costs Included: Construction	Costs Included: E&S Control	Source
Infiltration[1] Trenches	$33.7V^{0.63}$	✔		Wiegand et al., 1986
	2V to 4V; average of 2.5V	✔		Brown and Schueler, 1997
	\$4,400: 3-foot deep, 4-foot wide, 100-foot long trench	✔		SWRPC, 1991
	\$10,400: 6-foot deep, 10-foot wide, 100-foot long trench			
	3.9V+2,900: 3-foot deep, 100-foot long trench	✔		Modified from SWRPC, 1991
Infiltration Basins[2]	$13.2V^{0.69}$	✔	✔	Schueler, 1987; Modified from Wiegand et al., 1986
	1.3V: 0.25-acre infiltration basin (15,000 cubic feet)	✔		SWRPC, 1991
	0.8V: 1.0-acre infiltration basin (76,300 cubic feet)			
Porous Pavement[3]	50,000A	✔		SWRPC, 1991
	80,000A	✔		Schueler, 1987

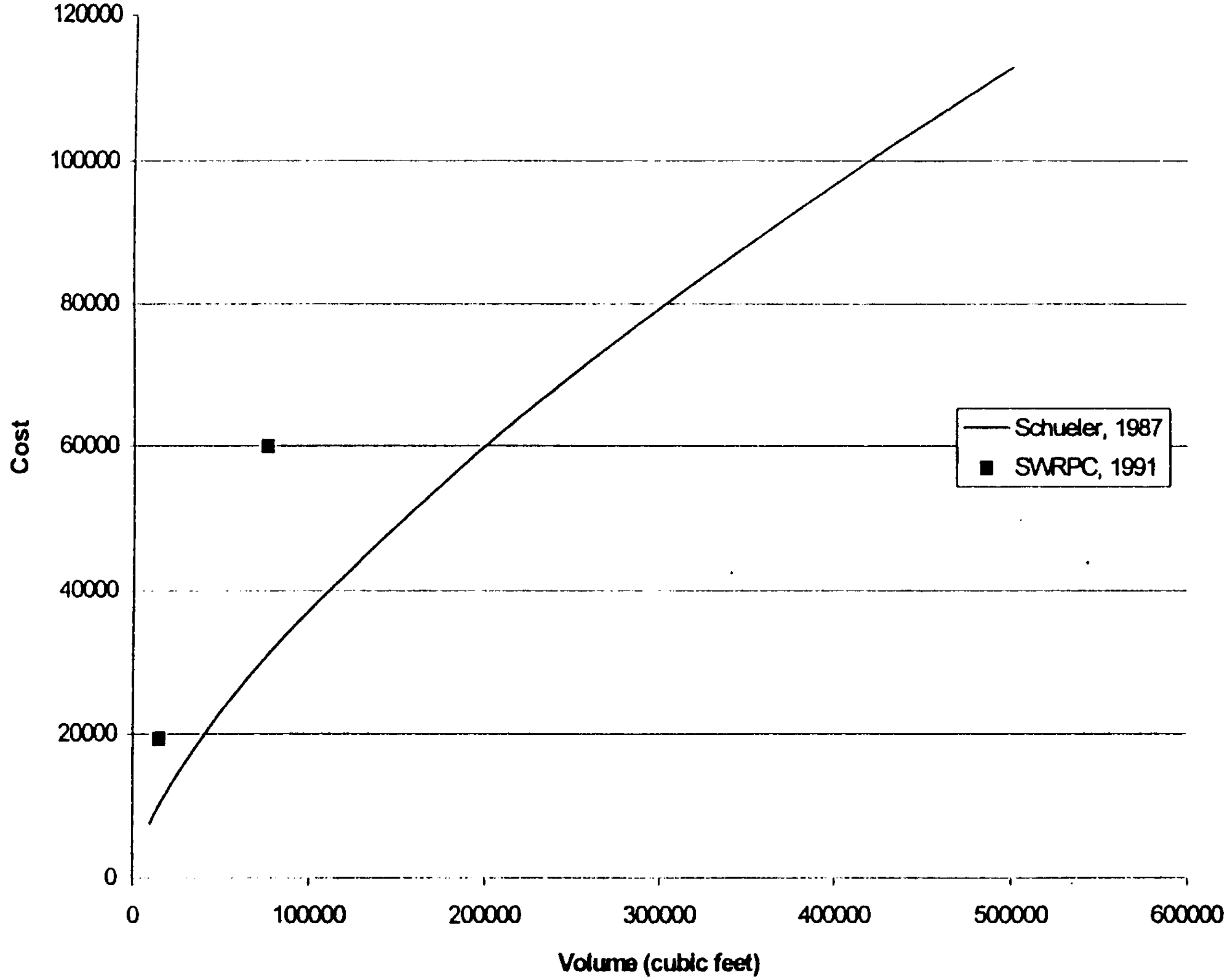
1: V for infiltration trenches refers to the treatment volume within the trench, assuming a porosity of 32%
2: V for infiltration basins refers to the total basin volume
3: A is the surface area in acres of porous pavement
4: Costs presented from SWRPC (1991) are "moderate" costs reported in that study.

Figure 3. Infiltration Trench Costs



R0073105

Figure 4. Infiltration Basin Construction Cost



R0073106

2.1.3 Sand Filters

Since sand filters are a relatively recent technology, less information is available on their cost than on most BMPs. In addition, the costs of sand filters vary significantly due to the wide range of design criteria for sand filters (Table 15). Brown and Schueler (1997) were unable to derive a valid relationship between sand filter cost and water quality volume, with costs ranging between $2 and $6 per cubic foot of water quality volume, with a mean cost of $2.50 per cubic foot. The water quality volume includes the pore space in the sand filter, plus additional storage in the pretreatment basin.

Because sand filters are a relatively new technology, no equation referencing the economies of scale has been developed. However, it appears that economies of scale do exist. For example, data from Austin indicates that the cost per acre decreased by over 80% for a design of a 20-acre drainage area, when compared with a 1-acre drainage area. (Schueler, 1994).

Table 15. Construction Costs for Various Sand Filters
Source: Schueler, 1994

Region (Design)	Cost/Impervious Acre
Delaware	$10,000
Alexandria, VA (Delaware)	$23,500
Austin, TX (<2 acres)	$16,000
Austin, TX (>5 acres)	$3,400
Washington, DC (underground)	$14,000
Denver, CO	$30,000-$50,000

2.1.4 Bioretention

Little information is available on the costs of bioretention because it is also a new practice. Brown and Schueler (1997) found consistent construction costs of approximately $5.30 per cubic foot of water quality volume for the construction cost. The water quality volume includes 9" above the surface area of the bioretention structure.

2.1.5 Vegetative BMPs

Vegetative BMPs include such practices as grassed swales and filter strips. The three major types of vegetative BMPs include filter strips, grassed channels (also called biofilters) and designed swales, which include a "made" soil bed and an underdrain system (Claytor and Schueler, 1997). The costs for these BMPs vary, and largely depend on the method used to establish vegetation (Table 16).

Table 16. Base Capital Costs of Vegetative BMPs

BMP	Cost Equation or Estimate[2]	Costs Included		Source
		Construction	E&S Control	
Filter Strips	Existing Vegetation: 0 Seed: $13,800/acre Sod: $29,000/acre	✔		SWRPC, 1991
Grassed Channels	25¢ per square foot	✔		SWRPC, 1991
Designed Swales[1]	$4.25 per cubic foot	✔		Modified from Brown and Schueler, 1997

1: Assumes that the cost of a designed swale is 80% of the cost of bioretention.
2: Costs presented from SWRPC (1991) are "moderate" costs reported in that study.

2.2 Design, Contingency and Permitting Costs

Most BMP cost studies assess only part of the cost of constructing a BMP, usually excluding permitting fees, engineering design and contingency or unexpected costs. In general, these costs are expressed as a fraction of the construction cost (Table 17). These costs are generally only estimates, based on the experience of designers.

Table 17. Design, Contingency and Permitting Costs

Additional Costs Estimate (Fraction of base construction costs)	Source	Comments
25%	Wiegand et al., 1986	Includes design, contingencies and permitting fees
32%	Brown and Schueler, 1997	Includes design, contingencies, permitting process and erosion and sediment control

2.3 Land Costs

The cost of land is extremely variable both regionally and by surrounding land use. For example, many suburban jurisdictions require open space, reducing the effective cost of land for BMPs to zero (Schueler, 1987). On the other hand, the cost of land may far outweigh construction and design costs in ultra-urban settings. For this reason, some underground BMPs that are relatively expensive to construct may be attractive in this "ultra-urban" setting (Lundgren, 1996) if sub-surface conditions are suitable. The land consumed per treatment volume depends largely on how much of the BMP's treatment is underground, and varies considerably (Table 18).

Table 18. Relative Land Consumption of Storm Water BMPs
Source: Claytor and Schueler, 1997

BMP	Land consumption (% of Impervious Area)
Wet Pond	2-3%
Marsh or Wetland	3-5%
Infiltration Trench	2-3%
Infiltration Basin	2-3%
Porous Pavement	0%
Sand Filters	0%-3%
Bioretention	5%
Swales	10%-20%
Filter Strips	100%

Note: Represents the amount of land needed as a percent of the impervious area that drains to the practice to achieve effective treatment.

2.4 Operation and Maintenance Costs

In most studies, operation and maintenance costs have been estimated as a percentage of base construction costs (Table 19). While some BMPs require infrequent, costly maintenance, others need more frequent but less costly maintenance. Accordingly, selection of appropriate structural BMPs must factor in maintenance cost (and a responsible party to carry out maintenance) to ensure the necessary long-term performance. Typical maintenance activities are included in Table 20

Table 19. Annual Maintenance Costs

BMP	Annual Maintenance Cost (% of Construction Cost)[1]	Cost for a "Typical" Application (See Table 10)	Source(s)
Ponds and Wetlands	3%-6%	$3,000 to $6,000	Wiegand et al., 1986 Schueler et al., 1987 SWRPC, 1991
Dry Ponds	-1%	$1,200	Livingston et al., 1997; Brown and Schueler, 1997
Wetlands	-2%	$3,800	Livingston et al., 1997; Brown and Schueler, 1997
Infiltration Trench	5%-20%	$2,300 to $9,000	Schueler, 1987 SWRPC, 1991
Infiltration Basin	1%-3%	$150 to $450[2]	Livingston et al., 1997; SWRPC, 1991
	5%-10%	$750-$1,500	Wiegand et al., 1986; Schueler et al., 1987; SWRPC, 1991
Sand Filters	11%-13%	$2,200	Livingston et al., 1997; Brown and Schueler, 1997
Swales, grassed channels	5%-7%	$200 to $2,000	SWRPC, 1991
Bioretention	5%-7%	$3,000 to $4,000	(Assumes the same as swales)
Filter strips	$320/acre (maintained)	$1,000	SWRPC, 1991

1: Livingston et al. (1997) reported maintenance costs from the maintenance budgets of several cities, and percentages were derived from costs in other studies

2: This value was extrapolated from the costs for much larger basins.

R0073110

Table 20. Maintenance Schedules for BMPs

BMP	Activity	Schedule
Pond/ Wetland[1]	• Cleaning and removal debris after major storm events; (>2" rainfall). • Harvest vegetation when a 50% reduction in the original open water surface area occurs. • Repair of embankment and side slopes. • Repair of control structure.	Annual or As Needed
	• Removal of accumulated sediment from forebays or sediment storage areas when 60% of the original volume has been reduced.	5-year cycle
	• Removal of accumulated sediment from main cells of pond once 50% of the original volume has been reduced.	20-year cycle
Infiltration Trench[1]	• Cleaning and removal of debris after major storm events; (>2" rainfall). • Mowing and maintenance of upland vegetated areas. • Sediment cleanout. • Repair or replacing of stone aggregate. • Maintenance of inlets and outlets.	Annual or as needed
	• Removal of accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been reduced.	4-year cycle
Infiltration Basin[2]	• Cleaning and removal of debris after major storm events; (>2" rainfall). • Mowing and maintenance of upland vegetated areas. • Sediment cleanout.	Annual or as needed
	• Removal of accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been reduced.	3- to 5-year cycle
Sand Filters[3]	• Removal of trash and debris from control openings. • Repair of leaks from the sedimentation chamber or deterioration of structural components. • Removal of the top few inches of sand, and cultivation of the surface, when filter bed is clogged.	Annual or as needed
	• Clean out of accumulated sediment from filter bed chamber once depth exceeds approximately one-half (½) inch, or when the filter layer will no longer drawdown within 24 hours. • Clean out of accumulated sediment from sedimentation chamber once depth exceeds 12 inches.	3- to 5-year cycle
Bioretention[4]	• Repair of erosion areas • Mulching of void areas • Removal and replacement of all dead and diseased vegetation • Watering of plant material	Bi-Annual or as needed
	• Removal of mulch and application of a new layer	Annual

Table 20. Maintenance Schedules for BMPs

BMP	Activity	Schedule
Dry Swale/ Grass Channel/ Biofilters[1]	• Mowing and litter and debris removal • Stabilization of eroded side slopes and bottom • Nutrient and pesticide use management • Dethatching swale bottom and removal of thatching • Discing or aeration of swale bottom	Annual or as needed
	• Scraping swale bottom, and removal of sediment to restore original cross section and infiltration rate • Seeding or sodding to restore ground cover (use proper erosion and sediment control)	5-year cycle
Filter Strip[5]	• Mowing and litter debris removal • Nutrient and pesticide use management • Aeration of soil on the filter strip • Repair of eroded or sparse grass areas	Annual or as needed

1: Modified from Livingston, et al. (1997)
2: Modified from Livingston et al. (1997), based on infiltration trench requirements
3: Modified from Claytor and Schueler (1997)
4: Modified from ETA and Biohabitats (1993)
5: Modified from Livingston et al. (1997) based on grass swale recommendations.

2.5 Lifelong BMP Cost: Two Scenarios

In order to compare various BMP options, costs were calculated for a 5-acre commercial site and a 38-acre residential site. Construction costs were evaluated using the following steps:

1) Calculate the water quality volume (WQ_v).
   using Schueler's Simple Method. The water quality volume used was for the 1" storm. Thus, the volume is equal to:

$$WQ_v = (.05+.9I)\ A/12$$

Where:

WQ_v = Water Quality Volume (Acre-Feet)
I = Impervious Fraction in the Watershed
A = Watershed Area (Acres)

2) Calculate the detention storage volume.
   Total detention storage was determined using standard peak flow methods (NRCS, 1986). Detention storage was calculated for a 5" storm.

3) Calculate total volume.
   Many BMPs do not require any detention storage, but for BMPs that do provide flood storage, such as ponds, the total volume is the sum of the water quality and detention volumes calculated in steps 1) and 2).

4) Determine the construction cost.
   The construction cost for each BMP is determined based on equations described in section 3.0.

2.5.1 5-Acre Commercial Development

The following data were used as the basis for the 5-acre commercial development.

Table 21. Data for the Commercial Site

Area (A)	5 acres
Impervious Cover (I)	65%
Water Quality Volume: P·Rv·A/12 P=1" of rainfall Rv = 0.5+0.9(I) A = Drainage Area	0.26 ac-ft
Total Detention Storage (TR-55)	0.74 ac-ft
Total Storage	1.00 ac-ft

These data were then used to compare various BMP options (Table 22). Grassed channels and filter strips were not included in this analysis because, although they do improve water quality, their pollutant removal is significantly lower than for other storm water BMPs (Brown and Schueler, 1997a). Again, it is important to note that the cost of land is not included in this calculation. Although ponds are the least expensive option on an annual basis, the cost of land may drive designs to less space-consumptive BMPs, such as sand filters or bioretention systems.

Table 19. BMP Costs for a Five-acre Commercial Development

BMP	Construction Cost Equation	Construction Cost	Typical Design, Contingency and Other Capital Costs (30% of Construction Costs)	Annual Maintenance Costs (% of Construction, $)	Life[4] (Years)	Notes	Sources
Pond	$18.5V_t^{0.70}$	$32,700	$9,810	5%; $1,640	50	Much of the cost associated with this BMP is the extra storage to provide flood control and channel protection. Ponds are very reliable.	Brown and Schueler, 1997; Wiegand et al., 1986; Schueler et al., 1987; SWRPC, 1991 US EPA, 1993
Infiltration Trench	$3.9V_{wq}+2{,}900$	$47,100	$14,100	12%; 5,650	10	Although infiltration trenches are designed to last a long time, they need to be inspected and rebuilt if they become clogged.	SWRPC, 1991; Schueler, 1987; US EPA, 1993
Infiltration Basin	$1.3V_{wq}$	$4,716	$1,410	8%; $377	25	Infiltration basins are not very reliable, and tend to become clogged.	SWRPC, 1991; Wiegand et al., 1986; Schueler et al., 1987; SWRPC, 1991; US EPA, 1993
Sand Filter	$4V_{wq}$	$44,500	$13,400	12%; $5,340	25	Sand filters require frequent maintenance in order to function long-term.	Brown and Schueler, 1997; Livingston et al., 1997; US EPA, 1993
Dry Swale	$4.25V_{wq}$	$48,100	$14,400	6%; $2,890	25	Dry swales are a relatively new BMP. Little is known about their long-term performance.	Brown and Schueler, 1997; SWRPC, 1991; US EPA, 1993
Bioretention	$5.30V_{wq}$	$60,000	$18,000	6%; $3,600	25	Bioretention is a relatively new BMP. Little is known about its long-term performance.	Brown and Schueler, 1997; SWRPC, 1991

1: V_{wq} = Water Quality Volume 2: V_t=Total Volume
3: Sand filter volume was estimated at 4V, which is slightly high, to account for the relatively small drainage area.
4: Life: Length of time without major modifications or reconstruction

2.5.2 38-Acre Residential Development

The following data were used as the basis for the 38-acre residential development.

Table 23. Data for the residential 38-acre site

Area (A)	38 acres
Impervious Cover (I)	36%
Water Quality Volume:	1.1 ac-ft
Total Detention Storage (TR-55)	2.8 ac-ft
Total Storage	3.9 ac-ft

The same analysis conducted for the commercial site was repeated for the larger site (Table 24). Swales, bioretention and infiltration systems were not included in this analysis, because these BMPs are best applied on small sites.

2.5.3 Adjusting Costs Regionally

The cost data in these examples can be adjusted to specific regions of the country using the conversion factors in Table 10. For example, if costs for rainfall region 1 were needed, the data in Tables 19 or 21 would be multiplied by 1.12.

In addition, design variations in different regions of the country may cause prices to be changed. For example, wetland and wet ponds may be restricted in arid regions of the country. Furthermore, while ponds with a wet pool are used in semi-arid regions, they usually incorporate design variations to improve their performance (Saunders and Gilroy, 1997). In cold regions, BMPs may need to be adapted to account for snowmelt treatment, deep freezes and road salt application (Oberts, 1994, Caraco and Claytor, 1997).

Table 24. BMP costs for a thirty-eight acre residential development

BMP	Construction Cost Equation	Construction Cost	Design, Contingency and other Capital Costs (30% of Construction)	Annual Maintenance Costs (% of Construction; $)	Life[4] (Years)	Notes	Sources
Pond	$18.5V_t^{0.70}$	$84,800	$25,400	5%; $4,240	50	Pond systems are relatively easy to apply to large sites.	Brown and Schueler, 1997; Wiegand et al., 1986; Schueler, 1987; SWRPC, 1991; US EPA, 1993
Sand Filter	$2V_{wq}$	$95,800	$28,700	12%; $11,500	25	Although the sand filter is used in this example, some evidence suggests that sand filters may be subject to clogging if used on a site that drains a relatively pervious drainage area such as this one.	Brown and Schueler, 1997; Livingston et al., 1997; US EPA, 1993

1: V_{wq} = Water Quality Volume 2: V_t=Total Volume
3: Sand filter volume was estimated at 2V, which is slightly low, to account for the relatively large drainage area.
4: Life: Length of time without major modifications or reconstruction

3.0 NON-STRUCTURAL BMP COSTS

Non-structural BMPs, or "source controls", prevent degradation of water resources by preventing pollution at the source, rather than treating polluted runoff. Non-structural practices include a variety of practices, including: street sweeping, illicit connection identification, public education, land use modifications, waste collection and proper materials storage. While non-structural practices play an invaluable role in protecting surface waters, their costs and benefits are not as easily quantified as for structural BMPs. This is primarily because there are no "design standards" for these practices. For example, a public education program may vary from one part-time individual to several full-time staff. It is possible to identify costs associated with specific components of these programs based on past experience. The extent of benefits may only be speculative, partly because the contribution of human behavior to urban storm water pollution is unknown.

3.1.1 Street Sweeping

The costs of street sweeping include the capital costs of purchasing the equipment, plus the maintenance and operational costs to operate the sweepers. Both equipment and operating costs vary depending on the type of sweeper selected. There are several different options for sweepers, but the two basic choices are mechanical sweepers versus vacuum-assisted sweepers.

Mechanical sweepers use brushes to remove particles from streets. Vacuum-assisted dry sweepers, on the other hand, use a specialized brush and vacuum system in order to remove finer particles. While the equipment costs of mechanical sweepers are significantly higher, the total operation and maintenance costs of vacuum sweepers are lower (Table 25).

Table 25. Sweeper Cost Data

Sweeper Type	Life (Years)	Purchase Price ($)	Operation and Maintenance Costs ($/curb mile)	Sources
Mechanical	5	75,000	30	Finley, 1996; SWRPC, 1991
Vacuum-assisted	8	150,000	15	Satterfield, 1996; SWRPC, 1991

Using these data, the cost of operating street sweepers per curb mile were developed, assuming various sweeping frequencies (Table 26). The following assumptions were made to conduct this analysis:

- One sweeper serves 8,160 curb miles during a year (SWRPC, 1991).
- The annual interest rate is 8%.

Table 26. Annualized Sweeper costs ($/curb mile/year)

Sweeper Type	Sweeping Frequency					
	weekly	biweekly	monthly	four times per year	twice per year	annual
Mechanical	1680	840	388	129	65	32
Vacuum-Assisted	946	473	218	73	36	18

Modified from Finley, 1996; SWRPC, 1991; and Satterfield, 1996

3.1.2 Illicit Connection Identification

One source of pollutants is connections to the storm drain system that carry material other than storm water, such as industrial wastes. These pollutants are then discharged through the storm drain system directly to streams without receiving treatment. These illicit connections can be identified using visual inspection during dry weather or through the use of smoke or dye tests. Using visual inspection techniques, illicit connections can be identified for between $1,250 and $1,750 per square mile (Claytor and Brown, 1996).

3.1.3 Public Education

Public education programs encompass many other more specific programs, such as fertilizer management, public involvement in stream restoration and monitoring projects, storm drain stenciling, and overall awareness of aquatic resources. All public education programs seek to reduce pollutant loads by changing people's behavior. They also make the public aware of and gain support for programs in place to protect water resources. Most municipalities have at least some educational component as a part of their program. A recent survey found that 93% of municipal storm water programs incorporate an education program (Livingston et al., 1997).

The City of Seattle, with a population of approximately 535,000, has a relatively aggressive education program, including classroom and field involvement programs. The 1997 budget for some aspects of the program is included in Table 27. Although this does not necessarily reflect typical effort or expenditures, it does provide a guideline for some educational expenditures. These data represent only a portion of the entire annual budget.

Table 27. Public Education Costs in Seattle, Washington
Source: Washington DOE, 1997

Item	Description	1997 Budget
Supplies for Volunteers	Covers supplies for the Stewardship Through Environmental Partnership Program.	$17,500
Communications	Communications strategy highlighting a newly formed program within the city.	$18,000
Environmental Education	Transportation costs from schools to field visits (105 schools with four trips each).	$46,500
Education Services/ Field Trips	Fees for student visits to various sites.	$55,000
Teacher Training	Covers the cost of training classroom teachers for the environmental education program.	$3,400
Equipment	Equipment for classroom education, including displays, handouts, etc.	$38,800
Water Interpretive Specialist-Staff	Staff to provide public information at two creeks.	$79,300
Water Interpretive Specialist - Equipment	Materials and equipment to support interpretive specialist program.	$12,100
Youth Conservation Corps	Supports clean-up activities in creeks.	$210,900

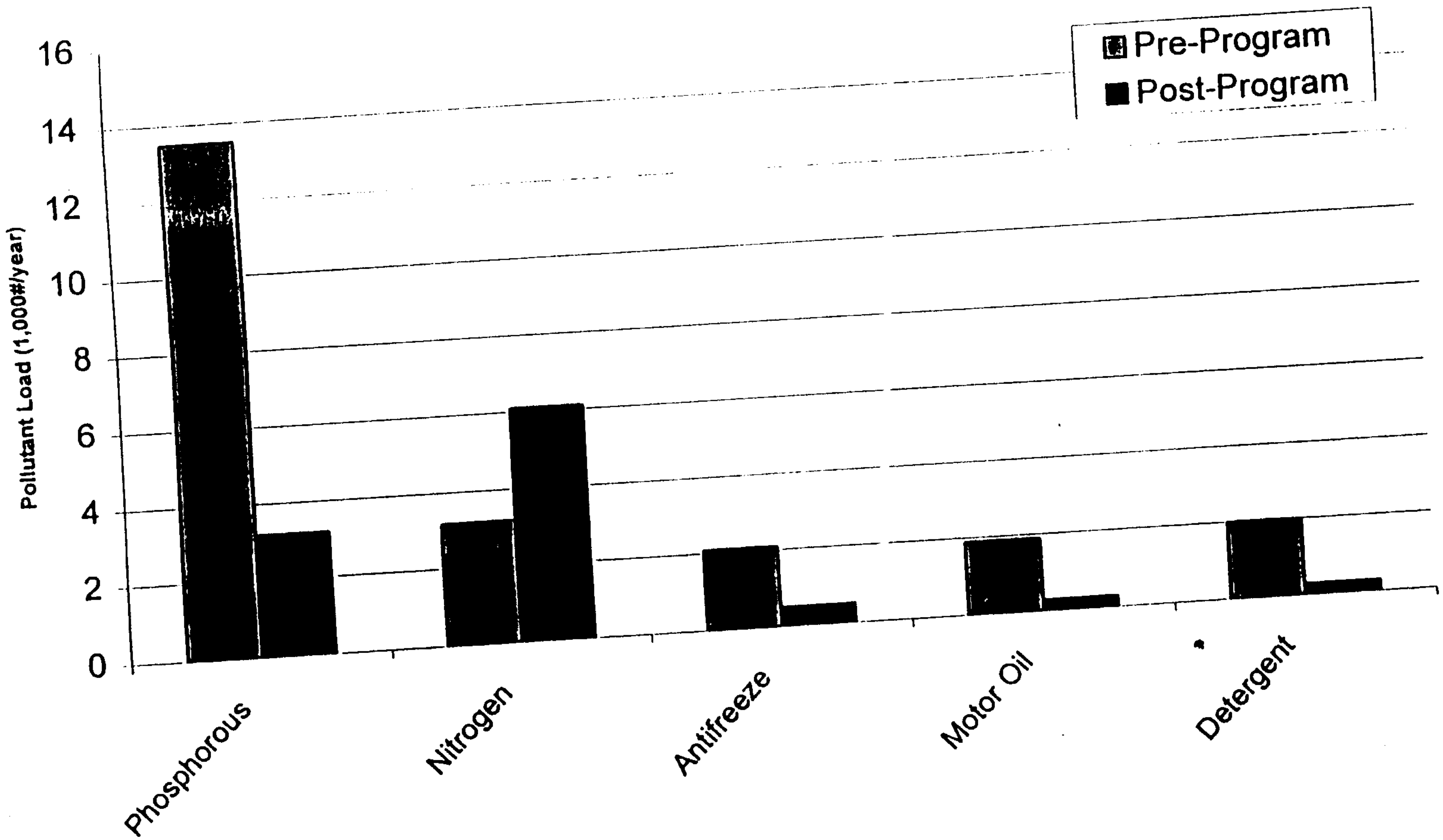
Some unit costs for educational program components are included in Table 28.

Table 28. Unit Program Costs for Public Education Programs

Item	Cost	Source
Public Attitude Survey	$1,250-$1,750 per 1,000 households	Claytor and Brown, 1996
Flyers	10-25¢/ flyer	Ferguson et al., 1997
Soil Test Kit*	$10	Ferguson et al., 1997
Paint	25-30¢/SD Stencil	Ferguson et al., 1997
Safety Vests for Volunteers	$2	Ferguson et al., 1997
* Includes cost of testing, but not sampling.		

Although public education has the obvious benefit of raising public awareness, and therefore promoting support of environmental programs, it is difficult to quantify actual pollutant reductions associated with education efforts. Public attitudes can be used as a gauge of how these programs perform, however. In one study, a public survey was used in combination with modeling to estimate pollutant load reductions associated with public education (Smith et al., 1993; Claytor, 1996; Figure 5). An initial study was conducted to estimate field application of fertilizers, use of detergents and pollution due to oil and antifreeze. Pollutant reductions were then completed assuming that 70% of the population complied with recommendations of the public education program. A follow-up survey was used to assess the effectiveness of the program. Although insufficient data were able to support a second model run, the follow-up survey indicated that educational programs influenced many citizen behaviors, such as recycling. They were unsuccessful, however, at changing the rate at which citizens apply lawn fertilizers.

Figure 5. Changes in Pollutant Load Based on a Public Survey
Source: Claytor, 1996



3.1.4 Land Use Modifications

One of the most effective tools to reduce the impacts of urbanization on water resources is to modify the way growth and development occurs across the landscape. At the jurisdictional or regional level, growth can be managed to minimize the outward extension of development. Jurisdictions can direct growth away from environmentally sensitive areas using such techniques as rezoning or the transfer of development rights. At the site level, the nature of development can be modified to reduce the impacts of impervious cover at individual development projects through techniques such as reduced street widths, clustered housing, smaller parking lots, and incorporation of vegetative BMPs into site design. While there are legal fees associated with changing both local and regional zoning codes, data suggests that concentrating development and minimizing impervious cover at the site level can actually reduce construction costs to both developers and local governments.

By concentrating development near urban areas, the capital costs of development can be lowered substantially due to existing infrastructure and other public services. With conventional development patterns, the cost of servicing residential developments exceeds the tax revenues from these developments by approximately 15% (Pelley, 1997). By encouraging growth to occur in a compact region, rather than over a large area, these capital costs can be reduced substantially (Table 29).

Table 29. Comparison of Capital Costs of Services for a Single Dwelling Unit
SOURCE: Frank, 1989; Quoted in Pelley, 1997

Development Pattern	Capital Costs (1987 Dollars)
Compact Growth	$18,000
Low-Density Growth	$35,000
Low-Density Growth, 10 Miles from Existing Development	$48,000

Savings can also be realized at the site level by reducing the costs of clearing and grading, paving and drainage infrastructure. A recent study compared conventional development plans with alternative options designed to reduce the impacts of development on the quality of water resources. The cost savings realized through these alternative options are summarized in Table 30. In all site designs, the road width was reduced from 28' to 20', reduced lot sizes or reconfigured lots to consume less open space, and provided on-site stormwater treatment.

Table 30. Impervious Cover Reduction and Cost Savings of Conservation Development SOURCE: DE DNREC, 1997

Location	**Techniques Used**	**Impervious Cover Reduction (%)**	**Cost Savings (%)**
Sussex County, DE	• Reduced street widths (from 28' to 20') • Smaller lots (from ½ acre to 1/8 acre) • Cluster development • Preserve woodland areas • Use vegetated BMPs that promote infiltration on site	38%	52%
New Castle County, DE	• Houses clustered into attached units around courtyards • Reduced road widths (28' to 20') • Preserve woodland areas • Use vegetated BMPs that promote infiltration on site	6%	63%
Kent County, DE	• Reduced road widths (28' to 20') • Minimum disturbance boundary • Smaller lots (1 acre to ½ acre) • Preserve woodland areas • Use vegetated BMPs that promote infiltration on site	24%	39%

3.1.5 Oil and Hazardous Waste Collection

Providing a central location for the disposal of oil or hazardous wastes protects water quality by offering citizens an alternative to disposing of these materials in the storm drain. Disposal costs vary considerably depending on the size of the program, and what types of wastes are collected. One study estimated the capital costs at approximately $30,000, with about $12,000 maintenance for a used oil collection recycling program in a typical MS4 (Apogee, 1998a). This estimate was based on data from the Galveston Bay National Estuary Program. Data from the City of Livonia, Michigan indicates that the cost of hazardous waste disposal averages about $12 per gallon (Ferguson et al., 1997).

3.1.6 Proper Storage of Materials

Proper storage of materials can prevent accidental spills or runoff into the storm drain. The design of storage structures varies depending on the needs of the facility. There are also training costs associated with the proper storage of materials. Typical cost estimates, based on standard construction data, are $6 to $11 per square foot for pre-engineered buildings and $3.40 to $5 per square foot for a 6" thick concrete slab (Ferguson et al., 1997).

4.0 BENEFITS OF STORM WATER BMPS

Although it is possible to quantify the economic benefits of water quality improvement (USEPA, 1983), it is difficult to create a "balance sheet" of economic costs and benefits for individual BMPs. Instead, the benefits can be outlined in terms of: 1) effectiveness at reducing pollutant loads 2) other direct water quality impacts and 3) additional economic benefits or costs.

4.1 Storm Water Pollutant Reduction - Structural

A primary function of storm water BMPs is to prevent pollutants from reaching streams and rivers. While all BMPs achieve this function to some extent, there is considerable variability between different types of BMPs. For example, while swales are on par with ponds for removing suspended solids, they are not nearly as efficient at removing phosphorous. Some of this variability is because the pollutant removal mechanisms utilized by each BMP influence the types of pollutants (e.g., soluble versus suspended) that can be removed.

4.1.1 Solids

There are two sources of total suspended solids (TSS) in urban waterways: sediment carried in urban runoff, and streambank erosion caused by the increased runoff from urbanized watersheds. Most BMPs are relatively effective at removing suspended solids from storm water (Table 31), and some others also have the ability to control storm water flows, thus reducing streambank erosion (See Section 4.3). The primary mechanism for removing solids from urban runoff is settling, but another mechanism is filtering through a vegetative or soil medium.

While turbidity and dissolved solids (TDS) are also significant problems in urban streams, little data are available to determine the effectiveness of various BMPs at removing the fine solids that contribute to elevated turbidity. Available data suggest that BMPs are less effective at removing TDS than TSS. While these fine sediments are also removed through settling, they settle at a much slower rate than larger particles, and thus require long retention times.

Table 31. Effectiveness of Storm Water BMPs at Removing Solids
Source: Schueler, 1997

BMP		Median Solids Removal (%)		
		TSS	TDS	Turbidity
Ponds	Detention Pond	7	ND	ND
	Dry ED Pond	61		
	Wet Pond	77	5[3]	
	Wet ED Pond	60		
Wetlands	Shallow Marsh	84	-24[3]	69[3]
	ED Wetland	63		
	Pond/Wetland	72		
Infiltration	All Infiltration	99[1]	ND	ND
Filters	Sand or Organic Filters	87	16	-32[3]
Bioretention	Bioretention	81[2]	ND	60[2]
Vegetative BMPs	Channels	0	ND	ND
	Designed Swales	81	ND	60[3]
	Filter Strips	69[3]	ND	ND

ED = Extended Detention
1: Not based on actual monitoring data. Source: Schueler, 1987
2: Assumes the same removal efficiency as designed swales.
3: Based on fewer than 5 data points.
ND = No or insufficient data, ED = Extended detention

4.1.2 Oxygen Demanding Substances and Dissolved Oxygen

Oxygen demanding substances, usually organic materials, can be removed by settling or filtering in BMPs. Another mechanism for BOD removal is degradation by microbes in a BMP. This mechanism is most active in BMPs with a permanent pool, such as ponds and wetlands. Three different measures are commonly used to assess the oxygen demanding substances in storm water: Total Organic Carbon (TOC), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). All three of these parameters have been monitored in storm water, but too few studies are available to make a statement about the removal efficiency of BMPs for each individual measure. The data in Table 32 represent the average removal for all three measures of oxygen demand.

Table 32. Effectiveness of Storm Water BMPs at Removing Oxygen Demanding Substances
Source: Schueler, 1997

BMP		Median Removal (%)
Ponds	Detention Pond	(-1)[3]
	Dry ED Pond	25
	Wet Pond	45
	Wet ED Pond	27[3]
Wetlands	Shallow Marsh	21
	ED Wetland	ND
	Pond/Wetland	4
Infiltration	All Infiltration	90[1]
Filters	Sand or Organic Filters	66
Bioretention	Bioretention	67[2]
Vegetative BMPs	Channels	18
	Designed Swales	67[3]
	Filter Strips	ND

1: Not based on actual monitoring data. Source: Schueler, 1987
2: Assumes the same removal efficiency as designed swales.
3: Based on fewer than 5 data points.
ND = No or insufficient data, ED = Extended detention

4.1.3 Nitrogen and Phosphorous

Nitrogen and phosphorous are often key pollutants, particularly if eutrophication of a downstream resource such as a lake or estuary are important. Nutrients exist in urban runoff in both organic and mineral phases. While organic nutrients generally remain in a solid phase, mineral forms go into solution as various ionic forms. For the most part, BMPs are more effective at removing the organic forms of nutrients than dissolved forms (Table 33). Ponds and wetlands can remove some portion of dissolved pollutants through biological activity in the permanent pool, and through seasonal uptake in plant materials. Designed swales also show some ability to remove dissolved pollutants, largely due to infiltration or biological activity in a wet soil matrix.

Table 33. Effectiveness of Storm Water BMPs at Removing Nitrogen and Phosphorous Source: Schueler, 1997

BMP		Median Solids Removal (%)			
		Total N	Nitrate	Total P	Soluble P
Ponds	Detention Pond	5[3]	3[3]	10[3]	2[3]
	Dry ED Pond	31[3]	9[3]	19	-9[3]
	Wet Pond	30	24	47	51
	Wet ED Pond	35[3]	42[3]	58	58[3]
Wetlands	Shallow Marsh	24	78	38	37[3]
	ED Wetland	36[3]	29[3]	24[3]	32[3]
	Pond/Wetland	13	15	54	39
Infiltration	All Infiltration	60-70[1]	ND	65-75[1]	ND
Filters	Sand or Organic Filters	44	-13	51	-31[3]
Bioretention	Bioretention	ND	38[2]	9[2]	0[2]
Vegetative BMPs	Channels	0	2	-14	-15[3]
	Designed Swales	ND	38	9	0[3]
	Filter Strips	ND	-4[3]	8[3]	ND

1: Not based on actual monitoring data. Source: Schueler, 1987
2: Assumes the same removal efficiency as designed swales.
3: Based on fewer than 5 data points.
ND = No or insufficient data, ED = Extended detention

4.1.4 Pathogens

Bacteria and other pathogens can cause effects to human health, impact wildlife, and cause unwanted economic impacts such as shellfish bed closings. The three most common bacteria measured in BMP performance studies are Fecal Coliform, Fecal Streptococci and E. Coli. The ability of various BMPs to remove bacteria has not been extensively documented, but some data are available (Table 34). Some removal mechanisms include: light, sedimentation, filtration, and growth inhibitors such as cool temperatures, low nutrients and low carbon (Schueler, 1998). Swales and channels appear to export bacteria based on monitoring studies. Two possibilities for this phenomenon are that pet droppings may be a source of bacteria, or that the moist, organic environment of "wet" swales may encourage bacterial growth.

Table 34. Effectiveness of Storm Water BMPs at Removing Pathogens
Source: Schueler, 1998

BMP		Median Pathogen Removal (%)		
		Fecal Coliform	Fecal Streptococci	E. Coli
Ponds	Detention Pond	ND	ND	ND
	Dry ED Pond			
	Wet Pond	65	73[1]	51[1]
	Wet ED Pond			
Wetlands	Shallow Marsh	ND.	ND	ND
	ED Wetland			
	Pond/Wetland			
Infiltration	All Infiltration	98[1]	98[1]	98[1]
Filters	Sand or Organic Filters	51	58	ND
Bioretention	Bioretention	ND	ND	ND
Vegetative BMPs	Channels/Swales	-58	ND	ND
	Filter Strips	ND	ND	ND

1: Based on fewer than 5 data points.
ND = No or insufficient data, ED = Extended detention

4.1.5 Petroleum Hydrocarbons

Petroleum hydrocarbons originate primarily from automotive sources in the urban landscape. Hydrocarbons can be measured as polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH) or oil and grease. Total petroleum hydrocarbons (TPHs) are the only parameter that is measured frequently enough to assess pollutant removal (Table 35). Hydrocarbons are hydrophobic, meaning that they tend to bind to sediment rather than go into solution. BMPs that are effective at removing suspended solids also tend to be effective at removing hydrocarbons. Special attention must be given to disposal of sediment during maintenance of BMPs that serve high-petroleum land uses.

Table 35. Effectiveness of Storm Water BMPs at Removing Hydrocarbons Source: Schueler, 1997

BMP		Median TPH Removal (%)
Ponds	Detention Pond	ND
	Dry ED Pond	
	Wet Pond	83[2]
	Wet ED Pond	
Wetlands	Shallow Marsh	90[2]
	ED Wetland	
	Pond/Wetland	
Infiltration	All Infiltration	ND
Filters	Sand or Organic Filters	81[2]
Bioretention	Bioretention	62[1]
Vegetative BMPs	Channels	ND
	Designed Swales	62[2]
	Filter Strips	ND

1: Assumes the same removal efficiency as designed swales.
2: Based on fewer than 5 data points.
ND = No or insufficient data, ED = Extended detention

4.1.6 Metals

Metals, like nutrients, have both dissolved and solid phases in storm water. Solid phase metals tend to attach to sediments, and can be removed by settling. Dissolved phase, or ion, forms of metals can only be effectively removed by being converted into another form or by attaching to sediment. Another concern with metals is that, during peak events such as snowmelt, an acute concentration will occur. BMPs that dilute storm water runoff, such as ponds and wetlands, can help to prevent these acute events. Metal pollutant removal data are included in Table 36.

Table 36. Effectiveness of Storm Water BMPs at Removing Metals
Source: Schueler, 1997

BMP		Median Metals Removal (%)			
		Cd	Cu	Pb	Zn
Ponds	Detention Pond / Dry ED Pond	54[3]	26[3]	43	26
	Wet Pond / Wet ED Pond	24[3]	57	73	51
Wetlands	Shallow Marsh / ED Wetland / Pond/Wetland	69	39	63	54
Infiltration	All Infiltration	95-99[1]	95-99[1]	95-99[1]	95-99[1]
Filters	Sand or Organic Filters	ND	34	71	80
Bioretention	Bioretention	42[2]	51[2]	67[2]	71[2]
Vegetative BMPs	Channels	55[3]	14	30	29
	Wet and Dry Swales	42[3]	51	67	71
	Filter Strips	ND	ND	17[3]	51[3]

1: Not based on actual monitoring data. Source: Schueler, 1987
2: Assumes the same removal efficiency as designed swales.
3: Based on fewer than 5 data points.
ND = No or insufficient data, ED = Extended detention

4.1.7 Synthetic Organics

Synthetic organics include materials such as pesticides, household materials and other manufactured compounds. These materials are detected at very low concentrations in urban runoff, and are very expensive to monitor. Thus, little information is available on the effectiveness of structural BMPs at removing these pollutants. Like hydrocarbons and organic carbon, these materials tend to bind to sediment, and can also be treated through transformations to less damaging substances. However, since these materials are found in such low concentrations, it is not clear that traditional BMPs can remove them. Non-structural strategies, especially pollution prevention, may be more reliable.

4.1.8 Temperature

Stream warming is a common problem in urban settings, and occurs primarily because rainfall flows over the ground surface on hot pavement. Most BMPs (such as storm water ponds) appear to increase stream temperature, rather than decrease it, due to surface heating. One study in Maryland investigated the impact of various storm water BMPs on water temperature, based on the change in temperature between the inflow and outflow points (Table 37). Although all BMP options result in an increase in temperature, the wet pond appears to have the highest temperature increase, while the infiltration BMP has the lowest. It is important to note that the infiltration facility failed during part of the study, and thus water was ponded for a long period of time, allowing it to heat up.

Features can be incorporated into any BMP to reduce the impacts of stream warming. Some of these features include providing shade along channels and directing low flows through a pipe below the ground surface, rather than over heated rock. In streams that are very sensitive to warm temperatures, such as trout streams, some BMPs should be avoided entirely. For example, most ponds and wetlands with a permanent pool are restricted in cold water streams (CWP et al., 1997).

Table 37. Temperature Increase in Various BMPs
Source: Galli, 1990

BMP	Temperature Increase (°F)
Infiltration- Dry Pond	2.5
Extended Detention Wetland	3.2
Extended Detention Dry Pond	5.3
Wet Pond	9.1

4.1.9 pH

Most traditional BMPs are not effective at increasing the pH of storm water, which may be acidic. One possible role is for permanent pool BMPs to dilute toxic waves of pollutants that may occur during seasonal events, such as the spring snowmelt. The goal is not necessarily to reduce pollutants, but to reduce the shock associated with high volumes of low pH water occurring during a short time period. In addition, design features that limit anoxic conditions can prevent low pH conditions. When anoxic conditions develop in a storm water BMP, the pH of the water in this BMP drops, increasing the chances of acidic water being released.

4.2 Pollutant Reduction: Non-Structural BMPs

Unlike structural BMPs, it is generally not possible to associate specific pollutant removal rates with non-structural BMPs, with the exception of street sweeping (Table 38). However, some non-structural BMPs are targeted at specific pollutants. Table 39 outlines the most effective BMPs for removing specific types of pollutants.

Table 38. Sweeper Efficiencies (%)
Source: Satterfield, 1996

Sweeper Type	Constituent				
	Solids	BOD	TP	TN	Pb
Mechanical	55	43	40	42	35
Vacuum-Assisted	93	77	74	77	76

Note: These removal rates represent the fraction of pollutants picked up off the street, and thus overestimate actual reduction in storm water concentrations.

Table 39. Non-Structural BMPs Suited to Treating Various Pollutants

Pollutant	Appropriate BMPs	
Solids	Street Sweeping	Land Use Modifications
Oxygen Demanding Substances	Street Sweeping Education: Storm Drain Stenciling Land Use Modifications	Education: Pet Scoop Ordinance Illicit Connections Identification
Nitrogen and Phosphorous	Street Sweeping Education: Pet Scoop Ordinance Land Use Modifications Proper Materials Handling	Illicit Connections Identified Education: Lawn Care Materials Storage and Recycling
Pathogens	Illicit Connections Identified Land Use Modifications	Education: Pet Scoop Ordinance
Petroleum Hydrocarbons	Street Sweeping Education: Storm Drain Stenciling Proper Materials Handling	Illicit Connections Identified Materials Storage and Recycling Land Use Modifications
Metals	Street Sweeping Education: Storm Drain Stenciling Proper Materials Handling	Illicit Connections Identified Materials Storage and Recycling Land Use Modifications
Synthetic Organics	Illicit Connections Identified Education: Storm Drain Stenciling Proper Materials Handling	Education: Lawn Care Materials Storage and Recycling Land Use Modifications
Temperature	Land Use Modifications	
pH	Illicit Connections Identified Proper Materials Handling	Materials Storage and Recycling Land Use Modifications

4.2.1 Solids

Both highway runoff and soil erosion can be sources of solids in urban runoff. Street sweeping can reduce solids in urban runoff by decreasing the solids on the roadways when runoff occurs. The benefits associated with street sweeping depend largely on the climate. In arid regions, airborne pollutants are a serious concern, and there is a long time between storms for pollutants to accumulate. In humid regions, on the other hand, frequent rainfall makes the use of sweepers between storms less practical. In colder regions, sweeping is recommended twice per year: once in the fall after leaves fall and once in the spring in anticipation of the spring snowmelt (MPCA, 1989).

Modifying land use to preserve open space and to limit the impervious cover can also reduce solids loads in two ways. First, by preserving open space the amount of land cleared is limited, thus reducing erosion during construction. Natural vegetated cover has less than one percent of the erosion potential of bare soil (Wischmeier and Smith, 1978).

4.2.2 Oxygen Demanding Substances

Since the primary oxygen demanding substances are organic materials, BMPs that target these substances are the best suited to reducing the oxygen demand in storm water. BMPs that reduce sediment loads often also reduce the loads of the organic material associated with that sediment. Pet waste is also a significant source of organic pollutants, and its control can reduce the loads of oxygen demanding substances in urban runoff. Finally, programs geared at reducing illegal dumping and accidental spills of materials can reduce the oxygen demand associated with these substances.

4.2.3 Nitrogen and Phosphorous

Nitrogen and phosphorous are prevalent in urban and suburban storm water, as a component of the soil, due to the use of fertilizer on urban lawns, and due to airborne deposition. Street sweeping can reduce nutrient loads by removing deposited nutrients from the street surface. Programs that focus on lawn chemical handling or replacing turf with natural vegetation also act to reduce nutrient loading. Finally, programs that educate the public or industry about illegal dumping to storm drains can reduce the nutrient loads associated with dumping chemicals that have high nutrient content. Energy conservation and reduced automobile use can reduce airborne nitrogen deposition.

4.2.4 Pathogens

Pathogens, or bacteria, are prevalent in urban runoff, largely due to animal sources. Dogs in particular are a significant source of pathogens in the urban landscape. Thus, pet scoop ordinances (replacing "curb your pet") and associated education are effective tools at reducing bacteria in urban runoff. Illicit connections of sewage may also be a source of pathogens.

4.2.5 Petroleum Hydrocarbons

Petroleum hydrocarbons are present in many chemicals used in the urban environment, from gasoline to cleaning solvents. Since roadways are a major source of petroleum, scheduled street sweeping can be used to remove hydrocarbon build-up prior to storm water runoff. All programs geared at preventing spills of chemicals to the storm drain, either through deliberate or accidental dumping, are the most effective at reducing hydrocarbon loads. Finally, modifying the way land is developed can reduce hydrocarbon loads on both a site and a regional level by reducing the use of the automobile and replacing impervious surfaces with natural vegetation, which has virtually no hydrocarbon loading.

4.2.6 Metals

Metals sources in urban runoff include automobiles and household chemicals, which often have trace metals. Street sweeping can reduce metals loads deposited on the road surface. In addition, programs that focus on reducing dumping and proper material storage can reduce accidental or purposeful spills of chemicals with trace metals to the storm drain system. Finally, modifying land use can reduce metals loads by reducing impervious cover, thus reducing total runoff containing metals, and reducing the roadway length, which is often a source of runoff containing metals.

4.2.7 Synthetic Organics

Much of the source of synthetic organics in the urban landscape is household cleaners and pesticides. Thus, all education programs geared at reducing chemical and pesticide use, and proper storage and handling of these chemicals, can reduce their concentrations in urban runoff. In addition, land use modifications that replace turf with natural vegetation will reduce pesticide use.

4.2.8 Temperature

Most non-structural BMPs are not able to prevent the increase in temperature associated with urban development. One exception is the use of site designs that more closely mimic the natural hydrograph by reducing impervious cover and encouraging infiltration.

4.2.9 pH

The primary source of low pH in urban runoff is acid rain, and most non-structural BMPs are not used to treat this problem. BMPs that focus on proper materials handling and disposal can prevent dumping of chemicals with extremely high or low pH, but this is generally not a major problem in urban watersheds.

4.3 Hydrological and Habitat Benefits

As reviewed in Task 5, one major impact of urbanization is induced through the conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns. This process of urbanization has a profound influence on surface water hydrology, morphology, water quality, and ecology (Horner et al, 1994). In this section, the hydrologic and related habitat impacts are briefly discussed as well as the potential benefits that can be achieved by managing storm water runoff using structural and non-structural BMPs.

Many of these impacts can be directly or indirectly related to the change in the hydrologic cycle from a natural system to the urban system. Figure 5 (Task 5) illustrates the fundamental principles that occur along with the development process. In the natural setting, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In the urbanizing conditions, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. The result is that less water is available to streams and waterways during dry periods and more flow is occurring during storms. A recent study in the Pacific Northwest found that the ratio of the 2 year storm to the baseflow discharge increased more than 20% in developed subwatersheds (impervious cover approximately 50%) verses undeveloped subwatersheds (May, 1997).

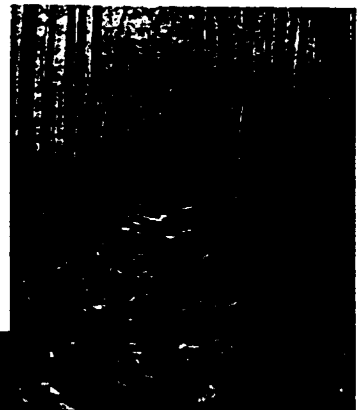
As a result of urbanization, runoff from storm events increases and accelerates flows, increases stream channel erosion, and causes accelerated channel widening and downcutting (Booth,1990). This accelerated erosion is a significant source of sediment delivery to receiving waters and also can have a smothering effect on stream channel substrates, thereby eliminating aquatic species habitat. As a result, aquatic habitat is often degraded or eliminated in many urban streams. The results are that aquatic biological communities are among the first to be impacted and/or simplified by land conversion and resulting stream channel modifications. Subsurface drainage systems which frequently serve urbanized areas also contribute to the problem, by bypassing any attenuation achieved through surface flows over vegetated areas.

A unifying theme in stream degradation is this direct link with impervious cover. Impervious cover, or imperviousness, is defined as the sum of roads, parking lots, sidewalks, rooftops, and other impermeable surfaces in the urban landscape. This unifying theme can be used to guide the efforts of the many participants in watershed protection. Figure 6 visually illustrates this trend in degradation for a series of small headwater streams in the Mid-Atlantic Piedmont. Here, four stream segments, each with approximately the same drainage area, and subjected to the same physiographic conditions, respond to the effects of increased impervious cover. Similar results have been observed in the Southern United States with studies in Virginia, North Carolina and Georgia evidencing this same decline in fish and macroinvertebrate populations with increasing impervious cover (Crawford et al., 1989; Weaver and Garman, 1994; Couch et al., 1996)

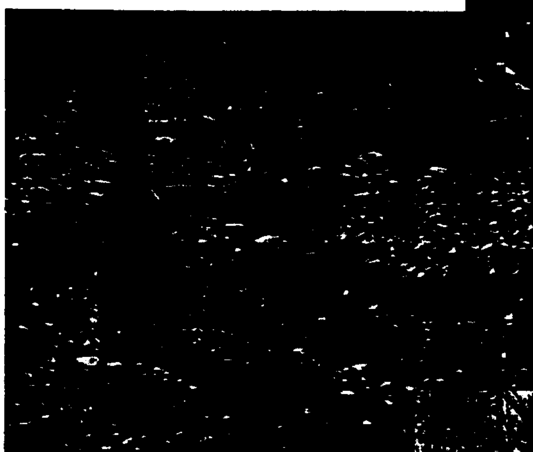
To mitigate for this impact, many local and state governments have required the installation of storm water management detention ponds to attenuate this increased runoff volume. It is important to recognize that the change in hydrology caused by urbanization affects more than just a single storm return interval (e.g., the 2 year event). Urbanization shifts the entire "runoff frequency spectrum" to a higher magnitude. As illustrated in Figure 7, the most significant change is to the smallest, most frequent storms that occur several times per year. In the undeveloped condition, most of the rainfall from these events is infiltrated into the underlying soil. In the developed condition, much of this rainfall is runoff. As the storm return interval increases, the difference between the undeveloped and developed condition narrows. Many jurisdictions only require management of specific storms, usually the two, ten and sometimes, the one hundred year events. The two-year storm is probably the most frequently used control point along this frequency spectrum. Hence, while BMPs may do a fairly good job of managing these specific control points, there have been very few locations across the country that have specific criteria in place to manage storm water over a wide range of runoff events.

Figure 6. Effects of Impervious Cover on Stream Quality

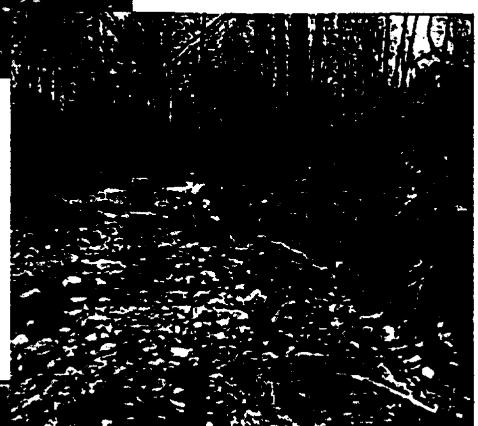
Sensitive Stream
(Impervious Cover ≤10%)
-Stable Channel
-Excellent Biodiversity
-Excellent Water Quality



Impacted Stream
(Impervious Cover 10-20%)
-Channel Becoming Unstable
-Fair to Good Biodiversity
-Fair to Good Water Quality



Restorable Stream
(Impervious Cover ≈ 40%)
-Highly Unstable Channel
-Poor Biodiversity
-Poor to Fair Water Quality



Non-Supporting Stream
(Impervious Cover ≈ 65%)
-Poor to No Biodiversity
-Poor Water Quality

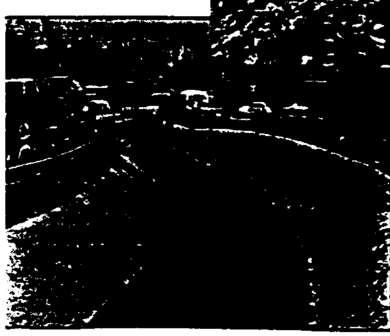
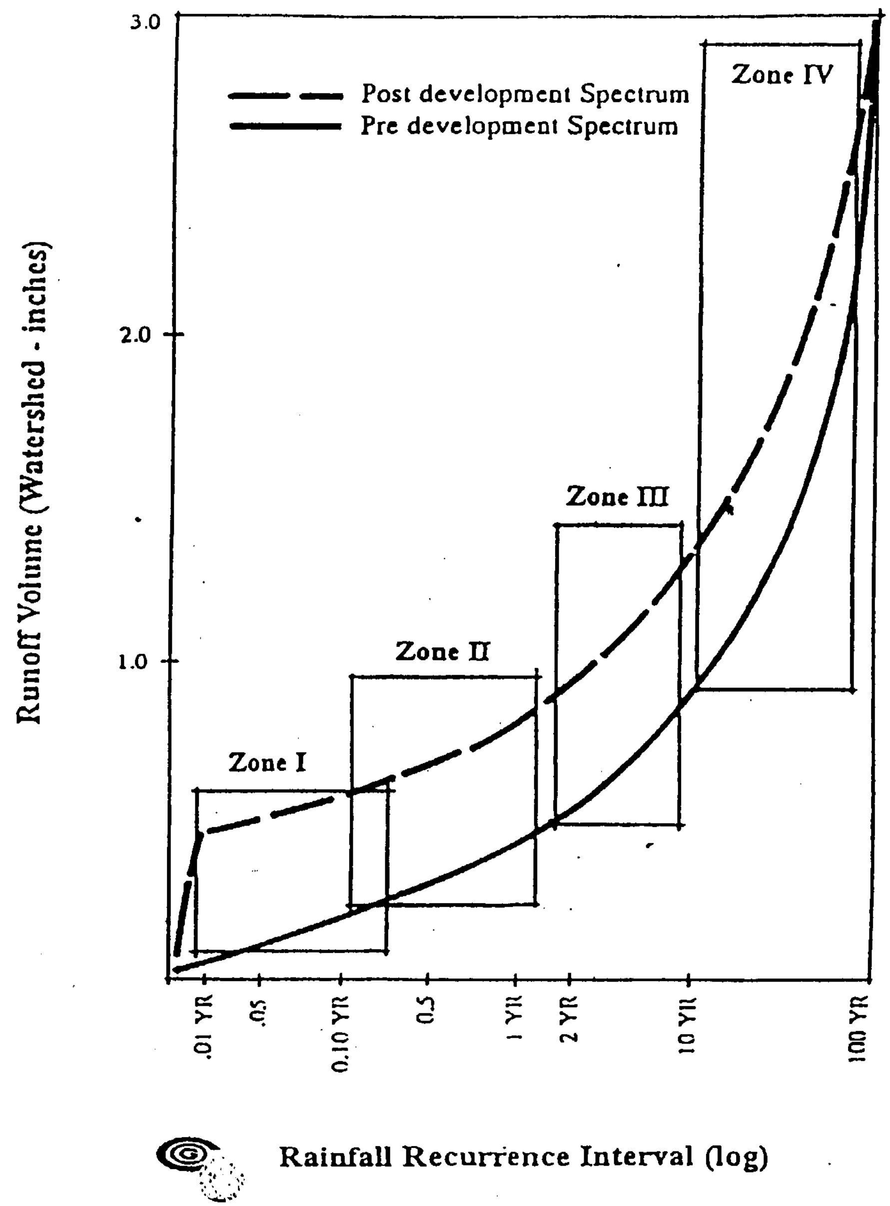


Figure 7. Rainfall Frequency Spectrum



R0073137

One recent study by MacRae (1997) concluded that stream channels below storm water detention ponds designed to manage the two year storm experienced accelerated erosion at three times the predeveloped rate. His findings went on to suggest that the streams were eroding at much the same rate as if no storm water controls existed.

Other jurisdictions have employed an additional level of detention storage above and beyond that required for the two year storm. This concept is often called extended detention (ED). McCuen and Moglen (1988) conducted a theoretical analysis of this design criteria based on sediment transport capacity of the predeveloped channel versus that with ED control. This study found ED could produce an 85% reduction in the predeveloped peak flow of the 2 year storm. What it did not analyze however, was the erosion potential over a wide range of storms. MacRae (1994) suggested a different storm water control criteria called the distributed runoff control (DRC). Here, channel erosion is minimized if the erosion potential along a channel's perimeter is maintained constant with predeveloped levels. This is accomplished by providing a non-uniform distribution of the storage-discharge relationship within a BMP, where multiple control points are provided along the runoff frequency spectrum.

4.3.1 Benefits of BMPs to Control Hydrologic Impacts

Numerous prior studies have documented the degradation of aquatic ecosystems of urban and suburban headwater streams. As stated above, in general, the studies point to a decrease in stream quality with increasing urbanization. Unfortunately, the benefits of BMPs to protect streams from hydrologic impacts has only recently been investigated and only for a few studies.

Maxted and Shaver (1997), Jones, et al. (1997), and Horner, et al. (1997) attempted to isolate the potential beneficial influence of local storm water best management practices on the impervious cover/stream quality relationship. Horner, et al (1997) examined the possible influence of streamside management on stream quality as a function of urbanization. Coffman, et al. (1998) recently presented data on the potential hydrologic benefits of alternative land development techniques. Called the Low Impact Development approach, this methodology attempts to mimic predeveloped hydrology by infiltrating more rainfall at the source, increasing the flowpath and time of concentration of the remaining runoff, and providing more detention storage throughout the drainage network, as opposed to a one location at the end of the pipe.

The preliminary findings of Maxted and Shaver (1997) and Jones, et al (1997) suggest that, for the BMPs examined, stream quality (as measured by a limited group of environmental indicators) cannot be sustained when compared to reference stream conditions. Jones et al., (1997) assessed several BMPs by conducting biomonitoring (fish and macroinvertebrate sampling) above and below BMPs and comparing them to a reference watershed. He found that the biological community tended to be degraded immediately below BMPs as compared to the reference watersheds. One major flaw in the study was the lack of analysis in developed watersheds without BMPs. This would have compared the influence of BMPs on the aquatic community as compared to no BMPs.

Maxted and Shaver (1997) examined eight subwatersheds with and without BMPs. Their study also concluded that BMPs did not adequately mitigate the impacts of urbanization once watershed impervious reached 20% cover. While this study was useful in defining the cumulative impacts of BMPs on watersheds, several critical questions remain. First, since no subwatersheds with less than 22% impervious cover were analyzed, little is known about BMP ability to protect the most sensitive species seen in less developed watersheds. Data for subwatersheds with BMPs was collected approximately three years after data for the subwatersheds without BMPs, so climatic/seasonal constraints may have affected the outcome as much, or more than the BMPs themselves.

Horner et al (1997) evaluated several subwatersheds, with varying levels of impervious cover, but only tangentially related the effectiveness of BMPs to protecting stream quality. Horner found that at relatively low levels of urbanization (approximately 4% impervious area) the most sensitive aquatic biological communities (e.g., salmonids) were adversely affected, and stream quality degradation (as measured by a several indicators) continued at a relatively continuous rate with increasing impervious area. Horner's study demonstrates a link between urbanization and stream quality in the Puget Sound region, but since the effects of BMPs were not directly assessed, the question of whether BMPs could "raise" these thresholds could not be answered.

Horner did find a positive relationship between stream quality and riparian buffer width and quality. Here, the otherwise direct relationship of degrading stream quality with increasing impervious cover was positively altered where good riparian cover existed. In other words, increasing the buffer width and condition tended to keep the stream systems healthier.

Coffman (1998), demonstrated techniques for maintaining predeveloped hydrologic parameters by replicating the curve number and time of concentration. The analysis indicated the amount of storage required on-site to accommodate the change in site imperviousness. The benefits of this type of development, while not yet fully monitored in a field study, are likely to include, increased groundwater recharge, reduced channel erosion potential, and decreased flood potential.

One major hydrologic benefit of storm water management structures is the potential to mitigate for the potential flooding associated with medium to larger storms. Storm water detention and retention facilities have been applied in many parts of the country since about 1970 (Ferguson and Debo, 1990). These detention facilities include wet and dry ponds, as well as rooftop and parking lot detention and underground storage vaults. These last do not provide any water quality benefits beyond hydrologic modification. These *storage facilities* attempt to retain flooding downstream from developments by reducing the rate of flow out of the particular structure being used. Although the rate of flow is reduced, the volume of flow is generally not reduced. Instead, this volume is delivered downstream at a slower rate, and stretched out over a longer time. With the exception of wet and dry ponds, these structures do not provide any water quality benefit beyond the hydrologic modifications. This technique has proved to be a successful method of suppressing flood peaks when properly applied on a watershed-wide basis.

4.4 Human Health Benefits

Storm water can impact human health through direct contact from swimming or through contamination of seafood. Most human health problems are caused by pathogens, but metals and synthetic organics may cause increased cancer risks if contaminated seafood are consumed. BMPs that reduce pathogens, metals and synthetic organics will help to limit these health risks.

Economic benefits of avoiding human health problems can include swimming and recreation costs, as well as saved medical costs. One study in Saginaw, Michigan estimated that the swimming and beach recreation benefits associated with a CSO retention project exceeded seven million dollars (Apogee, 1998a). As another example, the EPA estimates that Phase II storm water controls would reduce the cost of shellfish-related illnesses by between $73,000 and $300,000 per year (US EPA, 1997).

4.5 Additional and Aesthetic Benefits

Storm water BMPs can be perceived as assets or detriments to a community, depending on their design. Some examples of benefits include: increased wildlife habitat, increased property values, recreational opportunities, and supplemental uses. Detriments include: mosquito breeding, reduced property values, and safety concerns. For the most part, these detriments can be avoided through careful design.

Property Values/ Public Perception

A survey of residents in an Illinois subdivision indicates that residents are willing to pay between 5% and 25% more to be located next to a wet pond, but that being located next to a poorly designed dry detention pond can reduce home values (Emmerling-Dinovo, 1995). One reason that pond BMPs increase home values is the wildlife habitat they provide, particularly for aquatic species. A "call survey" of frog species found that wet ponds had the highest diversity of frog species, for example (Bascietto and Adams, 1983).

Dual Use Systems

Since BMPs can consume a large amount of space, communities may opt to use these facilities for other purposes in addition to storm water management. Two examples are "water reuse" ponds and dual use infiltration or detention basins. In one study, a storm water pond was used to irrigate a golf course in Florida, decreasing the cost of irrigation by approximately 85% (Schueler, 1994a). In the southwestern United States, BMPs are often completely dry in between rain events. In these regions, it is very common to design infiltration basins or detention basins as parks that are maintained as a public open space (Livingston et al., 1997).

Preventing Nuisance BMPs

Although BMPs can enhance the urban environment, they can also detract from it if designed improperly. BMPs should be designed to reduce the opportunity for mosquito breeding, enhance aesthetics and promote safety. Mosquito breeding is perhaps the greatest concern among citizens regarding storm water BMPs. Some simple design features, however, can reduce mosquito habitat. Successful designs avoid shallow or stagnant water, and reduce large areas of periodic drying, as occur in a dry pond (McLean, 1995).

Safety and aesthetics are also a concern among the public. These concerns can be alleviated using such design features as gently sloping edges to any BMP, a safety "bench", and the use of vegetatic surrounding ponds and infiltration basins. All BMPs need to have trash and debris removea periodically to prevent odor and aesthetic liabilities.

5.0 REFERENCES

American Public Works Association (APWA). 1992. A Study of Nationwide Costs to Implement Municipal Storm Water Best Management Practices. Southern California Chapter. Water Resource Committee.

Apogee. 1998a. Phase I Storm Water Modeling Technical Report. Prepared for: US Environmental Protection Agency. Washington, DC.

Apogee. 1998b. Case Studies of the Benefits of Controlling Urban Wet Weather Flows. Prepared for: US Environmental Protection Agency.

Bascietto, J. and L. Adams. 1983. *Frogs and Toads of Storm Water Management Basins in Columbia, MD.* Bulletin of MD Herpetological Society, 19(2): 58-60

Booth, D.B. 1990. *Stream Channel Incision Following Drainage Basin Urbanization.* Water Resources Bulletin, 26:3, pp 407-417.

Brown, W. and T. Schueler. 1997. The Economics of Storm Water BMPs in the Mid-Atlantic Region. Prepared for: Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Brown, W. and T. Schueler. 1997a. National Pollutant Removal Database of Current Urban Storm Water Best Management Practices. Prepared for: Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Caraco, D. and R. Claytor. Design Supplement for Storm Water BMPs in Cold Climates. Prepared for US EPA Region V. Chicago, IL. Center for Watershed Protection. Ellicott City, MD

Center for Watershed Protection (CWP), Environmental Quality Resources and Loiederman Associates. 1997. Maryland Storm Water Design Manual. Baltimore, MD

Claytor, R. 1996. *Public Survey Used to Estimate Pollutant Loads in Maryland.* Watershed Protection Techniques, 2(2): 361-363

Claytor, R. and W. Brown. 1996. Environmental Indicators to Assess Storm Water Control Programs and Practices. Prepared for: US EPA Office of Wastewater Management. Center for Watershed Protection. Ellicott City, MD

Claytor, R. and T. Schueler. 1997. Design of Storm Water Filtering Systems. Prepared for: Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Coffman, L., M-S Cheng, N. Weinstein, M. Clar. 1998. *Low-Impact Development Hydrologic Analysis and Design.* In Water Resources and the Urban Environment. ASCE. Proceedings of the 25th annual conference on water resources planning and management. E. D Loucks, ed.

Couch, C., E. Hopkins and P, Hardy. 1996. *Influence of Environmental Settings on Aquatic Ecosystems in the Apalachicola-Chattahoochee-Flint River Basin.* USGS Water-Resources Investigations Report 95-4278.

Crawford, J.K., and D.R. Lenant. 1989. *Effects of Land Use on the Water Quality and Biota of Three Streams in the Piedmont Province of North Carolina.* U.G. Geological Survey. Water-Resources Investigation Report 89-407. Raleigh, NC

Delaware Department of Natural Resources and Environmental Control (DE DNREC), 1997. Conservation Design for Storm Water Management. Dover, DE

Emmerling-Dinovo, C. 1995. *Storm Water Detention Basins and Residential Locational Decisions.* Water Resources Bulletin. 31(3): 515-521

Engineering Technologies Associates (ETA) and Biohabitats. 1993. *Design Manual for Use of Bioretention in Stormwater Management.* Prepared for: Prince George's County Department of Environmental Resources. Laurel, MD.

Ferguson, B., and T.N. Debo. 1990. *On-Site Stormwater Management: Applications for Landscape and Engineering.* Van Nostrand Reinhold, New York, NY. 270 pp.

Ferguson, T., R. Gignac, M. Stoffan, A. Ibrahim and J. Aldrich, 1997. Rouge River National Wet Weather Demonstration Project: Cost Estimating Guidelines, Best Management Practices and Engineered Controls. Wayne County, MI

Finley, S. 1996. *Sweeping Works.* Pavement Maintenance and Reconstruction. October/November, pp. 16-17

Frank, J. 1989. *The Costs of Alternative Development Patterns: A Review of the Literature:* The Urban Land Institute. Washington, DC

Horner, R.R., D.B. Booth, A. Azous, and C.W. May. 1997. *Watershed Determinants o Ecosystem Functioning.* in Effests of Watershed Development and Management on Aquatic Ecosystems. ASCE. Proceedings of an Engineering Foundation Conference. L.A. Roesner, ed. pp 251-274.

Horner, R.R., J.J. Skupien, E.H. Livingston, and E.H. Shaver. 1994. *Fundamentals of Urban Runoff Management: Technical and Institutional Issues.* Terrene Institute and U.S. Environmental Protection Agency, Washington D.C.

Jones, R.C., A. Via-Norton, and D.R. Morgan. 1997. *Bioassessment of BMP Effectiveness in Mitigating Stormwater Impacts on Aquatic Biota.* in Effests of Watershed Development and Management on Aquatic Ecosystems. ASCE. Proceedings of an Engineering Foundation Conference. L.A. Roesner, ed. pp 402-417.

Livingston, E., E. Shaver, J. Skupien and R. Horner. 1997. Operation, Maintenance and Management of Storm Water Management Systems. Prepared for: Office of Water, US EPA, Washington, DC. Watershed Management Institute. Ingleside, MD

MacRae, C.R. 1997. *Experience from Morphological Research on Canadian Stream: Is Control of the Two Year Frequency Runoff Event the Best Basis for Stream Channel Protection?* in Effects of Watershed Development and Management on Aquatic Ecosystems. ASCE. Proceedings of an Engineering Foundation Conference. L.A. Roesner, ed. pp 144-164.

MacRae, C.R. 1993. *An Alternative Design Approach for the Control of Stream Erosion Potential in Urbanizing Watersheds.* Sixth International Conference on Urban Storm Drainage, September. 12-17, 1993 Niagra Falls, Ontario.

Maxted, J., and E. Shaver. 1997. *The Use of Retention Basins to Mitigate Stormwater Impacts on Aquatic Life.* in Effests of Watershed Development and Management on Aquatic Ecosystems. ASCE. Proceedings of an Engineering Foundation Conference. L.A. Roesner, ed. pp 494-512.

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.B. Welch. 1997 *Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion.* Watershed Protection Techniques. Vol 2, No. 4. pp 483-494. Center for Watershed Protection. Ellicott City, Maryland.

McClean, J. 1995. *Mosquitos in Constructed Wetlands-A Management Bugaboo?* Watershed Protection Techniques, 1(4): 203-207

McCuen, R.H., and G.E. Moglen. 1988. *Multicriterion Storm-water Management Methods.* Journal of Water Resources Planning & Management, ASCE. 114.4., pp. 414-431.

Minnesota Pollution Control Agency (MPCA), 1989. Protection Water Quality in Urban Areas: Best Management Practices for Minnesota. St. Paul, MN

Oberts, G. 1994. *Performance of Storm Water Ponds and Wetlands in Winter.* Watershed Protection Techniques, 1(2): 64-67

Pelley, J., 1997. *The Economics of Urban Sprawl.* Watershed Protection Techniques, 2(4): 461-468.

Satterfield, C. 1996. Enviro Whirl 1 PM-10 Efficiency Study Removing Reentrained Road Dust. Lake, CA.

Smith, J., S. Paul, C. Collins, A. Cavacas and M. Lahlou. 1994. Public Survey and Pollutant Model for Prince George's County. IN: Proceedings from Watershed '93: A National Conference on Watershed Management. EPA 840-R-94-002

Saunders, G. and M. Gilroy. 1997. Treatment of Nonpoint Source Pollution With Wetland/Aquatic Ecosystem Best Management Practices. Lower Colorado River Authority. Austin, TX.

Schueler, T. 1997. *Comparative Removal Capability of Urban BMPs: A Reanalysis.* Watershed Protection Techniques, 1(2): 515-520

Schueler, T. 1994. *Developments in Sand Filter Technology to Improve Storm Water Runoff Quality.* Watershed Protection Techniques, 1(2): 47-54

Schueler, T. 1994a. *Water Reuse Ponds Developed in Florida.* Watershed Protection Techniques, 1(2): 72

Schueler, T. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments. Washington, DC.

Southeastern Wisconsin Regional Planning Commission (SWRPC). 1991. Costs of Urban Nonpoint Source Water Pollution Control Measures. Waukesha, WI.

United States Department of Agriculture (USDA) Natural Resources Conservation Service. 1986. Urban Hydrology for Small Watersheds. Technical Release No. 55. Washington, DC.

United States Environmental Protection Agency (US EPA) Office of Policy Analysis. 1983. A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvement. EPA-230-05-83-001. Washington, DC

US EPA Office of Water. 1993. Guidance to Specify Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-92-002. Washington, DC

US EPA Office of Wastewater Management. 1997. Economic Analysis of the Storm Water Phase II Proposed Rule: Final Draft. Prepared for: US Environmental Protection Agency. Washington, DC.

Washington Department of Ecology (DOE). 1997. NPDES Implementation Data for Seattle, Washington.

Weaver, L.A. and G.C. Garman. 1994. *Urbanization of a Watershed and Historical Change in a Stream Fish Assemblage.* Transactions of hte American Fisheries Society, 123: 162-172

Wiegand, C., T. Schueler, W. Chittenden and D. Jellick. 1986. *Cost of Urban Runoff Controls.* In: Proceedings of an Engineering Foundation Conference. Urban Water Resources. ASCE. Henniker, NH June 23-27, 1986. pp. 36-38

Wischmeier, W., and D. Smith, 1978. Predicting Rainfall Erosion Losses - A Guide to Conservation Planning. Agriculture Handbook 537, US Department of Agriculture. Washington, DC.

DMLN

Technical Note 116

Housing Density and Urban Land Use as Indicators of Stream Quality

A large number of indicators exist to measure the amount of urbanization in a watershed, and in turn, predict stream quality. Impervious cover has traditionally been the primary indicator of watershed urbanization, but two recent studies from Ohio and Illinois focus on housing density, urban land use, and population density as indicators of urbanization. These studies provide some of the first real data on relationships between urbanization and stream quality in the Midwest.

Midwestern streams have many attributes unique to the area. Most Midwestern streams flow across the gently sloping till and outwash plains created after the last great ice sheets receded from North America 10,000 years ago. Typically, these streams are low gradient, shallowly entrenched, alluvial systems with extensive associated wetlands (McNab and Avers, 1994). In terms of aquatic diversity, the Midwest has historically had the highest diversity of freshwater mussels in North America. Prior to settlement, over 80 species of freshwater mussels were present in the state of Illinois alone (INHS, 1996).

Unfortunately, over half of the remaining mussel species existing in the Midwest are now classified as endangered, threatened, or of special state concern (USFWS, 1998). The formerly extensive wetlands of the Midwest have been reduced by over 80% and intensive agricultural and land development practices have led to the straightening, channelization, and impoundment of many streams. These practices have resulted in high rates of sedimentation and nutrient enrichment in the region's streams and rivers.

Land development pressures are increasing in many Midwestern communities, rendering urbanization an even greater threat to the region's aquatic resources. For example, between 1970 and 1990, the northeastern Illinois area population grew by a modest 4%, yet the amount of land in urban/suburban use grew by more than 33% (NIPC, 1998). This pattern of growth appears to be continuing: Census Bureau estimates indicate that the region's population has grown as much since 1990 as it had in the previous two decades (NIPC, 1998).

> Numerous studies have demonstrated a link between increasing urbanization and stream degradation.

Over the past decade, numerous studies have linked increasing urbanization with stream degradation. The research by Chris Yoder and Ed Rankin perhaps best illustrates this relationship. They report, "Few if any, ecologically healthy watersheds exist in the older most extensively urbanized areas of Ohio and no headwater streams (i.e., draining <20 mi^2) sampled by Ohio EPA during the past 18 years in these areas have exhibited full attainment of the Warmwater Habitat (WWH) use designation" (Yoder, 1995; Yoder and Rankin, 1996).

A recent study by Yoder, Dale White, and Bob Miltner (1999) of the Ohio EPA further explored the effects of urbanization on a large number of Ohio streams. This study team utilized bioassessment techniques to link land uses with stream quality in two Ohio ecoregions. Fish, benthic macroinvertebrates, stream habitat and water chemistry were sampled in urban/suburban watersheds in the Cuyahoga River basin in northeastern Ohio and

Table 116.1: Sampling Parameters for the Cuyahoga and Area Streams

Sample Location	Drainage Areas (sq. mi.).	Macro-Invertebrate Samples	Fish Samples	Habitat Assessment	Water Chemistry Samples
Cuyahoga	2 - 700	80	82	82	103
Columbus	<35	0	80	80	0

R0073146

smaller subwatersheds in the Columbus metropolitan area of central Ohio. The Cuyahoga watersheds are characterized by extensive development, including a mix of older residential, commercial, and industrial land uses, along with more recent suburban development. The Columbus watersheds are characterized by residential urban land use, much of which has developed within the last two decades. However, a significant difference between the Cuyahoga and Columbus study areas is that many of the sample points in the Cuyahoga drainage were located in larger watersheds that were subjected to significant point source discharges. The smaller subwatersheds of the Columbus study area had far less influence from point source discharges. Table 116.1 summarizes the team's sampling effort.

The researchers chose housing density and urban land use as surrogates of watershed impervious cover. These two indicators were chosen because census data, for calculating housing density, and state land use information, for calculating percent urban land, were readily available. In addition to the effects of urbanization, the study also examined the potential effects of watershed scale and significant other stressors in the urban environment. Table 116.22 lists the predominant stressor types in the Cuyahoga basin.

Results

Data from the Columbus area streams showed a significant decrease in fish assessment scores when watersheds exceeded 33% urban land use, although there was considerable variation above and below this percentage among individual watersheds (Figure 116.1). At this level of urbanization, fish communities displayed a shift in community composition indicated by the loss of intolerant darters and sculpins, a decrease in insectivorous fish, and an increase in the proportion of tolerant species.

Overall, the Cuyahoga basin streams depicted a significant drop in fish index of biotic integrity (IBI) scores at around 8% urban land use (Figure 116.2). This relatively low level of urban land use was related to a significant impact to the biological community primarily because of watershed scale and the presence of other stressors not generally found in the Columbus area streams. The researchers found that when streams with a watershed size of less than 100 mi^2 were analyzed separately, the level at which fish IBI scores dropped significantly increased to around 15% urban land use (Figure 116.3). Figure 116.4 illustrates this data further broken down by the type of impact. The study showed that sites affected by combined sewer outfalls, significant wastewater treatment plant outfalls, and highly modified habitats (i.e., channelized, impounded) failed to attain their appropriate biocriteria regardless of the degree of urbanization.

Figure 116.1: Index of Biotic Integrity Scores Vs. Urban Land Use (quartiles) for All Columbus Area Samples

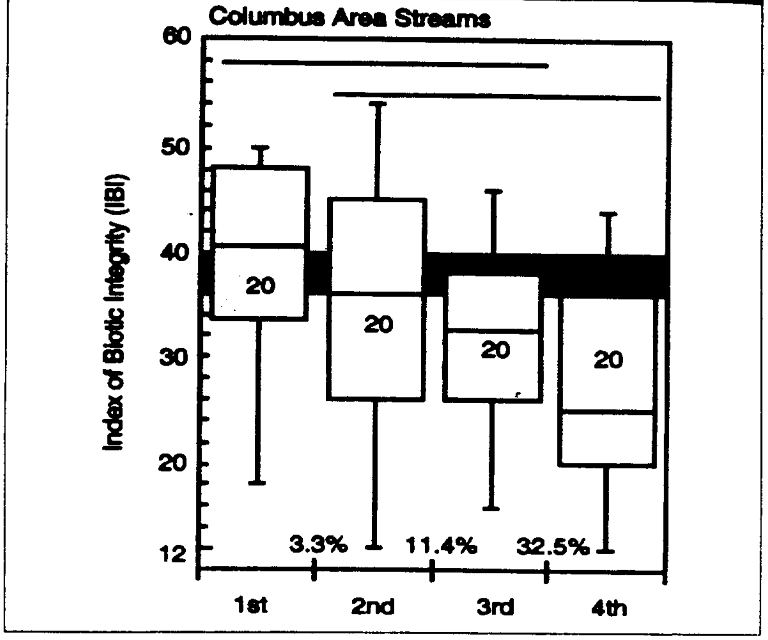


Figure 116.2: Index of Biotic Integrity Scores Vs. Urban Land Use (quartiles) for All Sites in the Cuyahoga Basin

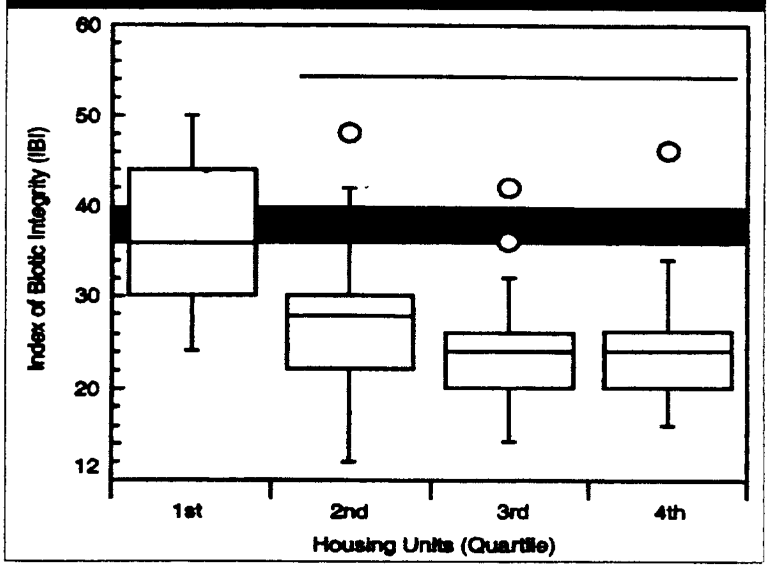


Table 116.2: Predominant Impact Types in the Cuyahoga Basin

Least impacted - large lot residential areas with significant open space
Gross in stream habitat alteration - gross channel modifications and/or impoundments
Combined sewer overflow discharges (CSOs)
Wastewater treatment plant discharges
Wastewater treatment plant discharges w/CSOs
Urbanization

R0073147

Housing density was also strongly linked to stream quality, but with somewhat differing results (Figure 116.5). While urban land use depicted a more or less continuous decline in stream quality with increasing urbanization, housing density displayed a threshold response coinciding with approximately one housing unit per acre, above which sites generally failed to attain their appropriate biological criteria.

Similar results were obtained in a study undertaken by Dennis Dreher (1997) of the Northeastern Illinois Planning Commission (NIPC). Dreher's study utilized a similar bioassessment approach with the main difference between the two studies being the choice of urbanization indicator. The Illinois study utilized population density as an indicator of urbanization, rather than housing density or urban land use.

The six-county Northeastern Illinois study area (Cook, DuPage, Kane, Lake, McHenry, and Will counties) includes the extensively urbanized Chicago metropolitan area and its adjacent suburbs, as well as large areas of outlying rural/agricultural land. Even though discharges from point sources and combined sewer overflows in this region have been reduced dramatically over the past 20 years, many of this region's waterways remain seriously impaired.

In this study, population density was chosen as the urbanization indicator for several reasons, the most notable being the difficulty in accurately quantifying the impervious cover in a large number of watersheds on a regional scale. In contrast, digital population data was readily available for the region and could be utilized with existing GIS resources. In addition, the author felt that local land use planners and government officials readily understand population density, perhaps more so than impervious cover.

Dreher found a strong correlation ($r^2 = 0.77$) between population density and fish community assessments for the Northeastern Illinois region (Figure 116.6). The majority of the streams assessed in urban/suburban watersheds with population densities of 1.5 to 8.0+ people per acre had community assessment scores in the fair to poor range, indicative of significant degradation. In contrast, nearly all the rural/agricultural streams (0.05 to 0.5 people/acre) had assessments scoring in the good or better range However, only two of the 13 rural/agricultural streams studied scored in the excellent range. The study also found that most "suburbanizing" watersheds in the range of 0.5 to 1.5 people per acre scored in the fair to good range. With substantial additional development still occurring, these watersheds are at risk of significant further degradation.

Conclusions

Both the Dreher study and the Yoder *et al.* study demonstrate that there is a strong negative relationship between increasing urbanization and stream quality in the Midwest and that bioassessment can play an important role in assessing and managing urban streams. As both studies used similar biological assessment methodologies, the efficiency and utility of the different urbanization indicators can be compared to determine which provides the best predictor of stream quality over a wide range of land use intensities and watershed scales. And indeed, all three indicators appear to pro-

Table 116.3: Comparison of Different Land Use Indicators and Their Applicability to Local Watershed Planning

Land use indicator	Typical value for low density residential use	Level at which significant impact observed	Advantage	Disadvantage	Appropriate scale	Utility for Local Watershed Planning
% Impervious Cover	10%	10-20%	Most accurate	Highest level of effort and cost	Sub-watershed or watershed	High
Housing Density	1 units/acre	>1 unit/acre	Low accuracy in areas of substantial commercial or industrial development, Moderately accurate at larger scales	Less accurate at smaller scales	Watershed or larger	Moderate
Population Density	2.5 people/acre	1.5 to 8+ people/acre	Low accuracy in areas of substantial commercial or industrial development, Moderately accurate at larger scales	Less accurate at smaller scales	Watershed or larger	Moderate
% Urban Land Use	10-100%	33% (variable)	Moderately accurate at larger scales	Does not measure intensity of urbanization	Watershed or larger	Low

vide useful information. Population density and percentage of urban land use were found to depict a continuous negative response to urbanization. Housing density, on the other hand, depicted a threshold response to urbanization. This may indicate that housing density's utility for predicting stream quality at intermediate levels of urbanization is limited. However, additional investigation will be needed in this area.

Both studies appear to have derived similar conclusions regarding the level at which significant stream degradation occurs. In analyzing their results, Yoder and his colleagues identified a threshold at one housing unit per acre, beyond which fish and macroinvertebrate assessments increasingly fail to attain their appropriate biological criteria. Assuming that one unit per acre would represent a suburban medium to low density development (single-family detached homes), then 2.5 people per acre would be a reasonable estimate of population density (ULI, 1997). This would coincide with Dreher's category of 1.5 to 8+ people per acre, at which streams typically scored in the fair to poor range. Based upon the results of these studies, it appears that there is agreement between these two indicators of urbanization, at least in terms of a threshold for use attainment. However, population density may be a more useful tool for predicting stream quality due to its more continuous negative response to increasing urbanization.

Urban land cover was also found to be a good predictor of stream quality, but other factors such as historic development patterns, the level of direct channel alteration, and the array of land uses included as urban land may limit the precision of this indicator.

Figure 116.3: Index of Biotic Integrity Scores Vs. Urban Land Use (quartiles) for All Samples With Drainage Areas <100 mi² in the Cuyahoga Basin

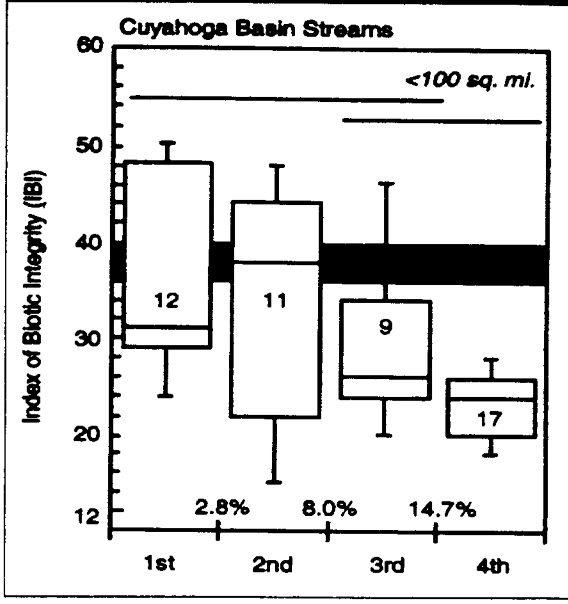
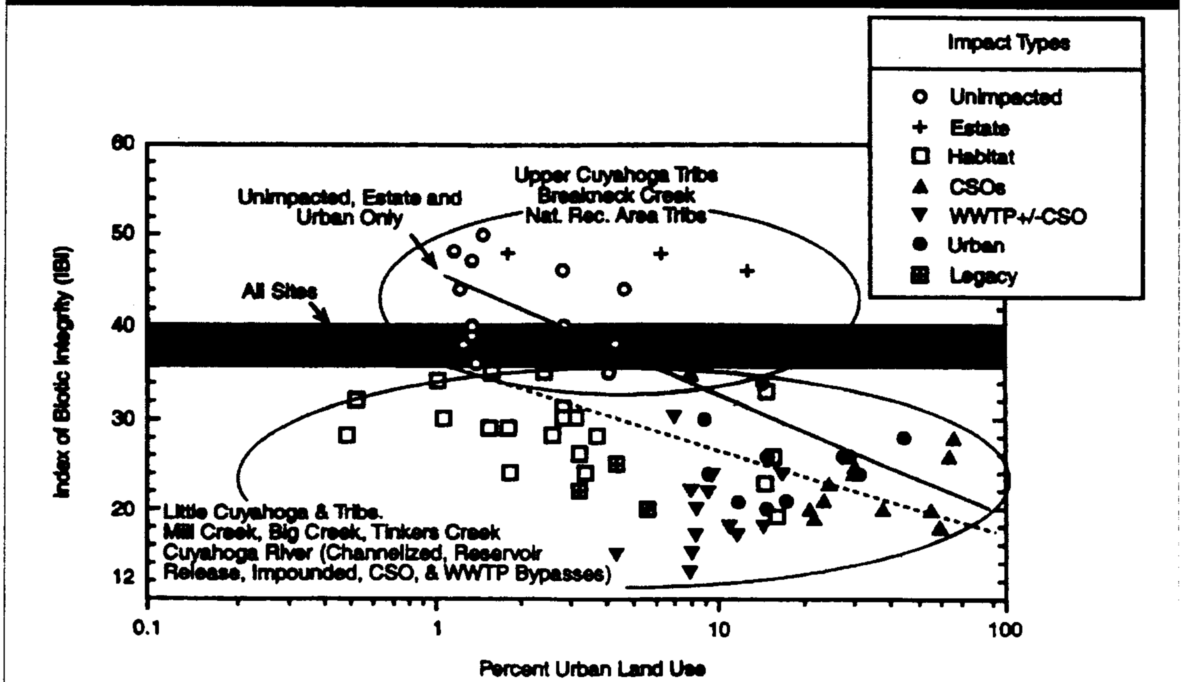
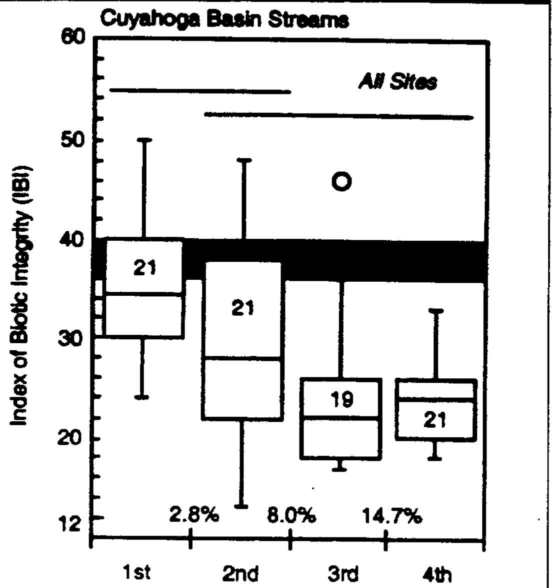


Figure 116.4: Index of Biotic Integrity Scores Vs. Percent Urban Land Use (quartiles) for Cuyahoga Streams With Drainage Areas <100 mi² by Stressor Groups



R0073149

Figure 116.5: Index of Biotic Integrity Scores Vs. Housing Density (quartiles) for All Sites in the Cuyahoga Basin



The Dreher study and the Yoder *et al.* study, as well as others, have demonstrated a clear negative relationship between increasing urbanization and stream quality. However, most assessments of this type to date have been conducted on large regional scales. Robert Steedman of the University of Toronto (1988) found that watershed scale played a significant role in the ability of the urban land use indicator to predict stream degradation. He found that large watersheds, with an average size of 112 mi^2, had poor land use/stream quality correlations (r^2=.11) when compared to small watersheds with an average watershed size of just 6.5 mi^2 (r^2=.78). This would appear to reinforce the idea that watershed scale is an important factor in assessing the utility of indicators of urbanization. As land use decisions are generally made at the local level, land use planners need tools that are applicable to smaller scale local planning areas. More work is still needed in identifying and applying these indicators at smaller scales to determine their practical usefulness in local watershed planning and management. Table 116.3 summarizes some of the advantages and disadvantages of several indicators of urbanization.

Overall, the results of these two Midwestern studies reflect the substantial impacts conventional land use practices have had on the biological integrity of rivers and streams, and may be used to forecast future quality if conventional practices continue. This does not bode well for our streams and rivers, as development pressures continue to grow in many Midwestern communities. However, these relationships may not predict the future quality of our streams and rivers if watershed planning and management practices are implemented to control both point and non-point source pollution. But the authors caution that planning and management decisions should not be based upon a single indicator of urbanization, without considering significant other physical and chemical stressors (i.e., historic alteration, CSO's, failing septic systems, etc.) that may be acting on the system. - ***KBB***

References

Dreher, D.W. 1997. "Watershed Urbanization Impacts on Stream Quality Indicators in Northeastern Illinois" pp. 129-135. in D. Murray and R. Kirshner (ed.) *Assessing the Cumulative Impacts of Watershed Development on Aquatic Ecosystems and Water Quality.* Northeastern Illinois Planning Commission. Chicago, IL.

INHS. 1996. "The Decline of Freshwater Mussels in Illinois." *Illinois Natural History Survey Reports,* May-June, 1996. Illinois Natural History Survey Champaign, IL.

McNab, W.H. and P.E. Avers. 1994. *Ecological Subregions of the United States.* United States Forest Service. Washington, D.C.

Northeastern Illinois Planning Commission (NIPC). 1998. *Policy Statement on the Regional Growth Strategy.* Chicago, IL.

Steedman, R.J. 1988. *Modification and Assessment of an Index Biotic Integrity to Quantify Stream Quality in Southern Ontario.* Can. J. Fish Aquat. Sci. 45:492-501.

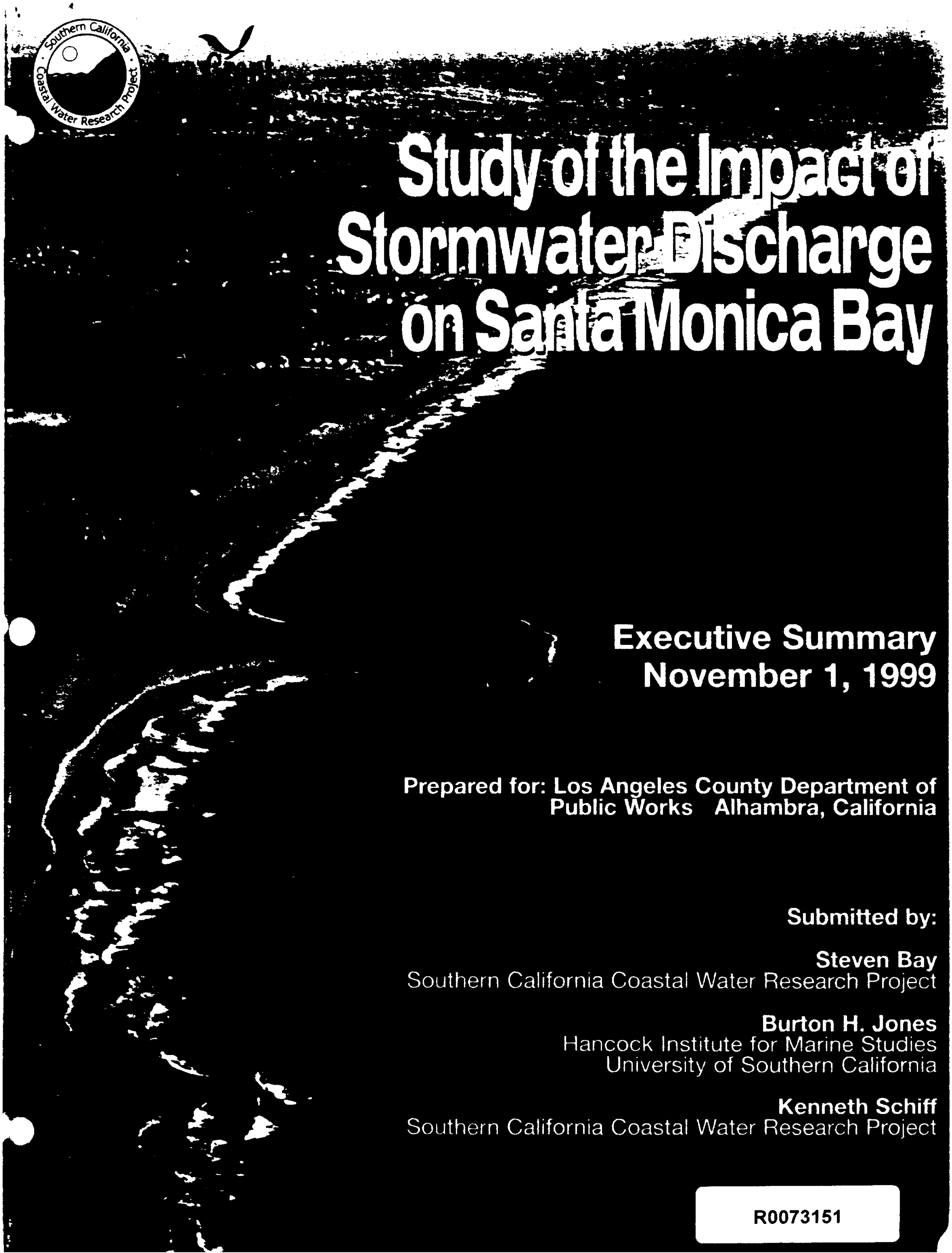
Urban Land Institute. 1997. *America's Real Estate.* Washington, D.C.

USFWS. 1998. *America's Mussels: Silent Sentinels* United States Fish ands Wildlife Service, Region 3 Endangered Species Home Page (http// www.fws.gov/r3pao/eco_serv/endangrd/clams/ mussels.html)

Yoder, C.O. 1995. Incorporating Ecological Concepts and Biological Criteria in the Assessment and Management of Urban Non-point Source Pollution, pp. 183-197. in D. Murray (ed.). *National Conference on Urban Runoff Management: Enhancing Urban Watershed Management at the Local, County, and State Levels.* EPA/625/R-95/003

Yoder, C.O. and E.T. Rankin. 1996. *The Role of Biological Indicators in a State Water Quality Management Process.* J. Env. Mon. Assess. 51(1-2): 61-88

Yoder, C.O., R. Miltner, and D. White. 1999. "Assessing the Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds." pp. 16-28. In R. Kirschner (ed.). *National Conference on Retrofit Opportunities for Water Resource Protection in Urban Environments.* EPA/625/R-99/002.



Study of the Impact of Stormwater Discharge on Santa Monica Bay

Executive Summary
November 1, 1999

Prepared for: Los Angeles County Department of Public Works Alhambra, California

Submitted by:

Steven Bay
Southern California Coastal Water Research Project

Burton H. Jones
Hancock Institute for Marine Studies
University of Southern California

Kenneth Schiff
Southern California Coastal Water Research Project

ACKNOWLEDGMENTS

The authors wish to acknowledge the Los Angeles County Department of Public Works and the Natural Resources Defense Council, who helped design the workplan, guide the study elements, and evaluate the results. We also acknowledge the expertise in sample collection and laboratory analysis provided by the following organizations: City of Los Angeles (R/V *Le Mer* and R/V *Marine Surveyor*), Southern California Ocean Studies Consortium (R/V *Sea Watch*), University of California Los Angeles (R/V *Sea World*), CRG Laboratories, Inc. (analytical chemistry), and MEC Analytical Systems, Inc. (benthic taxonomy). This project was funded by the Los Angeles County Department of Public Works, the University of Southern California Sea Grant Program, and the Southern California Coastal Water Research Project.

The conclusions presented in this document are the views of the authors and do not necessarily represent positions of the Los Angeles County Department of Public Works, the Natural Resources Defense Council, or other collaborating agencies.

Sea Grant Program
University of Southern California
USCSG-TR-02-99

This publication has been produced with support from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, under grant number NA 86 RG 0054, and by the California State Resources Agency. The views expressed herein do not necessarily reflect the views of NOAA or any of its sub-agencies. The U.S. Government is authorized to reproduce and distribute copies for governmental purposes.

Cover photos courtesy of:
Bob Van Wagenen, Ecoscan Resource Data, Watsonville, CA

INTRODUCTION

Urban stormwater runoff is now regarded as one of the largest sources of pollution to the coastal waters of the United States. In Southern California, point source control and advanced sewage treatment have greatly reduced the emissions of contaminants from sewage treatment plant and industrial discharges into the ocean. As a consequence, mass emissions from stormwater runoff now constitute a much larger portion of the constituent inputs to receiving waters and may represent the dominant source of some contaminants such as lead and zinc.

Stormwater runoff is widely believed to be one of the largest sources of contaminants to coastal waters.

While stormwater runoff can produce impacts in both freshwater and seawater environments, effects on the ocean are of greatest concern in urban Southern California. Our coastal waters provide many beneficial uses, including recreation, aesthetic enjoyment, fishing, marine habitat, fish reproduction, industrial water supply, and navigation. Ocean-dependent activities contribute approximately $9 billion annually to the economies of coastal communities in Southern California.

Substantial resources are spent monitoring the chemical constituents in stormwater runoff, yet little is known about effects of these inputs once they enter the ocean. Of greatest concern to the public are whether impairments are occurring to the beneficial uses that relate to human health (safety of swimming and seafood consumption) or ecosystem health (presence of a natural balance of species). Stormwater discharge has the potential to impair these beneficial uses through: 1) contamination of recreational waters or seafood with disease-causing microbes, 2) aesthetic degradation from trash and reduced water clarity, and 3) ecosystem degradation from contaminants or other stormwater constituents.

Current water quality monitoring programs do not assess the effects of stormwater runoff on the environment.

Understanding the effects of stormwater on beneficial uses is essential. Information about the extent and type of adverse impacts is useful to guide and refine management actions to improve water quality. The monitoring programs of various agencies collect information that is useful for assessing some beneficial use impairments, primarily those related to human health. For example, public health and sanitation agencies regularly conduct shoreline microbiological monitoring near storm drain discharges, which indicates impacts to swimming and shellfish consumption. However, very little information is available to assess the impacts of urban stormwater on ecosystem health. Studies of impacts to freshwater systems (particularly in the west) are rare; impacts to the coastal ocean have never been assessed.

This report summarizes a three-year study funded by the Los Angeles County Department of Public Works, Southern California Coastal Water Research Project (SCCWRP), and University of Southern California (USC) Sea Grant Program.

This study is one of the first to assess stormwater impacts on the marine ecosystem.

This study examined plume haracteristics, water column and seafloor biology.

The purpose of the study was to assess the impacts of urban stormwater runoff to the receiving waters of Santa Monica Bay. The goal of this study was to examine impacts that were relevant to ecosystem health, rather than impacts related to human health or recreation issues. This effort was conducted by an interdisciplinary team of scientists from SCCWRP, the University of Southern California, and the University of California at Santa Barbara.

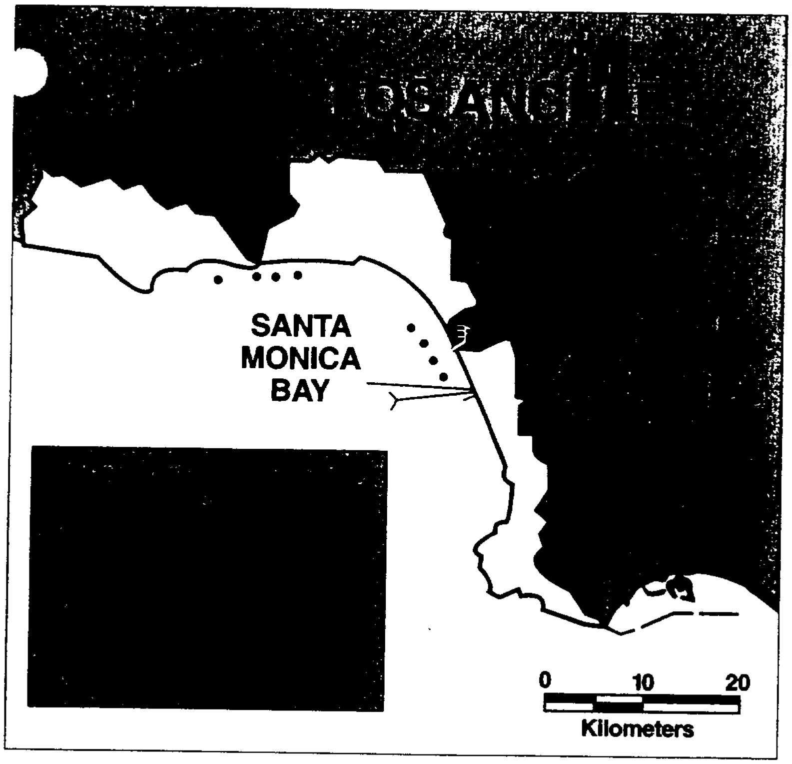
The Santa Monica Bay Receiving Waters Study incorporated four design elements. The first element used physical and optical oceanographic instruments to characterize the size, composition, and mixing of stormwater plumes, providing information on the impacts to beneficial uses that are associated with water clarity. The second element used toxicity tests to assess the biological effects of runoff on water column biota and to identify the responsible toxicants. The third element examined seafloor biota and chemistry in order to assess the long-term effects of storm-discharged particles with their associated contaminants.

Comparisons between Ballona and Malibu Creeks evaluated effects of different watershed types.

The fourth element of the study design was a comparison of stormwater impacts from different watershed types. Land use patterns and development within a watershed are thought to influence the composition and quantity of stormwater runoff. The influence of watershed type was investigated by comparing stormwater impacts in the receiving water offshore of the highly urbanized Ballona Creek watershed with impacts in the receiving water offshore of the less-urbanized Malibu Creek watershed (Figure 1).

Sampling and analysis were conducted over three wet seasons (1995/96 to 1997/98). This document provides a summary of the study and focuses on major concepts and important findings. For the detailed results and raw data, we encourage readers to consult the Annual Progress Reports, available through USC Sea Grant.

FIGURE 1



Locations of Ballona Creek and Malibu Creek sub-watersheds and the offshore sampling stations for sediment measurement. Other rtions of the Santa Monica Bay watershed e shown in white.

STORMWATER PLUME CHARACTERIZATION

The impact of stormwater on the coastal ocean is determined by the composition of the stormwater and the dynamics (mixing, transport, and persistence) of the stormwater plume once it enters the coastal ocean. These dynamics influence the location, duration, and magnitude of impacts from stormwater.

The low salinity and high turbidity of stormwater provide markers that allow plumes to be mapped in the ocean.

The research team mapped the three-dimensional distribution of the stormwater plumes resulting from several winter storm events during 1996-1998. Mapping was performed using a towyo system, which carried sensors to measure temperature, salinity, light transmission (turbidity), chlorophyll fluorescence (plant biomass), and ambient visible light. The towyo was towed through the water in a vertical zigzag pattern that enabled us to map the horizontal and vertical distributions of the measured parameters. In addition, surface water was pumped to similar sensors on the boat so that the distribution of these parameters at the water's surface could be mapped. Maps were constructed for two regions of Santa Monica Bay, the receiving waters offshore of Ballona Creek and those offshore of Malibu Creek.

The characteristics of stormwater discharged into Santa Monica Bay from the two watersheds were similar in several respects. The most obvious and important physical characteristic was that the stormwater, being primarily composed of freshwater, had very little salinity. This low salinity enabled us to trace the stormwater plume in the ocean and differentiate it from the ambient seawater, which was not directly influenced by stormwater discharge. The stormwater also contained high concentrations of suspended particulate material, derived from various sources such as land erosion, street dust, aerial deposition, and litter. Suspended particulate material increased the turbidity of water by scattering and absorbing light. The turbidity and salinity together allowed the differentiation of seawater influenced by stormwater discharge from seawater containing freshwater from direct rainfall input.

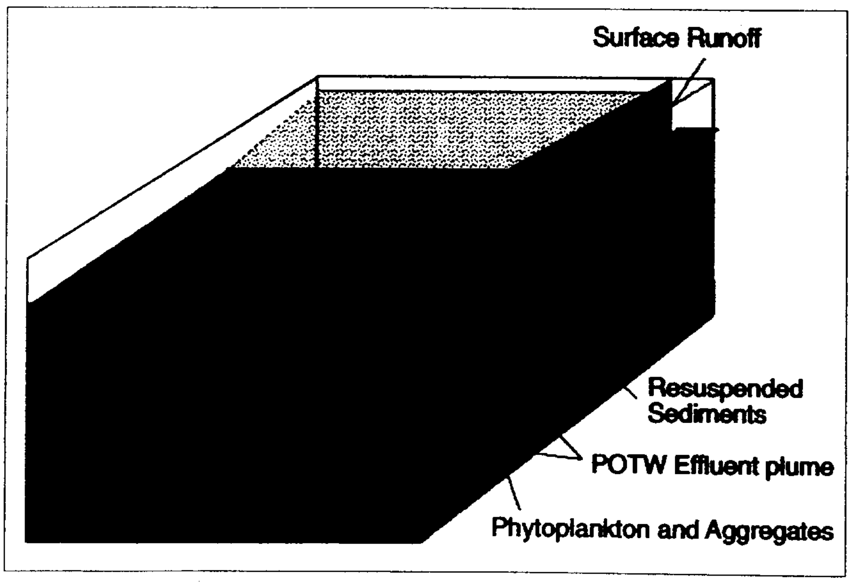


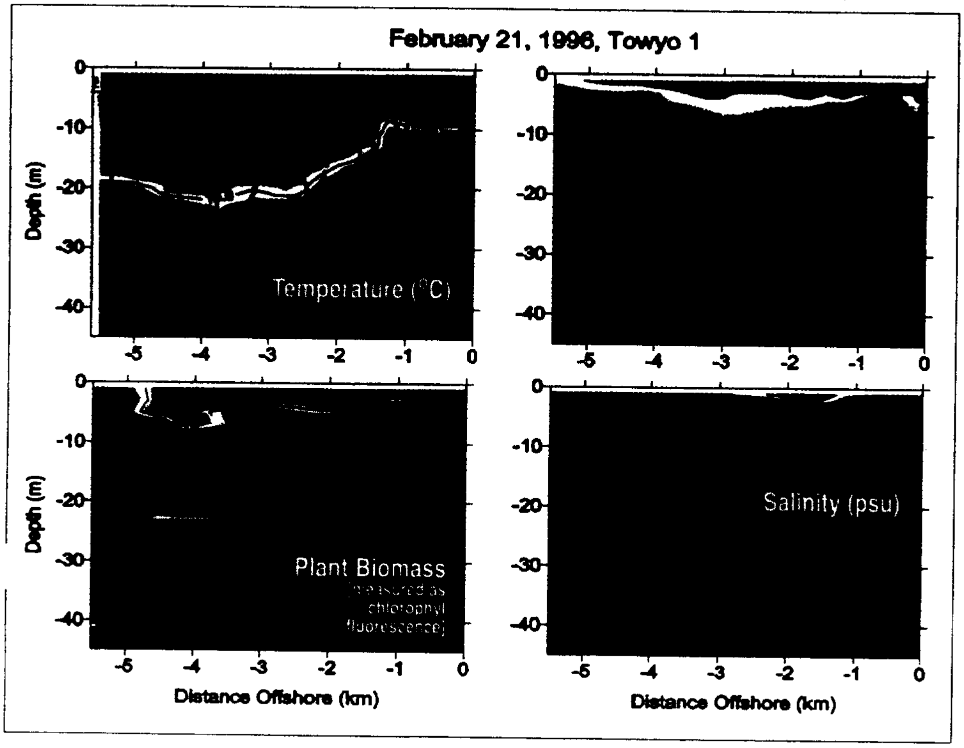
FIGURE 2

Schematic of coastal ocean with several sources of suspended particulate matter. Sources include surface runoff, Publicly Owned Treatment Works (POTW) discharge, bottom resuspension, and naturally occurring phytoplankton and detiritus.

The stormwater plume was most concentrated in the surface layer.

Understanding the dispersion and fate of stormwater plumes is a complex task. The distribution of dissolved components such as nutrients and small particles is dependent upon the amount of rainfall, the coastal currents, and the winds, which can drive currents and cause vertical mixing (Figure 2). Large stormwater particles often have a different fate; they settle out of the low salinity plume, become incorporated into bottom sediments, and may be redistributed later by wave resuspension and transport. As the plume disperses, the components of stormwater mix with other sources of suspended particles, nutrients, and freshwater in the receiving water. These sources include bottom resuspension, phytoplankton growth, and wastewater discharge.

FIGURE 3



Vertical cross-shelf sections of the Ballona Creek discharge plume following a storm event in February, 1996. The maps shown were generated using a towyo system, which carried sensors for temperature, salinity, turbidity (beam attenuation), and plant biomass (chlorophyll fluorescence). The zigzag pattern on the temperature section indicates the path of the towyo. The stormwater plume is indicated by water with a salinity less than 33.0 practical salinity units (psu).

Stormwater plumes usually formed relatively thin layers at the surface of the ocean that are 2-10 m deep (Figure 3). The depth of penetration increased with time as winds mixed the upper layer vertically. The horizontal scales of the plumes studied in Santa Monica Bay were variable, with plumes extending from 1 to 6 miles cross-shelf (offshore) for storms of 1- to 2-year frequencies (0.8 to 4 in. of rainfall). During the February 19-21, 1996 storm (4 in. of rainfall), the plume spread approximately 4 miles offshore of Ballona Creek (Figure 4).

The speed and direction of coastal currents determine the cross-shelf scale of the plume. The Coriolis force (an apparent force that acts on oceans and lakes) also has an influence on the distribution of stormwater plumes. This force is due to the rotation of the earth and its motion through space, resulting in a tendency for currents to turn toward the right in the Northern Hemisphere. If the plume is carried to the north when it enters the ocean, it will be more likely to remain near the coast due to the influence of the Coriolis force.

The distribution of stormwater plumes along the coast depended upon the tidal variations in the currents, the presence of additional runoff sources, and the amount of runoff. Longshore distances of up to 6 miles were measured for plumes within Santa Monica Bay.

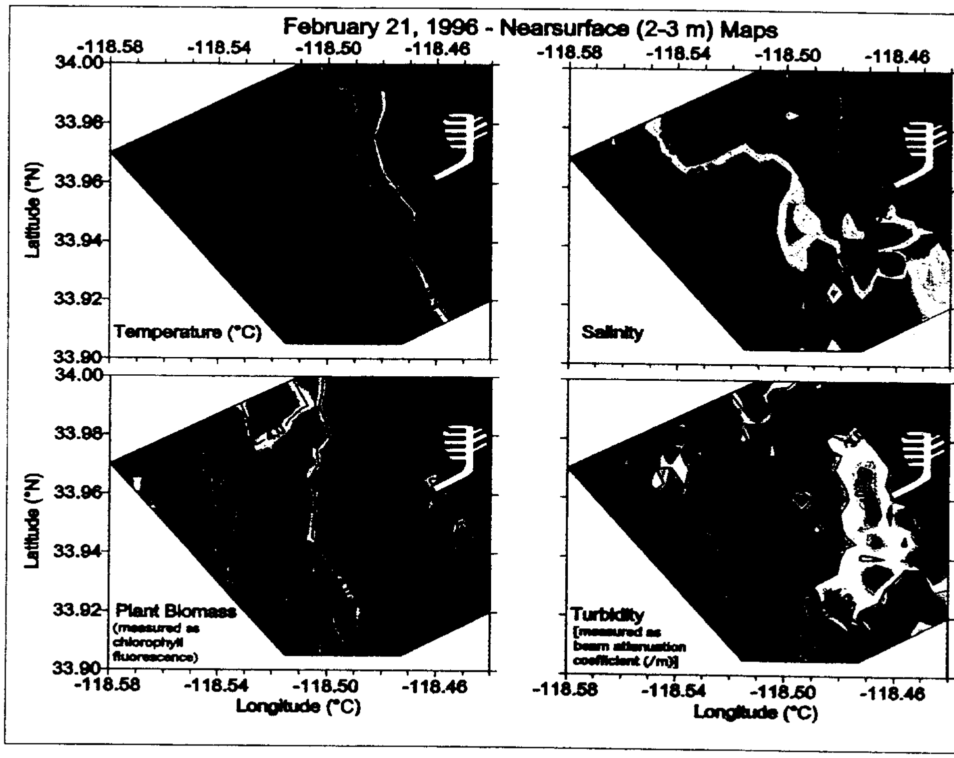
Spatial gradients in the dissolved and particulate components of the plume occurred as it was diluted through mixing with the receiving water. Although larger stormwater particles tended to settle out from the plume rapidly, smaller, lighter particles remained in suspension near the surface (Figures 3 and 4), where they can reduce the amount of light available for photosynthesis by marine plants. Measures of primary production were not part of this study, so adverse effects on phytoplankton in Santa Monica Bay resulting from turbid stormwater plumes were not determined.

Stormwater plumes reduced surface water clarity and persisted for several days after a storm.

The duration of stormwater plumes depends upon the rate of plume dispersion and particle sinking. Stormwater plumes were observed to persist in Santa Monica Bay for at least three days, even for the smallest storm sampled (0.8 in. rainfall). The maximum duration of stormwater plumes could not be assessed in this study because measurements did not extend more than three days after a storm.

High concentrations of the plant pigment chlorophyll were present in the surface layer during some storm events, indicating the presence of increased phytoplankton populations. Phytoplankton growth may have been stimulated by stormwater discharge due to the addition of nutrients to the surface layer, where light is readily available. Dense patches of phytoplankton were observed off of Malibu Creek on the boundary of stormwater plumes 1-2 days after rain events. Off of Ballona Creek, we observed increased phytoplankton in the plume even while a large proportion of suspended particulate material was still present in the surface water. The ecological effects of these changes in phytoplankton density were not determined in this study.

FIGURE 4



Near surface map of the February, 1996 stormwater plume from a 2-year storm off of Ballona Creek. The plume (surface water with a salinity less than 33.0 psu) extended approximately 4 miles offshore.

R0073157

WATER COLUMN BIOLOGY

The initial and most concentrated exposure to stormwater occurs in the upper few meters of the water column. A diversity of organisms occupies this habitat, ranging from mobile fish and mammals to drifting microscopic plants and animals (plankton). Plankton have a relatively high potential to be affected by stormwater toxicants because they have a limited ability to avoid the plume and are often more sensitive to contaminants than larger animals. Changes in the abundance and type of plankton present can have important consequences for the marine ecosystem. This group of organisms constitutes the base of the food chain for most marine life, so changes in plankton numbers may affect populations of other species. The larvae of many fish and other animals such as sea urchins, clams, and shrimp occur in the plankton, providing the potential for diminished reproductive success if their survival is reduced by water column toxicity.

Water column effects were measured using toxicity tests.

Toxicity tests were used to determine whether stormwater plumes contained harmful concentrations of dissolved constituents. Surface water samples were collected offshore of the two study sites in conjunction with measurements of the plume characteristics so that the data could be related to the concentration of the stormwater discharge plume. Samples of stormwater collected from Ballona Creek were also measured for comparison. The toxicity tests used sensitive stages of marine species that occur in Southern California. Most samples were measured using the sea urchin fertilization test, in which the effect of the sample on the ability of sea urchin sperm to fertilize eggs is measured. Sea urchin sperm are highly sensitive to some types of dissolved metals. The fertilization test is appropriate for stormwater monitoring because it is rapid (40 min exposure) and uses an organism which spends a portion of its life cycle in the water column of Santa Monica Bay. All tests were adjusted to the appropriate salinity prior to exposure so only the effect of chemical constituents were evaluated.

Virtually every sample of Ballona Creek stormwater tested was toxic.

Undiluted samples of urban stormwater collected from drainage channels (before discharge into the ocean) usually contained toxic concentrations of constituents. Toxicity was detected in virtually every sample obtained from Ballona Creek and this toxicity was often present even after the sample was diluted 10-fold in the laboratory. The results indicated that even though a large portion of the constituents present in stormwater may be bound to particles, the dissolved concentrations of some materials are high enough to cause toxicity. Prior research by SCCWRP and others has detected toxicity in stormwater from other watersheds in Los Angeles, Orange, and San Diego Counties.

The first storms of the year produced the most toxic stormwater.

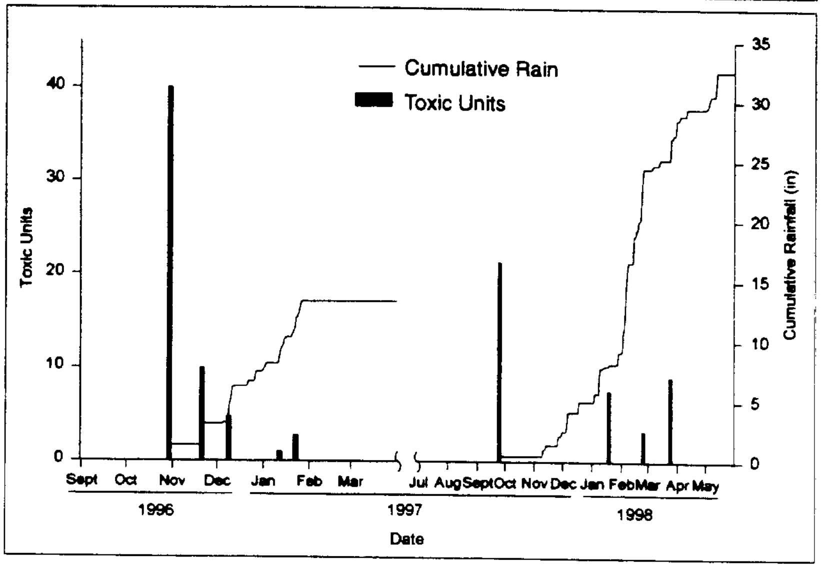
The results showed that time of year was an important variable influencing stormwater toxicity (Figure 5). Samples of Ballona Creek stormwater, obtained from the first storm of the season, were between two and ten times more toxic than samples from later storms. These

R0073158

data indicated that the first storms of the year provide the most concentrated inputs of toxicants to the environment.

Toxicity was frequently detected in surface water within the stormwater plume offshore of Ballona Creek, indicating that the initial dilution of stormwater discharge from this watershed was not sufficient to reduce the concentrations of stormwater toxicants below levels that are harmful to marine organisms. The magnitude of toxicity was greatest in the portion of the plume nearest the mouth of Ballona Creek (Figure 6), where the highest concentrations of stormwater were present. Within the plumes studied, toxicity was usually present whenever stormwater concentrations above 10% were present. The duration of toxicity in surface waters was not specifically addressed in this study, but can be expected to be determined by the rate of plume dispersion. In this study, toxicity was detected in surface water near the mouth of Ballona Creek two days after a storm event.

FIGURE 5

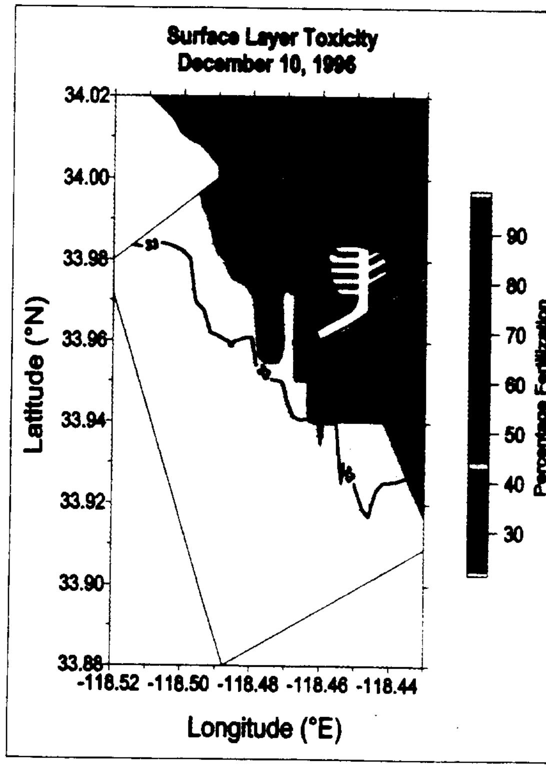


Seasonal changes in the toxicity of Ballona Creek stormwater over two storm seasons. Toxicity was measured using the sea urchin fertilization test. The greatest toxicity was observed in stormwater obtained from the first storm of each year.

Toxic portions of the stormwater plume were variable in size, extending from 1/4 to 2 miles offshore of Ballona Creek.

The spatial extent of surface water toxicity varied between storms, and was influenced by the amount of storm flow, the degree of toxicity of the stormwater, and the amount of mixing that occurred upon discharge. The greatest offshore extent of toxicity was measured following a storm on February 21, 1996, a two-year event, when toxicity was detected 2 miles offshore of Ballona Creek. For other storms, the toxic portion of the plume extended ¼-1 mile offshore. The distribution of toxicity along the shoreline was not determined in this study. The boundaries of stormwater plumes can be described using a number of parameters (i.e., salinity, turbidity, and toxicity) each with different thresholds of detection. Because a relatively high concentration of stormwater is

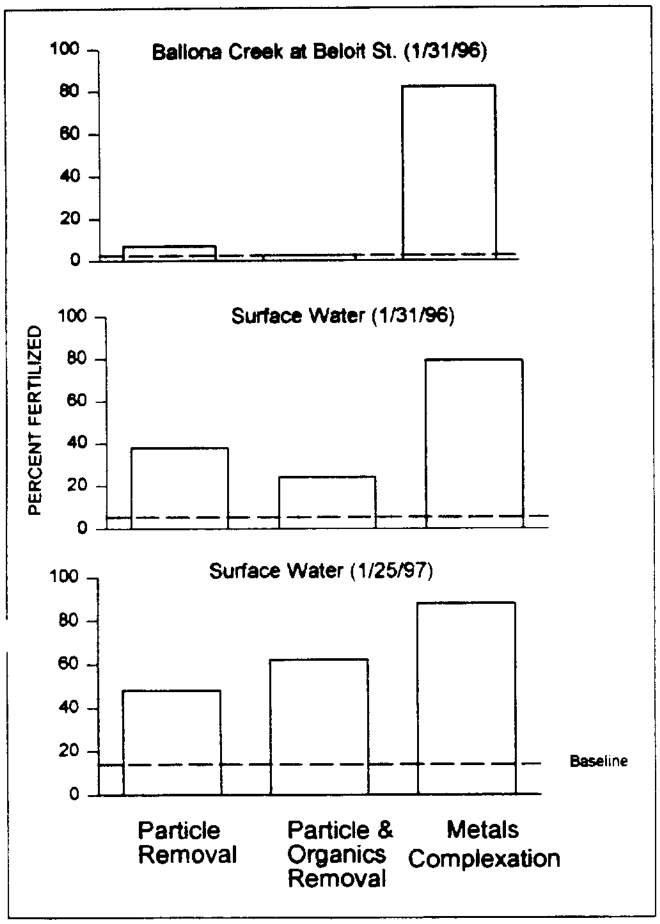
FIGURE 6



Map of surface layer toxicity (effect on sea urchin fertilization) from Ballona Creek stormwater discharge following a 2-year storm in December, 1996 (3.1 in. rainfall). Expected toxicity was calculated from measurements of salinity (indicates concentration of stormwater) and the concentration dose-response curve for the effects of stormwater on sea urchin fertilization. The greatest toxicity (lower fertilization percentage) was present closest to the point of discharge. The area of toxicity was smaller than the physical extent of the plume, as indicated by the solid line showing a salinity of 33 psu. This figure illustrates the relative size of the toxic portion of the plume for a single storm, but does not represent the largest plume offshore for other storms.

Surface water toxicity caused by unidentified sources was frequently encountered during dry weather.

FIGURE 7



Effect of toxicity identification evaluation treatments on the toxicity of Ballona Creek stormwater and two samples of surface water collected within the Ballona Creek discharge plume. Complexation of metals by addition of EDTA usually eliminated toxicity, as shown by the large increase in sea urchin fertilization above the untreated (baseline) value. Other treatments, removal of particles by filtration and removal of organic compounds, were of limited effectiveness. Similar results were found for other samples of stormwater and surface water.

needed to produce toxicity, the area of potential biological impact within a plume will be smaller than the region defined by physical characteristics such as salinity (Figure 6).

An unexpected result of this study was the detection of toxicity in receiving waters that appeared to be due to sources other than urban runoff. An average of 53% of the surface water samples collected offshore of Ballona and Malibu Creeks during periods of dry weather were found to be toxic. The location of the toxic samples was variable and there was no relationship between toxicity and the amount of freshwater in the samples, indicating that dry weather urban runoff was not the cause. Additional sources of receiving water toxicity were also indicated during the wet weather sampling, as some water samples were more toxic than could be accounted for by the amount of stormwater present.

The dry weather toxicity results suggest that factors other than stormwater discharge have a major influence on surface water quality in Santa Monica Bay. While the cause of dry weather toxicity was not determined, its frequent detection indicates that impaired surface water quality in Santa Monica Bay extends beyond the spatial and seasonal boundaries associated with stormwater discharge. Potential sources of dry weather toxicity include the deposition of contaminants from the atmosphere, biological events such as red tides, and inputs from boating activities.

Dissolved metals in stormwater were identified as important contributors to impaired water quality in Ballona Creek stormwater plumes. This conclusion was the result of experiments that combined chemical treatments designed to remove specific types of constituents in water samples with sea urchin toxicity tests, a process known as Toxicity Identification Evaluation (TIE). The toxicity of Ballona Creek stormwater and receiving water samples was usually eliminated when treatments were applied that neutralized toxic trace metals by complexation (Figure 7). Chemical analysis confirmed that dissolved concentrations of zinc, and occasionally copper, were at toxic levels in undiluted stormwater. The dissolved concentrations of other metals were below toxic levels for the sea urchin test. Measurements of receiving water also detected elevated concentrations of zinc (but not copper) in the stormwater plume offshore of Ballona Creek.

Chemical analysis were unable to attribute all of the toxicity measured to zinc and copper, indicating that additional constituents may contribute to the toxicity of stormwater discharged into Santa Monica Bay. The measured concentrations of zinc and copper in Ballona Creek stormwater were estimated to account for only 5-44% of the observed toxicity. Zinc concentrations in the toxic portion of the discharge plume were usually below levels shown to cause toxicity in the laboratory. The unaccounted-for toxicity may be due to synergistic interactions between toxic metals, variability in the

R0073160

chemical analysis, or the influence of other toxic chemicals, such as pesticides. Additional research is needed before these alternatives can be evaluated. TIE studies have not been completed for other stormwater discharges into the Bay, so we do not know if the pattern demonstrated for Ballona Creek is representative of other sites.

Zinc was the most important toxic constituent identified in stormwater. Copper and other unidentified constituents may also be responsible for some of the toxicity measured.

SEAFLOOR BIOLOGY

Much of the natural diversity and many of the commercially important species in the ocean occur on the seafloor. Clams and shrimp live in this environment, as well as worms and starfish, all of which serve as food for fish. This is also the location where stormwater particles, and associated contaminants, eventually settle. Unlike the water column, where a stormwater plume eventually mixes and disperses, the sediments on the seafloor can accumulate runoff inputs over an entire storm, over several storms, or over several seasons. These inputs can alter the seafloor biology by either changing the habitat, such as altering sediment grain size, or by the build-up of pollutants. The potential for impacts to seafloor organisms is great because they are not mobile and are therefore subjected to the accumulated stormwater inputs for long periods of time. Typically, these seafloor organisms are relatively sensitive and changes to the number or types of organisms may result in changes to fish populations.

The deposition of stormwater particles influences the physical and chemical characteristics of the seafloor.

We estimated impacts of stormwater runoff discharges on the seafloor by collecting samples from the ocean bottom between one and two weeks following large storm events, after the stormwater plumes had dispersed and particles had time to settle, and then again during dry weather. Seafloor samples were collected directly offshore of Ballona and Malibu Creeks at 75 ft. depth in the heart of the stormwater plumes, along intervals upcoast and downcoast representing gradients of plume impact, and then outside the area of the plume. The top 2 cm (< 1 inch) of these seafloor samples, which represented the most recent seafloor accumulations, were collected for contaminant analysis and toxicity testing. Sediment samples were analyzed for contaminants including trace metals, chlorinated hydrocarbons (DDTs and PCBs), and petroleum hydrocarbons (PAHs). The toxicity tests included survival of crustaceans (an amphipod) and sea urchins, fertilization success and development of sea urchin embryos, and bioaccumulation of contaminants from seafloor mud in adult sea urchins. A second sediment sample was collected, sieved through a fine mesh screen, and the organisms were enumerated to determine the abundance and diversity of the native seafloor fauna.

An increase in sediment constituents was present on the seafloor offshore Ballona Creek.

TABLE 1

		Sediment Concentration	
		Ballona Ck (n=8)	Malibu Ck (n=7)
Fines	% dry	31.6	53.1
TOC	% dry	0.594	0.963
Aluminum	µg/dry g	11492	17280
Arsenic	µg /dry g	5.1	5.6
Cadmium	µg /dry g	0.5	0.7
Chromium	µg /dry g	40.7	52.6
Copper	µg /dry g	12	13
Iron	µg /dry g	14997	21720
Lead	µg /dry g	26.4	10.3
Mercury	µg /dry g	0.18	0.08
Nickel	µg /dry g	14.29	27.76
Silver	µg /dry g	0.95	0.31
Zinc	µg /dry g	54	56
Total DDTs	ng/dry g	25.6	15.5
Total PCBs	ng/dry g	21.5	3.0
Total PAHs	ng/dry g	240.6	56.2

Average concentrations of sediment constituents offshore (75 ft. depth) of creek mouths in Santa Monica Bay following storm events between 1995 and 1997. Boxed numbers indicate significantly higher concentrations. Sediment offshore of the less urbanized watershed (Malibu Creek) had higher levels of naturally occurring constituents such as aluminum and iron. Higher concentrations of anthropogenic constituents such as lead and PAHs were present offshore of the more urbanized watershed (Ballona Creek).

Alterations to the seafloor habitat and sediment constituent concentrations had occurred offshore of the Ballona Creek watershed (Table 1). The sediments offshore of Malibu Creek generally had higher concentrations of naturally abundant constituents including fine-grained particles, organic carbon, and trace metals such as chromium. In contrast, the sediments offshore of Ballona Creek generally had higher concentrations of urban contaminants including common stormwater constituents such as lead and zinc, as well as other rarely detected constituents in routine stormwater monitoring programs, such as DDTs, PCBs, and PAHs. Moreover, sediments offshore of Ballona Creek showed evidence of stormwater impacts over a large area. Concentrations of copper, lead, zinc, DDTs, PCBs, and PAHs were highest directly offshore of the creek mouth and then decreased in both the upcoast and downcoast directions at distances up to 3 miles away (Figure 8). The increased sediment contamination was also observed more than 1 mile offshore, where water depths reached over 100 feet.

Biological communities offshore of Ballona Creek were similar to those offshore of Malibu Creek (Table 2). Both areas had comparable abundance and similar species composition. Seventeen of the 19 most commonly found taxa offshore of Ballona Creek were present offshore of Malibu Creek, and both watersheds had a low abundance of so-called "pollution indicator" organisms. Both areas had healthy benthic communities, as measured by the Benthic Response Index, which is a tool for assessing the relative importance of pollution indicator species at a site. Species richness and diversity were statistically higher near Malibu Creek than Ballona Creek.

Biological communities offshore of Ballona and Malibu Creeks were also similar to background reference conditions established in previous studies of Southern California (Table 2). The mean abundance, mean number of taxa per sample, and mean diversity at the creek sites were comparable to reference sites located in waters of similar depth, but distant from river and creek mouths. The present study was limited to the area offshore of the Ballona Creek jetty; previous studies by other scientists have shown impacts to benthic communities and the presence of pollution indicator organisms inside of the jetty (adjacent to Marina del Rey).

The seafloor biology results were consistent with the results from sediment toxicity tests. Seafloor sediments offshore of Ballona Creek did not kill amphipods or impair the fertilization success or normal embryo development of sea urchins. However, seafloor sediments were found to be a potential source of contaminants that bioaccumulate in seafloor organisms such as adult sea urchins. Concentrations of lead, DDTs, and PCBs were three to ten times higher in sea urchins exposed to sediments collected offshore of Ballona Creek than in sea urchins living on sediments from our reference location. While the effect of this bioaccumulation on the sea urchin is not known, it does represent a mechanism by which sediment- associated pollutants can enter the food chain and biomagnify within fish.

The fate of most stormwater constituents is unknown.

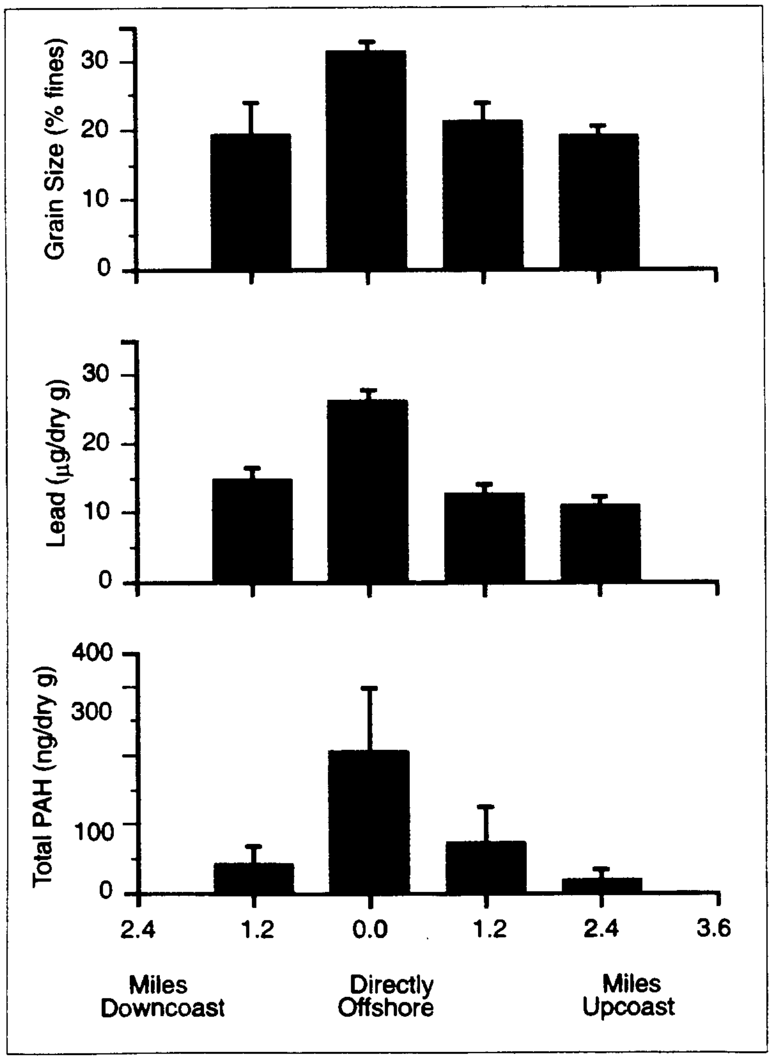
One significant finding of this study was that the fate of most stormwater constituents discharged to Santa Monica Bay is unknown. Although we documented the accumulation of contaminants on the seafloor offshore of Ballona Creek, these amounts were not permanent and represent only a fraction of the total mass emissions discharged. Further, reductions in constituent concentrations were observed at some locations that may have resulted from the resuspension and transport of sediments by waves and currents. Until the location where this material eventually settles is known, we cannot be certain that we have examined the seafloor areas having the greatest influence from stormwater or dry weather discharges. An additional concern is that constituents from other sources may have similar transport and fate mechanisms, producing enhanced impacts from the cumulative effects of multiple sources.

TABLE 2

	Ballona (n=8)	**Malibu** (n=7)	**Reference** (n=29)
Abundance (No. organisms/ 0.1 m²)	238 (±51)	316 (±55)	276 (±61)
No. Species (No. taxa/ 0.1 m²)	75 (±6)	91 (±8)	71 (±9)
Diversity (Shannon-Wiener H')	1.65 (±0.02)	1.73 (±0.04)	1.55 (±0.15)
Benthic Response Index (BRI units)	24.0 (±1.7)	1.65 (±0.7)	3.0 – 30.6

Biological community parameters offshore of a highly urbanized watershed (Ballona Creek), a less urbanized watershed (Malibu Creek), and other reference areas in near-coastal waters of Southern California at similar depths (30 to 75 feet). Values are the mean (±95% confidence limits).

FIGURE 8



Grain size and contaminant concentrations in surface sediments across the gradient of stormwater influence offshore of Ballona Creek. Sampling stations were located 1.5 miles offshore (75 ft. depth) and at various distances upcoast or downcoast of the creek. Each value represents the mean (±95% confidence interval) of eight samples, each collected after a storm event. The influence of stormwater particle deposition is shown by the elevated values directly offshore of Ballona Creek.

R0073163

EFFECTS OF WATERSHED TYPE

The comparison of receiving water impacts from different watersheds is a powerful tool to distinguish between natural and man-made effects. Although the Ballona Creek and Malibu Creek watersheds are similar in size and discharge into the same body of water (Santa Monica Bay), they differ in their degree of urbanization (Figure 1). The measurement of similar parameters in each receiving water area provides the information needed to distinguish between natural processes and impairment due to man-made factors. This approach also identifies which monitoring methods are most useful for detecting man-made impacts.

Different impacts to Santa Monica Bay were produced by an urbanized and an unurbanized watershed.

The characteristics and impacts of stormwater from the Ballona Creek and Malibu Creek watersheds were found to differ in a number of respects (Table 3). The impacts observed were the result of the interaction of three key factors: land use, flow characteristics, and receiving water conditions. Receiving water impacts were less near Malibu Creek and were related to the discharge of less toxic stormwater and lower peak flows.

Ballona Creek watershed is highly urbanized. Stormwater entering the concrete channel is rapidly transported to the ocean, with little opportunity for dilution.

Malibu Creek drains a mostly undeveloped watershed. Stormwater flow and particle inputs into the ocean are moderated by the presence of a natural creekbed and coastal lagoon.

R0073164

TABLE 3

	Ballona Creek	Malibu Creek
Watershed Characteristics	The largest watershed draining to Santa Monica Bay, 83% of its 130 square miles is developed. The principal land use is residential.	Similar in size to Ballona Creek (110 square miles), 88% of this watershed is undeveloped.
Flow Characteristics	The largely impermeable surface area (41% overall) and concrete channel drainage system results in rapid changes in flow following rainfall. Peak flows are relatively high and of shorter duration compared to other areas.	More permeable surface area (96% overall) absorbs early season rainfall and increases lag time between rainfall and peak flow. Discharges have relatively lower peak flows but duration can be days longer than concrete channelized systems. Discharge into Malibu Lagoon may reduce flows and particle loads to ocean.
Plume Characteristics	The stormwater plume in both areas consisted of a thin buoyant layer of low salinity water floating at the surface. The dissolved and particulate components of stormwater were most concentrated in the upper 2 m of the water column. Plumes extended up to 6 miles offshore and were widely distributed along the shore.	
	Higher flows and less mixing produced well-defined plumes that contained higher concentrations of stormwater near Ballona Creek.	Lower flows, more mixing, and discharges from adjacent canyons resulted in more complex and ill-defined plume boundaries near Malibu Creek.
Debris	Floating debris was often concentrated near the margins of the plume and contained many items of man-made origin, such as plastic.	Floating debris was dominated by organic materials of natural origin, such as twigs and charred wood.
Water Clarity	Less mixing of stormwater usually produced larger areas of reduced water clarity.	Stormwater inputs were often more turbid, but lower flows and greater dilution near the mouth resulted in better clarity.
Stormwater Toxicity	Samples from the creek were always toxic to sea urchins. Concentrations higher than 10% stormwater usually produced adverse effects in laboratory tests.	Samples were less toxic than Ballona Creek stormwater and occasionally nontoxic. High concentrations (>25%) usually needed to produce toxicity.

Characteristics of a highly urbanized watershed (Ballona Creek) and a less urbanized watershed (Malibu Creek) adjacent to Santa Monica Bay, California.

TABLE 3 Continued

	Ballona Creek	Malibu Creek
Receiving Water Toxicity	Surface water in most concentrated portion of plume was often toxic to sea urchins. Toxicity was detected in receiving waters up to 2 miles from discharge.	Toxicity in water column was rarely present and was not related to plume concentration.
Cause of Toxicity	Zinc is responsible for a portion of the stormwater toxicity. The influence of pesticides and other organics is uncertain.	Metals are implicated but have not been confirmed as important toxicants.
Seafloor Habitat	Sediments were higher in urban stormwater associated contaminants, such as lead and zinc.	Higher concentrations of constituents were derived from natural sources, such as fine sediments and organic carbon.
Sediment Toxicity	Changes in sediment toxicity were minor and not related to stormwater discharges.	
Seafloor Biological Communities	Biological communities were similar among Malibu Creek, Ballona Creek, and background reference sites.	

R0073166

RECOMMENDATIONS FOR FUTURE STUDIES

The Santa Monica Bay Receiving Waters Study produced the first integrated assessment of impacts from stormwater discharges into the Bay. The presence of well-developed plumes containing toxic materials demonstrates the need for continued studies of the impacts from urban stormwater runoff in Santa Monica Bay and elsewhere. Additional information regarding the sources, characteristics, and extent of the receiving water impacts should be determined in order to refine management actions.

A high priority should be placed upon locating sources of toxicity and contamination within the Ballona Creek watershed. Identification of the land uses or regions of the watershed that contribute most to the impacts will enable management actions to be targeted where they will have the greatest beneficial impact. Source identification studies should include sampling of systems tributary to Ballona Creek for measurement of toxicity and chemical constituents.

Additional receiving water studies are recommended for Santa Monica Bay to provide a more complete understanding of the nature and magnitude of stormwater impacts. Future studies should include constituents of concern that were not emphasized in this study, such as bacteria, nutrients, pesticides, and trash. These constituents should be incorporated into studies of plume persistence, cause of toxicity, and constituent fate.

Information on the duration, size, and cause of adverse impacts is needed to identify appropriate stormwater management actions.

Plume persistence information is needed to estimate the duration of exposure of: 1) swimmers to bacteria and 2) marine life to stormwater toxicants and nutrients. Improved information on plume persistence can be obtained by the use of moored sensors in the discharge area in combination with data from remote sensing instruments (e.g., satellites). A goal of these studies should be to develop plume dilution and/or tracking models of plume duration and magnitude. This information is valuable because different management responses may be appropriate for stormwater discharges that produce short- versus long-lived impacts.

Toxicity testing using multiple marine species is also needed to provide a more complete assessment of the causes of toxicity in stormwater discharged into Santa Monica Bay. Identification of zinc and copper as contaminants of concern was based primarily on studies with a single species (sea urchin). Because different species vary in their sensitivity to contaminants, tests with multiple species are needed to determine if other contaminants are present at toxic concentrations. Tests with crustaceans (e.g., shrimp) are especially recommended as they are likely to be sensitive to pesticides such as diazinon and chlorpyrifos, which have been found to be important factors in the toxicity of stormwater from other watersheds. These tests should include toxicity identification procedures so that potential constituents of

A suite of species should be used to identify toxicants in stormwater.

R0073167

concern (e.g., metals and pesticides) can be confirmed and others can be discounted. Toxicant identification is needed to prioritize chemical-specific management actions.

The fate of stormwater particles must be determined in order to assess seafloor impacts.

Chemical and oceanographic studies are needed to determine the fate of stormwater particles discharged into Santa Monica Bay. Although some of the particles in Santa Monica Bay stormwater plumes may be deposited near the mouth of an urban watershed, they do not necessarily persist there for long periods of time. Since the spatial extent of particle dispersal in Santa Monica Bay was not determined, there may be areas of significant accumulation that were not investigated. Studies of currents, sediment resuspension, and sediment transport, coupled with chemical source identification methods, should be conducted to determine whether stormwater discharge is a significant source of adverse sediment contamination within Santa Monica Bay. This information is needed to identify areas of the seafloor with the greatest potential for biological impacts from stormwater discharge.

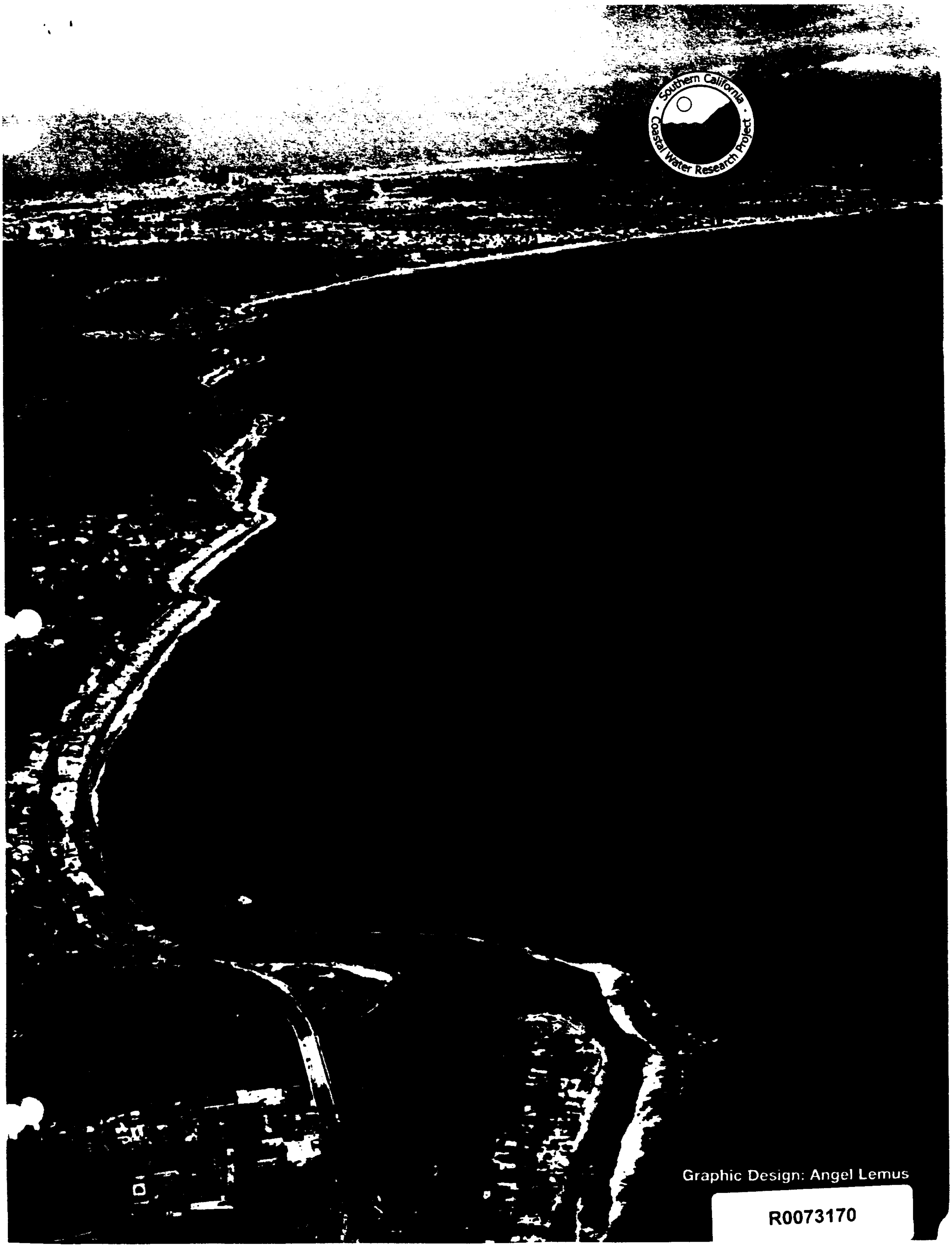
Additional receiving water systems should be studied to identify impairments from other watersheds.

The impacts of stormwater runoff on other receiving water systems should also be studied. This is because differences in watershed size and land use patterns will likely result in different levels of risk to the receiving water beneficial uses. For example, changes in land use may contribute different toxicants, and changes in watershed size will influence the magnitude of the toxicant input. The nature of the receiving water environment is also important. Semi-enclosed water bodies, such as most bays and harbors, do not have the mixing and dilution capacity of the open coastal environment studied in Santa Monica Bay. The potential for impairment will be greater in these areas because organisms will have an increased exposure to the stormwater plume and more stormwater particles will settle nearby and influence sediment quality. Until the effects of variations in watershed or receiving water characteristics can be accurately predicted, additional integrated studies will be necessary to assess impacts to receiving waters in other areas.

Published by the Sea Grant Program, Wrigley Institute for Environmental Studies, University of Southern California, Los Angeles, California. November 1,1999. (USCSG-TR-02-99)

Copies are available from:
USC Sea Grant Program
Los Angeles, CA 90089-0373
213-740-1961 • fax 213-740-5936
email: seagrant@usc.edu
http://www/usc.edu/go/seagrant

The National Sea Grant Program is a network of 29 university-based programs in coastal and Great Lakes states involving more than 300 institutions nationwide in research, education and the transfer of technology regarding coastal, marine and Great Lakes issues. Sea Grant is supported by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), in partnership with the states and private industry.



Graphic Design: Angel Lemus

For Immediate Release

Contact: Barbara Gula, ITV
(561) 997-5433

"STORMWATER MANAGEMENT: Pointless Pollution"
Techno 2100 **TV Special to Air on February 26**

Boca Raton, FL – Stormwater discharges are the largest contributor of pollutants to the nation's lakes, rivers and estuaries. Many of these nonpoint pollutants are generated by the everyday activities of all the people who live, work, play, or travel through a watershed.

Sediments, nutrients, oxygen-demanding substances, metals, oil and grease are examples of the types of pollution found in urban stormwater. Where do they come from? Construction sites, golf courses, parking lots...all common within our cities. These stormwater pollutants destroy habitats, make our drinking water unsafe, and cause severe environmental and health problems. What can we do to help control these types of pollutants?

Two back to back 30-minute episodes of the award-winning TV series TECHNO 2100 will explore **Stormwater Management: Issues & Answers**. Co-host Eric Livingston of the Florida Department of Environmental Protection details stormwater pollution issues and focuses on structural and nonstructural "Best Management Practices." These practices are being implemented to reduce or prevent these sources of non-point pollution. The program will also feature new technologies, programs and strategies being used to retrofit presently developed lands.

Stormwater Management: Issues & Answers is produced by Information Television Network with special thanks to: Virginia Dept. of Conservation and Recreation; Maryland Dept. of the Environment; Florida Dept. of Environmental Protection; Illinois Environmental Protection Agency; California State Water Resources Control Board; Louisiana Dept. of Environmental Quality; Wisconsin Dept. of Natural Resources; DNREC Soil and Water Conservation (Delaware); National Association of Counties Organization (NACO); U. S. Environmental Protection Agency (EPA); and the Association of State and Interstate Water Pollution Control Administrators.

Stormwater Management: Issues & Answers is scheduled to air on Saturday, February 26, from 1-2 PM Eastern, 12 noon-1 PM Central, 11 AM – 12 noon Mountain and 10-11 AM Pacific time on CNBC as paid programming. For additional information, please call 1-888-380-6500. The show will also be streamed on the Internet at ITV's website: www.itvisus.com.

###

State of California

Memorandum

To : Archie Matthews
Division of Water Quality

Date: FEB 11 1993

RECEIVED
00 MAY 31 AM 10: 13
CALIFORNIA REGIONAL WATER
QUALITY CONTROL BOARD
LOS ANGELES REGION

Elizabeth M. Jennings

From : Elizabeth Miller Jennings
Senior Staff Counsel
OFFICE OF THE CHIEF COUNSEL
STATE WATER RESOURCES CONTROL BOARD
901 P Street, Sacramento, CA 95814
Mail Code: G-8

Subject: DEFINITION OF "MAXIMUM EXTENT PRACTICABLE"

ISSUE

What is the meaning of the standard "maximum extent practicable" (MEP) as used in the Clean Water Act's storm water provisions, and how can this standard be communicated to the regulated community? How can this concept be included in the draft BMP manual?

CONCLUSION

The standard "maximum extent practicable" is not specifically defined for use in the storm water program. It has been defined in other rules, however, to require taking all actions which are technically feasible. I have included draft language for the manual.

DISCUSSION

Section 402(p) of the Clean Water Act (33 U.S.C. § 1342(p)) provides that permits issued for discharges from municipal separate storm sewers must require controls to reduce the discharge of pollutants "to the maximum extent practicable". The statutory language provides that municipal permits:

> "Shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other

R0073172

> provisions as the [EPA] Administrator or the State determines appropriate for the control of such pollutants." Clean Water Act Section 402(p)(3)(B)(iii); 33 U.S.C. § 1342(p)(3)(B)(iii).

Neither Congress nor the U.S. Environmental Protection Agency (EPA) has defined the term "maximum extent practicable", and yet this is the critical standard which municipal dischargers must attain in order to comply with their permits. (The State could have spelled out the specific controls which the municipalities were required to undertake. However, such an approach would have relinquished the municipal dischargers of any flexibility in implementing their storm water programs.)

On its face, it is possible to discern some outline of the intent of Congress in establishing the MEP standard. First, the requirement is to reduce the discharge of pollutants, rather than totally prohibit such discharge. Presumably, the reason for this standard (and the difference from the more stringent standard applied to industrial dischargers in Section 402(p)(3)(A)), is the knowledge that it is not possible for municipal dischargers to prevent the discharge of all pollutants in storm water. The second point which is clearly encompassed in the standard is that it is the permitting agency, and not the discharger, which is the ultimate arbiter on whether there has been sufficient reduction of pollutants.

The most difficult issue is determining how much pollutants must be reduced, or, in other words, which best management practices (BMPs) must be employed in order to comply with the MEP standard. While the term is not defined in the Clean Water Act or the EPA regulations, the same term does appear in other federal laws and regulations, and there are some definitions or interpretations which may be useful to the storm water program.

In the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. § 7901, et seq.), the Department of Energy was required to designate within one year of the Act's adoption "to the maximum extent practicable" contaminated areas within the vicinity of uranium processing sites. In addressing a lawsuit brought after the Department designated very few of the "vicinity properties", the federal court declared that MEP means "a substantial majority of the locations" should have been designated within the year. Sierra Club v. Edwards (D.C.D.C. 1983) 19 ERC 1357. Where a NEPA regulation required that "to the maximum extent practicable" environmental clearance was required for uncompleted projects which had never undergone NEPA review, a court held that the regulation "mandates a meaningful environmental review" rather than a "perfunctory evaluation". Save the Courthouse Committee v. Lynn (S.D.N.Y. 1975) 408 F.Supp. 1323.

In an interim final regulation recently promulgated by the Department of Transportation, MEP is defined, where operators of onshore oil pipelines must have resources "to the maximum extent practicable" to remove and to mitigate or prevent worst case discharges. 49 CFR Part 194. MEP is defined to mean:

> "The limits of available technology and the practical and technical limits on an individual pipeline operator in planning the response resources required to provide the on-water recovery capability and the shoreline protection and cleanup capability to conduct response activities ...."

Finally, the term MEP is used in the Superfund legislation, wherein permanent solutions and alternative treatment technologies must be selected "to the maximum extent practicable". CERCLA, Section 121(b). The legislative history of the language indicates that the relevant factors in determining whether MEP is met include technical feasibility, cost, and state and public acceptance. 132 Cong. Rec. H 9561 (Oct. 8, 1986).

While each of the above interpretations and definitions varies, they do follow a pattern. The pattern that emerges is that there must be a serious attempt to comply, and that practical solutions may not be lightly rejected. If a municipality reviews a lengthy menu of BMPs, and chooses to select only a few of the least expensive, it is likely that MEP has not been met. On the other hand, if a municipal discharger employs all applicable BMPs except those where it can show that they are not technically feasible in the locality, or whose cost would exceed any benefit to be derived, it would have met the standard. In any case, the burden would be on the municipal discharger to show compliance.

The definitions contained in the pipeline regulation and the Superfund legislative history are most analogous to storm water regulation. The major emphasis in both of these rules are technical feasibility. Similarly, the municipal dischargers should be required to employ whatever BMPs are feasible, i.e., are likely to be effective and are not cost prohibitive. Thus, where a choice may be made between two BMPs which should provide generally comparative effectiveness, the discharger may choose the least expensive alternative and exclude the more expensive BMP. However, it would not be acceptable either to reject all BMPs which would address a pollutant source or to pick a BMP based solely on cost, which would be clearly less effective.

As you know, the BMP Guidance manual is being published by the Task Force, which is made up of dischargers, rather than by the State Water Board. As far as I know, there is no intention for the State Water Board to adopt the manual as its own guidance document. Therefore, it is important to stress in the manual, both in the section on MEP and in the front of the manual, that this manual is not a publication of the State or the Regional Water Boards, and that these Boards have not specifically endorsed the contents. Rather, the manual was assembled by a group of dischargers in the interest of assisting themselves and others to comply with the storm water permits. In the section on MEP, it should be stated that the final determination regarding whether a discharger was reduced pollutants to the maximum extent practicable can only be made by the Regional or State Water Boards, but that selection and implementation of BMPs through consideration of the listed factors should assist dischargers in achieving compliance.

The following language is suggested in order to clarify that the manual is not the product of the State Water Board:

> "This Manual was produced and published by the Storm Water Task Force, an advisory body of municipal agencies regulated by the storm water program. This Manual is not a publication of the State Water Resources Control Board or any Regional Water Quality Control Board, and none of these Boards has specifically endorsed the contents thereof. The purpose of this manual is to assist the members of the Task Force and other dischargers subject to storm water permits, in attaining compliance with such permits."

The following language is recommended in place of Insert A in the manual for municipal dischargers:

> "Although MEP is not defined by the federal regulations, use of this manual in selecting BMPs should assist municipalities in achieving MEP. In selecting BMPs which will achieve MEP, it is important to remember that municipalities will be responsible to reduce the discharge of pollutants in storm water <u>to the maximum extent practicable</u>. This means choosing effective BMPs, and rejecting applicable BMPs only where other effective BMPs will serve the same purpose, the BMPs would not be technically feasible, or the cost would be prohibitive. The following factors may be useful to consider:
>
> "1. Effectiveness: Will the BMP address a pollutant of concern?

"2. Regulatory Compliance: Is the BMP in compliance with storm water regulations as well as other environmental regulations?

"3. Public acceptance: Does the BMP have public support?

"4. Cost: Will the cost of implementing the BMP have a reasonable relationship to the pollution control benefits to be achieved?

"5. Technical Feasibility: Is the BMP technically feasible considering soils, geography, water resources, etc.?

"After selecting a menu of BMPs, it is of course the responsibility of the discharger to insure that all BMPs are implemented."

RUTAN & TUCKER, LLP
ATTORNEYS AT LAW
A PARTNERSHIP INCLUDING PROFESSIONAL CORPORATIONS
611 ANTON BOULEVARD, FOURTEENTH FLOOR
COSTA MESA, CALIFORNIA 92626-1998
DIRECT ALL MAIL TO: POST OFFICE BOX 1950
COSTA MESA, CALIFORNIA 92628-1950
TELEPHONE 714-641-5100 FACSIMILE 714-546-9035
INTERNET ADDRESS www.rutan.com

Direct Dial: (714) 662-4642
E-mail: rmontevideo@rutan.com

May 23, 2000

VIA CERTIFIED MAIL, RETURN RECEIPT REQUESTED AND FIRST CLASS U.S. MAIL

Mr. Dennis Dickerson
Executive Officer
Los Angeles Regional
Water Quality Board
320 W. 4th Street, Suite 200
Los Angeles, California 90013

Re: Failure of Executive Officer to Respond to Notice of Intent to Implement Permittees' August, 1999 SUSMP--Order No. 96-054, Part 2.I.G.1.A

Dear Mr. Dickerson:

On May 5, 2000, I informed you of the Cities of Bellflower, Bell Gardens, Burbank, Cerritos, Commerce, Compton, Diamond Bar, Downey, Hawaiian Gardens, Huntington Park, Industry, Irwindale, La Canada-Flintridge, La Mirada, La Verne, Lakewood, Lawndale, Monrovia, Montebello, Palos Verdes Estates, Paramount, Pico Rivera, Pomona, Rancho Palos Verdes, Rosemead, San Gabriel, Santa Fe Springs, Signal Hill, South Gate, Vernon, Walnut, and Whittier ("Cities") intent to implement the Standard Urban Storm Water Mitigation Plan submitted to you on behalf of the Permittees in August of 1999. I further notified you that because of your office's failure to take action on this SUSMP within 120 days of its submittal, as required by the Administrative Review Process under Order No. 96-054, that the Cities herein intended to move forward with this SUSMP. As of this date, more than ten (10) days has now elapsed since the May 5 Notice, without a response from the Executive Officer to this Notice.

Accordingly, in accordance with the Administrative Review Process under Order No. 96-054, and given your failure to respond to our Notice of Intent to implement this August, 1999 SUSMP Program within the requisite ten (10) day period, the Cities herein must now be permitted to proceed and implement their August, 1999 SUSMP Program ***without*** modification by the Executive Officer.

If you have any questions with respect to the above, or need any additional information in connection with this matter, please do not hesitate to contact the undersigned. Thank you for your attention to this matter.

Respectfully submitted,

RUTAN & TUCKER, LLP

Richard Montevideo
Counsel for City Petitioners

RM/jb

cc: City Petitioners

MARYLAND DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway ● Baltimore, Maryland 21224
(410) 631-3000

May 31, 2000

Ms. Elizabeth M. Jennings, Esq.
Office of Chief Counsel
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

And,

Mr. Xavier Swamikannu
Storm Water Program
California Regional Water Quality Control Board – LA Region
320 W. 4th Street, Suite 200
Los Angeles, CA 90013

Dear Ms. Jennings and Mr. Swamikannu:

Enclosed are several items that may help you understand the goals attributed to Maryland's stormwater management program. The Maryland Department of the Environment is nearing 20 years worth of experience in administering an urban runoff program. Some basic tenets of the program and the successes and failures are described in the three reports provided.

Additionally, a brief background summary is provided in order to explain the transition we are making from current requirements to those proposed in the "2000 Maryland Stormwater Design Manual." This summary also helped to better answer the design and performance standards questions that you posed regarding stormwater management in our State. We hope this material will be of some use to you.

If you have any questions or need any more information, please call me at 410-631-3543.

Sincerely,

Brian S. Clevenger
Water Management Administration

w\Enclosures

R0073179

MARYLAND'S STORMWATER MANAGEMENT PROGRAM SUMMARY

Introduction

The State of Maryland has recently completed the development of the "*2000 Maryland Stormwater Design Manual*" (Manual). This document took nearly 5 years to compose and is intended to improve the State's stormwater management program that has been in existence since 1982. The Maryland Department of the Environment, Water Management Administration (MDE/WMA) provides here a synopsis of Maryland's program's evolution over the last 18 years. This summary will provide the perspective needed to answer questions regarding programmatic goals, performance standards, and strengths and weaknesses. Apologies for the lack of brevity.

Background

Maryland's stormwater management program was a logical progression from its erosion and sediment control efforts. The Attorney General of the State declared "sediment" a pollutant in 1969. The next year a statute was passed that required sediment control practices to be implemented for any earth disturbing activities over 5,000 square feet. Maryland's erosion and sediment control program was implemented statewide by local government beginning in 1970.

The next step from controlling runoff from grading and construction would obviously be controlling runoff after development has been completed. This progression then, is stormwater management. Recognizing that urban runoff was a contributing factor to water quality degradation, the Maryland legislature passed the Stormwater Management Act in 1982. This law, and commensurate regulations adopted the following year, sought to ensure that pre-development runoff characteristics were maintained after development.

During the mid 1980s when Maryland's program was first conceived and implemented, the prevailing attitude was that if peak discharge increases caused by urbanization were controlled, the receiving waters would be protected from excess volume, increased velocities, channel erosion, sedimentation, flooding, etc. Therefore, Maryland's program was, and is currently, based on this flood control perspective. Current State regulations require that all new development project designs include provisions for reducing peak discharge increases for the 2 and 10 year frequency storm events back to pre-development conditions. Clearly, this requires a best management practice (BMP) approach and typically, the BMP of choice is a pond.

Because of the prevailing attitudes regarding how best to control stormwater (e.g., flood management), very little specific design criteria were included in Maryland's stormwater management program. The approach taken, and the one we work under currently, was a "preferred practices" list. State regulations require that infiltration be considered first and, if not feasible, the designer would then progress through a list of BMPs each with lesser water quality efficiency than the one previous. In latter years, rules-of-thumb for water quality design were implemented sporadically throughout the State (e.g., one half inch times total site imperviousness). However, Maryland still operates under its original design criteria (e.g., 2 and 10 year management and the preferred practices list).

Chesapeake Bay Protection and Environmental Awareness

Given the above historical explanation, several points need to be made that will provide other factors affecting program implementation and help explain why a major change of philosophy has been contemplated with the Manual. First, it cannot be overemphasized how much Chesapeake Bay restoration efforts play on bringing to the forefront environmental concerns, especially those related to water quality. Chesapeake Bay garners much attention in the State, region, and, arguably, the world for protection and restoration. This was the case in 1983 when the Six Bay states and Washington, D.C signed the original "Chesapeake Bay Agreement." Therefore, the protection of this valuable resource was very much a factor for implementing an urban runoff program.

Another factor contributing to Maryland's stormwater management program development was the groundswell of environmental awareness caused primarily by nutrient enrichment of the Chesapeake Bay. Nutrient reduction goals, wetland protection, and sediment control all served as catalysts for grass roots organizations to bring to light the importance of environmental issues. This public and sometimes political support cannot be overlooked.

Technical Program Improvements Needed

Finally, because of over 12 years of program oversight and experience, changes with our program were clearly needed in the mid 1990s. Some issues have been mentioned above (e.g., no specific water quality design standards; too much flood control emphasis). However, explaining a couple of technical issues related to our program will address questions regarding stormwater management program goals and specific issues such as redevelopment.

As originally conceived, the State program makes no mention of where new development takes place. Nor does it specify what land use types are affected. If 5,000 square feet of earth is disturbed with new development, you must address stormwater runoff. This would presumably include redevelopment or in-fill situations. However, as with most regulatory programs, Maryland's stormwater regulations contain exemptions and allow for waivers provided certain conditions are met. Since 1982, certain projects have been waived depending on hydrological circumstances. Three major waiver categories have been allowed and these demonstrate the flood management program emphasis on which the program was founded. These categories are:

1) Less than a ten percent increase in the pre-development 2 year storm event,
2) Direct discharges to tidewater, and
3) Projects completely surrounded by an existing storm drain system of sufficient capacity to convey the increase in discharge caused by the new development.

The emphasis on peak management and flood control is quite obvious. It was MDE's want to change this emphasis when regulatory changes were proposed and the Manual was conceived in

1995. Beginning with the Manual's composition, the issue of stormwater control for redevelopment projects was debated vigorously.

The above waiver provisions that local jurisdictions applied to certain "new development" caused most redevelopment and in-fill work to avoid BMP implementation. A fast food restaurant built in the corner of a shopping mall parking lot would surely not change hydrologic characteristics, especially peak discharge. Additionally, this and similar urban "redevelopment" would most likely be surrounded by an existing storm drain system of adequate capacity. Therefore, most redevelopment is waived under Maryland's original and current stormwater regulations. This was an additional reason why MDE felt improvements were warranted.

Summary

Under increased environmental awareness caused by Chesapeake Bay protection concerns, Maryland instituted a stormwater management program that emphasized peak flood management for new development projects disturbing 5,000 square feet of earth. Relatively little specific water quality control design criteria were included in original regulations as a "preferred practices" list was used. With an obvious flood control emphasis, most redevelopment projects were waived because pre-development hydrologic conditions remained after construction completion.

With over 12 years of program implementation experience, a recognition that improved water quality management was needed, and a need to eliminate many waivers of stormwater management requirements for such things as redevelopment, MDE developed the "*2000 Maryland Stormwater Design Manual.*" This document, along with major regulatory modifications, is intended to address many of Maryland's stormwater management program weaknesses. When adopted later this year, major improvement to controlling urban runoff is expected.

POLICY STATEMENT ON CONTROLS AND REQUIREMENTS FOR NEW DEVELOPMENT AND REDEVELOPMENT IN THE STATE OF MARYLAND

i) Why did your state elect to have requirements on new development and redevelopment?

In 1982, restoration and protection of Chesapeake Bay was one of the most important factors contributing to the development of Maryland's stormwater management program. Heightened environmental awareness and a recognition that urban runoff contributed to water quality degradation combined to produce a program that emphasized peak flood control. Because of this emphasis on peak management, typical redevelopment projects were often waived from stormwater controls.

To address various program shortcomings, MDE development the "*2000 Maryland Stormwater Design Manual*" (Manual). This document is intended to provide better water quality control, an area not specifically addressed currently. Relative to redevelopment, the choice to impose requirements was based primarily on "everyone contributes runoff, everyone ought contribute management." However, a balance between management contributions for environmental purposes, and, practical requirements that make economic sense must be struck. Everyone should contribute management. However, conventional BMPs (e.g., ponds) are not feasible in major metropolitan areas where land values prevent typical management strategies. Flexibility is key.

ii) Does your state have design standards and performance standards for treatment control BMPs for new development/redevelopment?

Currently, there are no performance standards for BMPs only design standards. Maryland requires that BMPs be designed to maintain pre-development peak discharges for the 2 and 10 year storm events in most of the State.

Maryland's proposed Manual contains both design standards and performance standards. A suite of design volumes has been developed to address recharge (Re_v), water quality (WQ_v), channel protection (Cp_v), and overbank flood protection (Q_p). All of these volumes need to be included in new development designs. Additionally, BMP performance standards are implicit in Maryland's proposed Manual. Based on pollutant removal efficiency studies, all BMPs in the Manual have been equated in terms of efficiency. If a BMP is designed according to the criteria specified in the Manual, an 80% total suspended solids (TSS) and a 40% total phosphorus (P) reduction will both be realized. In fact, this 80:40 criteria is used to judge whether new technology is allowed to be used to address the required suite of volumes above. If the proverbial "new mousetrap" can meet 80% TSS and 40% P removal, it can be used as a stand alone BMP.

iii) Do you have thresholds for new development and or redevelopment (impervious area; size; etc.) for requirements to apply?

If a project disturbs 5,000 square feet of earth in Maryland, the site design must address stormwater management.

iv) What development categories do the requirements apply to [i.e. commercial; parking lots; residential, etc.]?

There are no specific development categories. If you disturb 5,000 square feet with any new development, you automatically are included. State regulations, however, do "exempt" agricultural land management activities.

v) How long have such requirements been in place? Are they statewide or region specific?

Stormwater management has been on the books since 1982. This is a statewide program that does have design variations based on hydrologic areas of the State (e.g., no 10 year management requirements in the Coastal Plain on our "Eastern Shore."

vi) Have the design standards and performance standards unduly burdened cities and builders with unsupportable costs? Has compliance been difficult? Has change been for the better or have you seen none? Any noticeable improvements in water quality?

All of these questions have been, are, and will not doubt continue to be debated. Volumes could be written to explain perspectives for burdens, costs, compliance, or noticeable improvements. To avoid this, some very random thoughts about these issues.

Generally, the answer to all of these questions could be "it depends on whom you ask" or "it depends on where you ask it." Maryland has three distinct geographic areas. These are a "Western" section; a central, "Urban" area; and our "Eastern Shore." The Urban area houses most of the State's population; can be defined in terms of the corridor between Washington, D.C., Baltimore, and toward Philadelphia, PA; and, not coincidentally, contains the most sophisticated stormwater programs in our State. It is not uncommon for a central Maryland county to have 8 or 10 plan reviewers and as many field staff dedicated solely to stormwater functions. The burden on these places currently is minimal.

As you travel west or east from this Urban region, the stormwater programs locally tend to become more burdensome. There is less sophistication technically, less resources, and obviously less compliance. In Western Maryland and on our Eastern Shore, localities may only have a single staff person to perform both review and inspection. The burden associated with changing to the proposed Manual in these regions will increase dramatically. However, again, it depends on whom you ask.

Environmental groups have told us we are not doing enough and have actually demanded "zero discharge" from new development. Developers and builders believe we are making them do too much now and are severely questioning our proposed changes and the Manual requirements. Frankly, and with tongue only partially in cheek, we believe we are close to where we need to be with the Manual because we have aggravated an equal number of people on both sides of this regulatory fence.

Some really random thoughts:

- In the beginning of the program (circa 1982), the design standards were very burdensome. Localities had to hire staff and purchase vehicles and equipment. Developers endured the added cost of BMP construction.
- Currently, stormwater management on both sides is a routine part of the development process.
- Compliance varies with the level of resources and the distance from Urban Maryland as described above. One difficulty we do have is the interpretation of the same requirement differently from locality to locality.
- We have seen only modest water quality improvement. This is expected to change dramatically with our Manual.

vii) Typically, what is your estimate of the range in additional cost (in percent of project cost) that the requirements have imposed on builders?

Obviously, this depends on that real estate saying "location, location, location." However, currently, stormwater management for 2 and 10 year control ranges from 0% to 20%. We have proposed to make optional the control of the 10 year storm. Because "lots are money" and "more stormwater means less lots," costs are anticipated to decrease about 20% of current costs without 10 year management. Costs will increase commensurately with 10 year management under the Manual.

viii) How have municipalities ensured that the post construction BMPs O & M has been provided and/or BMPs are properly maintained?

Operation and Maintenance Agreements are required as a condition of plan approval and permit issuance. Localities are required by State regulation to inspect and cause to be maintained BMPs every three years. Some jurisdictions assume ownership of BMPs. This is best for ensuring future maintenance. Other localities require private ownership, which makes it difficult for requiring maintenance due to the limited resources of entities such as homeowners' associations.

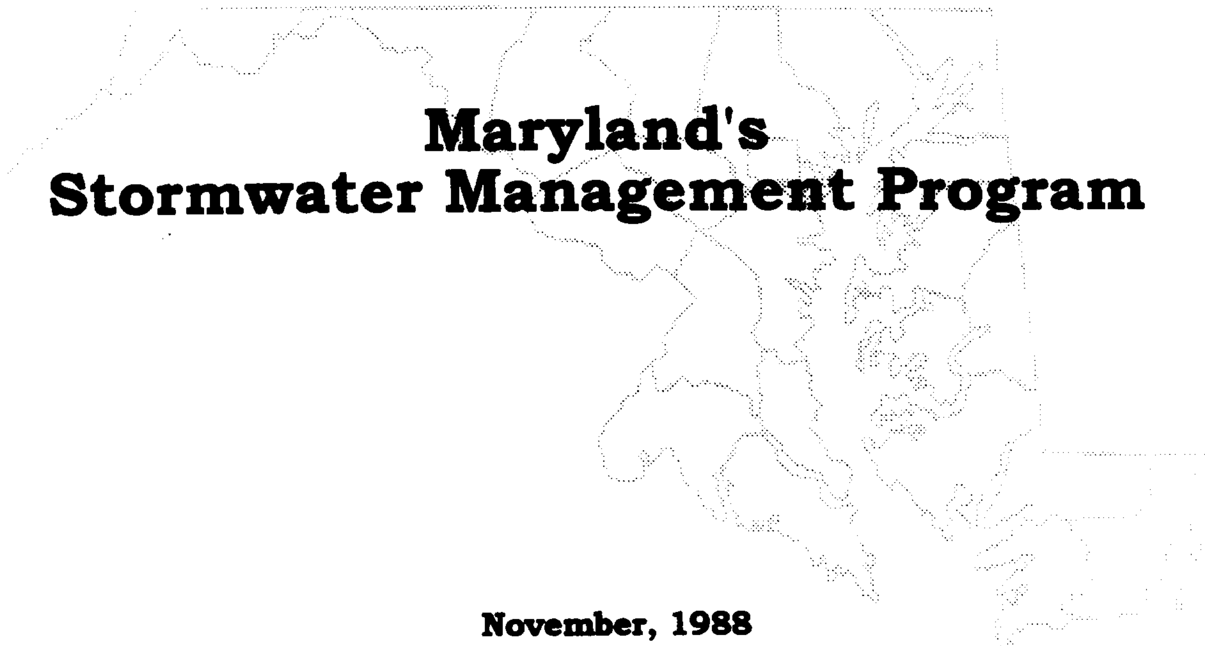
ix) What are the policy goals that the standards are intended to achieve (reverse impairment; hold the line; etc.)?

Basically, the best way to describe our proposed program's goal is to minimize damage caused by urban runoff. For us, this boils down to basic hydrology. When you change natural conditions to developed conditions, bad things happen to water quality. We also know that all soils have some recharge value, sustained bankfull discharges create severe channel erosion, and minimizing impervious surfaces is the best way to mimic pre-development hydrology. Therefore, we are hoping to change how development occurs. Hopefully, we can incorporate water management early in the site design process rather than having a BMP placed at the bottom discharge point of a site as an afterthought.

Individual volume goals and design criteria:

1) Recharge (Re_v) – mimic existing annual groundwater recharge rates.
2) Water quality volume (WQ_v) – 80% TSS removal (a Coastal Zone Management Act requirement), 40% P removal (a Chesapeake Bay Program goal), and treatment of 90% of the average annual rainfall.
3) Channel protection volume (Cp_v) – the 2 year storm control policy has actually created more channel erosion in some cases. This method sustains bankfull discharges over a longer period of time. Therefore, more frequent storm event control is essential. We are choosing the 1 year storm using extended detention. This is delaying the 1 year storm's inflow hydrograph by 24 hours.
4) Overbank flood protection (Q_p) – 10 year storm control is optional provided no additional downstream flooding occurs.

5) Redevelopment – the goal is to reduce by 20% the total site imperviousness. If not feasible, BMPs elsewhere in the watershed, stream restoration, fees paid are all acceptable but subject to local approval.



Maryland's Stormwater Management Program

November, 1988

Prepared By:
Robert L. Kort

MDE

Maryland Department of the Environment
Water Management Administration

2500 Broening Highway
Baltimore, Maryland 21224

The Sediment and Stormwater Administration (SSA) was incorporated into the Water Management Administration (WMA) in October, 1992. For additional information concerning this publication, please contact WMA (410) 631-3543.

MARYLAND'S STORMWATER MANAGEMENT PROGRAM

Robert L. Kort[1]

ABSTRACT

The adverse impacts of urbanization have contributed to a decline in the water quality of some of Maryland's streams and rivers, and the Chesapeake Bay. One of the state of Maryland's initiatives in response to this was the creation of a statewide stormwater management (SWM) program in 1982. This multipurpose program addresses a full range of hydrologic consequences and not just traditional runoff peak control. The Maryland Department of the Environment administers the program and is responsible for program implementation, plan review and approval, grants administration, education and training, and inspection and enforcement. Local jurisdictions administer their own programs that must meet minimum State standards. Water quality measures to enhance pollutant removal are emphasized. Practices used for the treatment of stormwater include infiltration structures, shallow marsh creation, extended detention basins, and water quality inlets. Retrofitting of existing SWM structures is done to enhance pollutant removal. Maryland's erosion and sediment control program is a key part of management efforts. Research and monitoring are conducted, and the use of innovative practices is encouraged.

INTRODUCTION

Urbanization generates detrimental changes to the hydrologic equilibrium of the land surface and the receiving fluvial estuarine environments. These changes include: increases in peak flow and total volume of stormwater runoff; accelerated stream channel erosion; decreases in low flow volumes in receiving streams; and decreases in water quality and the stream environment.

Efforts to control these conditions in the state of Maryland have resulted in statewide programs for erosion and sediment control, stormwater management (SWM), and flood plain management. Impetus for the control of runoff from new developments came from pressure by environmental groups because of the declining water quality of some of the state's streams and rivers, and the Chesapeake Bay; and the U.S. Environmental Protection Agency report on the Bay. The report documented the declining water quality of the Bay and identified urban stormwater as one of the causes. Nutrients, sediments, toxics, and other pollutants from surface runoff entering the Bay are not readily flushed out into the ocean but accumulate within the Bay.

Prior to a statewide program, stormwater management efforts in Maryland had focused on the control of increased peak flows and were not universally implemented. Water quality as well as quantity control implemented on a statewide basis had to be addressed if the program was to protect and improve the quality of surface waters in Maryland. The State's multipurpose program was designed to address the full range of hydrologic consequences resulting from urban development, and reduce the adverse effects of stormwater runoff. Erosion and sediment control is a key part of management efforts - runoff during construction is often greater than after site stabilization.

LAWS AND REGULATIONS

Legislation creating a statewide stormwater management (SWM) program in Maryland was enacted in 1982. It required each county and municipality to adopt a stormwater management program by July, 1984 subject to minimum criteria established in Regulations promulgated in July, 1983. For the first time in Maryland, water quality protection became a major component of all stormwater programs. Highlights of the act include:

1. Providing for an approved SWM plan for residential, commercial, industrial, or institutional land development. Agricultural land is exempt from these requirements;

----

[1] Water Resources Engineer, Maryland Department of the Environment, Sediment & Stormwater Administration, 2500 Broening Highway, Baltimore, MD 21224

2. Permitting each county and municipality to adopt a fee system to cover the cost of SWM plan review and program implementation;

3. Requiring the State to review the local SWM programs at least once every 3 years;

4. Providing for civil and criminal penalties for violations of the SWM Law;

5. Requiring the State to provide technical assistance, training, research, and coordination in SWM technology to the local governments;

6. Requiring that Rules and Regulations be adopted, and outlining the items to be addressed by these;

Rules and Regulations established criteria and procedures for SWM in Maryland to ensure effective implementation of the local programs as well as the State program. The Regulations contained:

1. Responsibilities of the State for implementation and supervision of the SWM program.

2. The minimum content of the local county and municipal SWM ordinances;

3. Exemptions from the provisions of the regulations;

4. Allowance for waiver provisions in local ordinances for individual developments;

5. Minimum control requirements based on the hydrologic characteristics and SWM needs of different parts of the state;

6. A preferential list of SWM measures plus design criteria that must be used in developing a SWM plan;

7. Requirements for proper construction inspection of SWM facilities;

8. Provisions for periodic inspection and maintenance of stormwater facilities.

The Regulations were not universally accepted throughout Maryland, especially in the nine counties with existing programs (Maryland has 23 counties) and some municipalities for which SWM programs also existed. There was some resentment by local governments to the State redirecting the local programs. Change was not always easily accepted. One newspaper article from a county with no SWM program told how "the County Commissioner's room shook under the specter of a monster... Armageddon? No. Stormwater Management Regulations." It then related how the requirements "...could put an end to life as we know it." Nine public hearings were held throughout the state and there was considerable consultation with the local jurisdictions.

An amendment to the SWM law was enacted in the spring of 1988 that provides for the use of stormwater management practices to enhance water quality when land is redeveloped, even when the amount of impervious area does not increase. The SWM Rules and Regulations will be updated to reflect this change.

IMPLEMENTATION

The Sediment and Stormwater Administration of the Maryland Department of the Environment is responsible for administering the state's stormwater management and sediment control programs. The Administration is currently composed of three Programs: the Policy and Evaluation Program, the Construction Management Program, and the Compliance Program.

The Policy and Evaluation Program is responsible for promulgation of Rules and Regulations which establish criteria and procedures for State, county, and municipal programs. Publications are produced to provide technical guidance for local jurisdictions in the implementation of their programs. Research is conducted to refine current practices and evaluate innovative approaches initiated by the Program.

This Program administers the State's nonpoint source management program. The primary goal of the program is to implement Maryland's Chesapeake Bay Nutrient Reduction plan which calls for a 40% reduction in nutrient loadings to the Bay.

The Program oversees local stormwater management programs which are reviewed and evaluated every three years. The county or municipal stormwater management ordinance, the administrative procedures that guide implementation of the program, the plan review and approval process, the use of State funding for program implementation, and the effectiveness of inspection and enforcement procedures to correct violations are considered during the review.

Education and training opportunities are available for government agencies, consultants, developers and home builders, and environmental groups. Events include: a sediment and stormwater conference, inspectors workshops, technical assistance, presentations to groups upon request, and displays at various events.

The Construction Management Program reviews and approves sediment control and SWM plans for State and Federal construction projects to ensure compliance with SWM Regulations. Coordination occurs with inspectors from the Enforcement Division to evaluate field implementation and approve field modifications as required. In FY89 there were 400 new State and Federal projects for which over 1000 submittals were received and reviewed.

Funding is provided by the State for stormwater management retrofit projects and local SWM programs. Retrofit funds are used for the implementation of state-of-the-art best management practices and the modification of existing SWM structures in urban areas to enhance water quality benefits. Since 1984 five million dollars has been awarded under this program. Funds come from the sale of State bonds. The grant program funds plan review, inspection, and other personnel to implement the local programs. Grant funds of approximately $1.6 million per year have been authorized for the 23 counties and 9 municipalities with approved SWM programs. Funding is from the financial commitment included in Maryland's "Chesapeake Bay Initiatives" and comes from state general funds.

The Compliance Program is responsible for inspection and enforcement of sediment control and SWM for all State and Federal construction projects. It is also responsible for sediment control inspection and enforcement for some of Maryland's counties and municipalities. The Program is organized into four field regions. Periodic and unscheduled inspections of approved projects are made to ensure compliance with approved plans.

A majority of the inspector's time is spent on erosion and sediment control as opposed to SWM. Good erosion and sediment control is crucial for innovative SWM practices such as infiltration and shallow marshes - sediment can clog infiltration structures or smother young marsh plants. Stormwater responsibilities include inspection of structures during construction, coordinating field modifications to the approved plans, and responding to citizen's complaints about drainage problems due to a particular project. Twelve to fourteen thousand site inspections of approved projects are made annually.

Enforcement actions, either administrative or legal, are based on the nature, extent, and impact of the violations. Primary emphasis is given to "in the field" corrective action and follow-up. Administrative civil penalties of $1,000 per day for sediment control violations are possible. Fifteen to twenty criminal or judicial civil actions are initiated yearly. The Program is responsible for emergency response and immediate enforcement actions for violations of the Laws and Regulations.

PRACTICES

The primary goal of the Maryland SWM Program is to maintain after development, as nearly as possible, the predevelopment runoff characteristics. Achieving this goal requires that the full range of hydrologic consequences resulting from urban development be addressed. In addition to the traditional control of peak flow, consideration of flow volume reduction, stream low flow augmentation, water quality control, and ecological protection is necessary.

A preferential list of SWM Practices to be considered on each proposed development is used. Justification needs to be provided by the person developing land for rejecting each practice based on site conditions. Ranking is determined by the water quality benefits associated with each practice. A combination of successive practices may be used to achieve the applicable water quantity control requirements. Minimum control requirements are established based on the hydrologic characteristics and SWM needs of different parts of the state. Most of the state has a 2 and 10-year control requirement because stream channel erosion and flood increases are of equal concern. Only 2-year control is required for the extremely flat terrain of Maryland's Eastern Shore.

State Regulations require consideration of infiltration practices first because of the many benefits they provide to negate the adverse environmental impacts resulting from land development. Infiltration of stormwater from a site can recharge groundwater, augment low stream flows, reduce the total runoff volume, and enhance water quality. If their use for peak discharge control is not feasible due to limiting constraints, the practice can be designed to capture the first flush of runoff. The first flush is recommended to be 0.5 inches of runoff per impervious area (MDE, 1986). Capturing this volume will result in the removal of many waterborne pollutants.

"Standards and Specifications for Infiltration Practices" (MDE, 1984) were developed to provide design guidance to consultants and regulatory agencies. The document establishes minimum criteria for the design, review, approval, construction, and maintenance of infiltration practices. Practices detailed include the infiltration basin, infiltration trench, dry well, porous asphalt pavement, and vegetated swales with check dams. Feasibility tests to determine if infiltration is suitable for a specific site, and the extent to which it may be applied are included.

The use of infiltration throughout the state has proceeded in a somewhat cautious manner due to concerns and unanswered questions. Research is currently in progress to investigate the potential for ground water pollution through the entry of runoff into the soil subgrade. Premature failure of infiltration practices due to a lack of adequate runoff filtering in the design, poor construction techniques, or a lack of proper sediment control during construction has been a problem. Maintenance of these structures may be difficult to accomplish or neglected. A utility approach that would include the financing of SWM maintenance is being pursued to address this. This involves the creation of a local government enterprise that provides services of stormwater management (quantity and quality control), drainage, and flood control. It is funded by user charges based on runoff volumes or impervious area, not property taxes.

The second item on the preferential list is open vegetated swales which have a high resistance to flow, and natural depressions. These practices retard the runoff and provide some water quality benefit. Vegetative methods, when kept within erosion control design limitations, are generally preferred over structural methods. The State's intention with this preference is to encourage local jurisdictions to be more flexible in the utilization of curb and gutter.

The third item on the preferential list is stormwater retention structures or wet ponds. The benefits of retention ponds regarding water quality enhancement are well documented in the U.S. EPA Nationwide Urban Runoff Program (NURP) studies (Wash. COG, 1983). In addition to water quality benefits, retention ponds provide aesthetic and possible wildlife benefits when properly designed. They provide an excellent opportunity for creation of shallow marsh habitat. Design criteria for the creation of artificial wetlands have been prepared (MDE, 1988). The guidelines contain physical and biological requirements for constructing wetlands. Research is currently proceeding at three artificial wetlands in Maryland to monitor water quantity and quality benefits.

The last item on the preferential list is detention structures (dry ponds) which generally only provide shaving of peak discharge rates to a specified level. Detention ponds have little or no water quality benefits, which accounts for their lowly position on the State preferential list. The use of extended detention is encouraged since it allows additional time for the settling of particulate pollutants and decreases downstream erosion of the receiving stream. The State has used a criteria that requires the runoff volume generated from the one year frequency storm be released over a minimum of 24 hours. Recent research has indicated that even slower runoff release rates than currently required are preferable to adequately protect stream channels (McCuen et al, 1988). Forthcoming changes to SWM Regulations will require the use of extended detention instead of detention.

CONCLUSION

Maryland's statewide SWM program is six years old. The decline of some of the state's streams and rivers, and the Chesapeake Bay was years in the making, and it will be years before SWM and other initiatives to restore surface water quality will fully achieve that goal. What has been learned in the short term can provide guidance for those considering the implementation of a SWM program:

1. The SWM program should have a clearly defined direction and the enabling legislation and regulations should reflect this;

2. Innovation, research, and monitoring are needed for successful evolution of a program;

3. A commitment to program implementation requires adequate monetary and manpower support;

4. Erosion and sediment control should be included as an integral part of the program;

5. Inspection of SWM practices is critical to avoid failure due to improper construction;

6. Maintenance of SWM structures is critical. A funding mechanism, such as a stormwater utility, is required;

7. An education and training program is essential. A lack of understanding SWM concepts can lead to poor design, plan review, and construction;

8. Enforcement penalties for non-compliance with stormwater requirements that are extreme enough to act as a determent are necessary;

9. Implementation of "natural engineering" techniques and practices which preserve and enhance existing features of a site should be addressed;

Stormwater management is not an exact science and will continue to evolve as our knowledge and experience increases. Implementation of Maryland's program has not been a simple process... the stormwater problem is multifaceted and has to be approached that way.

LITERATURE CITED

Maryland Department of the Environment, Sediment & Stormwater Administration, 1984. Standards and Specifications for Infiltration Practices. Baltimore, MD, 179 pp.

Maryland Department of the Environment, Sediment & Stormwater Administration, 1986. Minimum Water Quality Objectives and Planning Guidelines for Infiltration Practices. Baltimore, MD, 27 pp.

Maryland Department of the Environment, Sediment & Stormwater Administration, 1987. Guidelines for Constructing Wetland Stormwater Basins. Baltimore, MD, 24 pp.

McCuen, R.H.,Moglen, G.E., Kistler, E.W., & Simpson, P.C., 1988. Policy Guidelines for Controlling Stream Channel Erosion with Detention Basins. Prepared for the Maryland Department of the Environment, Sediment & Stormwater Administration. 47 pp.

Metropolitan Washington Council of Governments, 1983. Urban Runoff in the Washington Metropolitan Area: Final Report Washington Area Urban Runoff Project. Prepared for the U.S. EPA, 168 pp.

Shaver, H.E., 1986. Infiltration as a Stormwater Management Component. In: Urban Runoff Quality - Impact and Quality Enhancement Technology, Ben Urbonas & Larry Roesner (Editors). Proceedings of an Engineering Foundation Conference, pp. 270-280.

Shaver, H.E., 1988. Institutional Stormwater Management Issues. In: Design of Urban Runoff Water Quality Controls, Larry Roesner, Ben Urbonas, and Michael Sonnen (Editors). Proceedings of an Engineering Foundation Conference, pp. 340-348.

This is an updated version of:

Kort, R.L., 1988. Maryland's Stormwater Management Program. In: Nonpoint Pollution: 1988 - Policy, Economy, Management, and Appropriate Technology, Vladimir Novotny (Editor). Proceedings of an American Water Resources Association symposium, pp. 195-201.

Rev. 2-90

Controlling Stormwater:

Some Lessons From The Maryland Experience

Prepared By:
Greg Lindsey
Molly Cannon

October, 1990

MDE

Maryland Department of the Environment
Water Management Administration
2500 Broening Highway
Baltimore, Maryland 21224

The Sediment and Stormwater Management Administration (SSA) was incorporated into the Water Management Administration (WMA) in October, 1992. For additional information concerning this publication, please contact WMA (410) 631-3543.

INTRODUCTION

The State of Maryland has implemented a number of programs designed to control nonpoint source pollution. Maryland's Stormwater Management Program is the cornerstone of efforts to control urban nonpoint source pollution and has received national and international attention. This paper provides a synopsis of State efforts to control stormwater, a review of the strengths and weaknesses of the programs, and some observations about the implications of new federal programs and regulations for Maryland programs. Lessons from the Maryland experience are summarized.

STORMWATER MANAGEMENT IN MARYLAND

The Stormwater Management Act

Programs to control urban stormwater in Maryland are a subset of a wide variety of programs aimed at controlling urban nonpoint source pollution. Related programs not reviewed here include, for example, a parallel, complementary Erosion and Sediment Control Program also administered by the Sediment and Stormwater Administration; the Department of Natural Resources' Chesapeake Bay Critical Areas Program; and the Department of the Environment's Water Quality Certification Program. Figure 1 is a timeline that includes significant events in the evolution of programs to manage stormwater in Maryland.

The Stormwater Management Act was passed by the Maryland General Assembly in 1982. The primary goal of State and local programs established by the Act is to "maintain after development, as nearly as possible, the predevelopment runoff characteristics." Regulations promulgated by the State in 1983 define this to mean, for quantity control for most of Maryland, on-site control of the 2 and 10 year storm events. In addition, for quality control, the Administration has established a list of preferred management practices. Pursuant to this list, local officials responsible for plan review are required to investigate the feasibility of infiltration of the first half inch of runoff -- the so-called first flush that contains most of the pollutants in runoff. If infiltration is not feasible, other practices may be used. These other practices, in order of preference, are vegetated swales, retention ponds, extended detention ponds, and detention facilities. The position of each practice on the list was determined primarily by its potential to provide pollutant removal. Infiltration is preferred because it offers the highest potential for reduction in pollutants such as sediment and phosphorus, has potential for groundwater recharge and maintenance of base flow, and mitigates thermal impacts. All incorporated counties and municipalities in Maryland were required to adopt ordinances, by 1984, that establish programs which, at minimum, provide these controls on every development that disturbs more than 5,000 square feet of land and significantly changes sit hydrology (waivers may be issued if the differences in pre- and post- two and ten year discharge are less than 10%).

FIGURE 1. MILESTONES IN THE EVOLUTION OF MARYLAND'S STORMWATER MANAGEMENT PROGRAM

	1982	1983	1984	1985	1986	1987	1988	1989	1990
STATE ACTIVITIES									
	MARYLAND SWM MGMT. ACT ADOPTED	MARYLAND SWM REGULATIONS PROMULGATED	COUNTY AND MUNICIPAL ORDINANCE ADOPTED		STATE REGULATQRY REVIEWS OF LOCAL STORMWATER MANAGEMENT PROGRAMS UNDERTAKEN PROGRAM GRANTS-IN-AID AWARDED.................. CAPITAL COST SHARE GRANTS AWARDED...............				
			PROGRAM GRANTS-IN-AID AUTHORIZED			CHESA-PEAKE BAY NUTRIENT REDUCTION GOALS ESTABLISHED	MD'S NUTRIENT REDUCTION PLAN PREPARED	BAYWIDE NUTRIENT REDUCTION STRATEGY ADOPTED	
			CAPITAL COST SHARE GRANTS AUTHORIZED						
FEDERAL ACTIVITIES									
						CONGRESS PASSES WATER QUALITY ACT	EPA ISSUES DRAFT NPDES REGULA-TIONS FOR STORMWATER SYSTEMS	CONGRESS ALLOCATES FUNDS FOR NONPOINT PROGRAMS	EPA AWARDS NONPOINT SOURCE GRANTS TO STATES
									FINAL NPDES REGULA-TIONS TO BE ISSUED
	1982	1983	1984	1985	1986	1987	1988	1989	1990

SWM=STORMWATER

The Act is quite broad, and those who drafted it recognized that it would significantly change the way development occurs throughout the State. The authors also recognized that the mandates of the law would push technical knowledge in the area of stormwater management and that significant assistance would have to be provided to local governments to achieve successful implementation. The Act authorized local governments to establish fee systems to cover the cost of plan review and program implementation, mandated that State regulatory officials review local programs at least triennially, required that the State conduct research and provide technical assistance and training in the application of stormwater management technology and program implementation, and provided for civil and criminal penalties for violation of the law.

In addition to establishing minimum controls and preferred practices, the 1983 regulations established state responsibilities, criteria for exemptions and waivers, and requirements for construction and maintenance inspection and enforcement. State regulatory staff responsible for program review are required to determine whether local programs are "acceptable." To be acceptable, local programs must have (1) an approved ordinance, (2) adequate administrative procedures, (3) adequate plan review, (4) acceptable construction inspection and enforcement, and (5) acceptable maintenance inspection and enforcement.

Since 1982, the Administration has worked with Maryland's 23 counties and 151 municipalities to implement local programs. Forty-seven municipalities chose to implement programs; the remaining 104 adopted resolutions that gave the County governments the authority to implement programs within their respective jurisdictions. The Administration has conducted 25 local program reviews, completed a number of research studies, and held several training conferences and workshops to assist local officials. Details concerning implementation are summarized below.

Stormwater Program Grants-in-Aid

In 1984, as part of a legislative package known as the Chesapeake Bay Initiatives, the General Assembly authorized two additional programs related to stormwater management. One of these was the Stormwater Management Grants-in-Aid Program. This program, which became effective in 1985, has allocated approximately $1.5 Million annually to local governments to assist them with implementation. Grants-in-Aid may be used to fund personnel; to apply, local governments must have an Administration-approved program. Criteria used to evaluate funding requests are not rigorous and pertain mainly to the "reasonableness" of the request. In general, this refers to whether there appears to be sufficient work to justify the proposed positions. To assist local jurisdictions in estimating manpower requirements, the Administration provides productivity guidelines to local jurisdictions. Most funds are used to pay plan review staff and inspectors; some clerical and administrative positions also are funded. The grants program is competitive; some local governments choose not to seek support. The program is not an entitlement program.

Stormwater Pollution Control Cost-Share Program

The Stormwater Pollution Control Cost-Share Program, which also was authorized in 1984 and implemented in 1985, is a grant program that provides matches of up to 75% of the cost of stormwater management retrofits -- projects to serve areas developed without stormwater management. The objectives of the Cost-Share Program are to demonstrate best management practice (BMP) pollutant removal efficiency, cost effectiveness, social acceptability, and maintenance requirements. Grants are awarded competitively; funds for the projects are raised through the sale of state bonds. In total, between 1984 and 1990, the General Assembly authorized $5 Million for capital projects.

Chesapeake Bay Agreements

In 1987, the Governors of Maryland, Virginia, and Pennsylvania, the Mayor of Washington DC, the Chairman of the Chesapeake Bay Commission, and the Administrator of the USEPA signed an agreement calling for a 40% reduction in nutrient loadings to the Chesapeake Bay. In 1988, Maryland's Nutrient Reduction Plan was completed. This Plan outlines a strategy for implementation of the nutrient reduction objectives. In general, the Plan calls for a 40% reduction in all point and nonpoint sources, including urban stormwater. To control urban runoff, three programs are identified: (1) the continuation of the existing cost share program; (2) a massive new retrofit program to be funded by stormwater utilities; and (3) a redevelopment program aimed at "explicit management of development intensity. No complete cost estimates for implementing these programs are available. Although direct construction costs for retrofits have been estimated at $71,000,000, this estimate is extremely low and does not include any ancillary costs such as planning, modeling, or design.

EPA Nonpoint Source Control Programs

In 1987 Congress passed the Water Quality Act, a comprehensive overhaul of the Clean Water Act. In Section 319, the Act required that all states develop assessment and management reports that identify and categorize sources of nonpoint pollution and outline coordinated strategies for implementation of programs to control them. The primary goal of Maryland's Assessment and Management Reports is to implement the Nutrient Reduction Plan. State officials made nutrient reduction the focus of the nonpoint source program because significant effort had been put into developing the Nutrient Reduction Plan, quantitative goals already were in place (i.e., the 40% reductions), and steps towards implementation already were underway. Maryland's Assessment and Management Reports were approved in August and December, 1989, respectively. In 1989, Congress authorized $40 Million for implementation of nonpoint source management plans, and in March, 1990, EPA awarded to Maryland a grant for FY 1990 for $447,771.

NPDES Permits for Stormwater Discharges

The 1987 Water Quality Act also directed EPA to promulgate regulations to require National Pollutant Discharge Elimination System (NPDES) Permits for stormwater discharges. It appears that numerous industries and at least five major jurisdictions in Maryland will be required to apply for permits. To receive permits, local jurisdictions must have in place, among other items, programs to control pollutants from urban runoff from both existing and new development. Final regulations are to be issued in July 1990. Like existing NPDES programs for wastewater treatment facilities and hazardous waste management operations, the program is designed to be administered by the States.

Observations

To summarize, Maryland requires by statute and regulation that local governments manage both the quantity and quality of runoff from new development; the State assists local governments in implementation with both program grants and technical assistance. The State also has established a grants program for capital projects to address pollution problems in older areas developed without stormwater controls. Since creation of these programs, the State has established an extremely ambitious objective: a 40% reduction of nitrogen and phosphorus loadings from urban runoff from existing areas. More recently, the USEPA has required that the State develop nonpoint source management plans to address urban stormwater runoff. Finally, EPA will soon begin regulating some stormwater systems and facilities. Thus, the government apparatus to manage stormwater in Maryland includes the State's regulatory program, two grant programs, and the nutrient reduction program, all of which now are overlain by two federal programs, one of which is regulatory. This may seem complicated, but readers should keep in mind that this is only a partial picture. We have not described at all, for example, the State's Erosion and Sediment Control Program, which in certain ways is more complex than the regulatory program required under the Stormwater Management Act. In addition, the Maryland's Critical Areas Law establishes special stormwater-related requirements for projects in the Critical Area (the strip of land 1000 feet wide that surrounds the high tide area of the Chesapeake Bay). The Department of Environment's Water Quality Certification Group has issued special guidance and requirements for stormwater discharges into wetlands. Though incomplete, these brief summaries provide a good snapshot of some of the major state and federal activities that impact the stormwater management component of nonpoint source management program.

IMPLEMENTATION

We provide here some results -- an overview of the status of implementation of each of the programs summarized above. We conclude this section with a subjective evaluation of progress. When possible, we make judgements of both technical progress (i.e., an assessment of progress towards objectives) and administrative performance.

The Stormwater Management Act and Implementation of Local Programs

Local jurisdictions implemented stormwater management programs in 1984 following approval of local ordinances by the Administration. In late 1984 and early 1985, the State completed a cursory review to determine whether the local jurisdictions had begun implementation. The data that were collected were used to set priorities for the first round of triennial field reviews. To date, the Administration has reviewed all the counties but one and Baltimore City (a total of 23 jurisdictions have been reviewed). None of the 47 smaller municipalities that opted to implement their own programs has been reviewed. Using the five criteria noted above, the Administration determined that 13 of the programs were acceptable; 10 were found to be unacceptable. Since the initial review, two programs have been brought into compliance and are now acceptable. Presently, according to the most recent data available, 15 of the major programs in the State are acceptable, while 8 are unacceptable (Table 1).

These findings require some interpretation. Per the regulations (COMAR 26.09.01), programs can be unacceptable if they are deficient in any of the categories. In general, programs found to be deficient had inadequate administrative procedures or documentation in files, were failing to provide adequate plan review, were issuing waivers for too many projects, or were failing to provide adequate construction inspection. Reviewers during the first round of reviews essentially ignored the issue of maintenance: the program was too new for local officials to establish a performance record in this area. While a about a third of the counties apparently are operating unacceptable programs, these data may be misleading. Many of the findings were made four to five years ago when programs were new and few data were available for evaluation. During the early reviews, programs were judged to be acceptable if all programs elements were in place; track records for performance evaluations were not available. The findings of program evaluations are summarized by year in Table 2. We conclude from these data that the Administration has become more stringent in its review of local programs. This makes sense; as local officials gain experience, it seems reasonable to expect more of them. However, given that almost a third of the programs were last reviewed in 1985 and 1986 when reviews were less rigorous, it may be that more than eight of the major jurisdictions are not operating acceptably.

Although a number of programs may be unacceptable, it is difficult to judge what this means in terms of environmental impact. For example, a finding of unacceptable for failure to provide adequate documentation in plan review files may be nothing more than a paper deficiency. On the other hand, it may be a clue that local officials are issuing waivers in situations in which stormwater management, at least quality controls, ought be required. In and of itself, issuance of a waiver may not be significant, either in terms or runoff quantity or quality. However, the cumulative effects of waiving projects are precisely those that the regulations are intended to prevent.

Several problems emerged consistently during the reviews. These include the issuance of waivers for development of agricultural land in row crops because hydrologic models show that runoff volumes will decrease following development, failure to adhere to the preference list for facilities, no construction inspections, failures to require submittal of as-built plans, no maintenance of facilities (including failure to maintain inventories), and the failure to notify homeowners' associations that responsibility for maintenance had been transferred to them. While some of these problems can and have been corrected during the review process, others will require changes in regulations.

Table 1. Most Recent Sediment and Stormwater Administration Stormwater Reviews.

County/ City	Date of Review	Finding
Allegany	2/87	Acceptable
Anne Arundel	6/89	Acceptable
Baltimore County	4/86	Acceptable
Baltimore City	4/87	Acceptable
Calvert	10/85	Acceptable
Caroline	4/87	Unacceptable
Carroll	4/86	Acceptable
Cecil	3/90	Acceptable
Charles	11/85	Acceptable
Dorchester	4/87	Acceptable
Frederick	5/89	Unacceptable
Garrett	7/97	Acceptable
Harford	8/87	Unacceptable
Howard	10/88	Unacceptable
Kent	3/87	Unacceptable
Montgomery	1/88	Acceptable
Prince George's	11/86	Acceptable
Queen Anne's	4/90	Acceptable
Somerset	9/89	Unacceptable
St. Mary's	3/86	Unacceptable
Talbot	9/89	Unacceptable
Washington	Ongoing	
Wicomico	4/86	Acceptable
Worcester	11/85	Acceptable

Current Status: 15 Acceptable (65%)
8 Unacceptable (35%)

(Note: Programs in Cecil and Anne Arundel Counties initially were found unacceptable but in rereviews were found to be acceptable.)

Table 2. Findings of Program Reviews by Year.

Year	Jurisdictions found Acceptable	Jurisdictions found Unacceptable	Reviews
1985	3	0	3
1986	4	1	5
1987	4	3	7
1988	1	2	3
1989*	1	4	5
1990*	2	0	2
Total	15	10	25

* Includes one re-review in which one county was upgraded from unacceptable to acceptable.

R0073199

In assessing the review process, we also examined our own performance. First, reviews have not been completed as frequently as required by the Stormwater Management Act. Not only have the major jurisdictions not been reviewed triennially (in 1990 a second round of reviews should be completed), but only one of the 47 municipalities (Baltimore City) which elected to implement their own programs has been reviewed. The failure to achieve timely reviews is attributable primarily to staff shortages; only two to three individuals have been available at any one time to undertake reviews, and these individuals also have had other responsibilities.

The 23 reviews completed initially have been conducted by nine individuals, including several engineers, a geographer, and a planner. Despite general guidance in the regulations, reviewers have emphasized different criteria, and the reviews reflect this. We examined each of the reviews in detail to determine if the reviewers addressed the same program elements. We established seventeen items pertinent to the review and noted whether reviewers commented on that program aspect. For example, we found that each review included a summary comment on the quality of plan review, but that comments about the quality of hydrologic and hydraulic calculations were included in only 15 of the 23 reviews. Seventeen of the reviews included the number of inspectors on staff, but only eight noted the types of enforcement tools available to the inspectors, and nine reviewers included findings relative to enforcement activity and the use of enforcement tools. Of the 17 program elements that were included in the review, the only single program element that was mentioned explicitly in each of the 23 initial reviews was the quality of plan review and design. Staff responsible for program review have used the assessment of past reviews to develop new procedures for conducting triennial reviews to ensure consistency in administration. These include a requirement for annual administrative reviews based on data supplied by each local jurisdiction in a detailed 20 page data form.

<u>Stormwater Program Grants-in-Aid</u>

Data on the program grants-in-aid awarded by the Administration are presented in Table 3. Between 1985 and 1988, the State of Maryland has awarded almost $9 Million in grants-in-aid. Twenty-one of Maryland's 23 Counties have requested and received funds; nine of the 47 municipalities have requested and received funds. Slightly over 82% of the total funds have been awarded to counties; almost 18% has been awarded to municipalities. Of the counties that have received funds, 14 of the programs at the last review were acceptable; seven were unacceptable. One of the two counties that has not requested funds was unacceptable; a review has not been completed for the other. The City of Baltimore is the only municipality to receive funds that has been reviewed. In sum, 65% of the grants has gone to counties with acceptable programs; just over 17% has gone to counties with unacceptable programs. Just over 6% of the total grants has been given to Baltimore City, which operates an acceptable program. Program reviews have not been completed for the other eight municipalities that have received almost 12% of the total awards.

It is difficult to assess the effect that the grants have had on jurisdictions responsible for implementing stormwater programs, let alone the effects of the grants on mitigating adverse effects of development on water resources. We do not even know, for example, the percentage of each local stormwater budget that is comprised of state funds. Thus, we cannot assess the extent to which state funds have helped local jurisdictions to establish successful program. We noted above that just over 17% of the grants ($1.56 Million) has been allocated to seven counties that operate unacceptable programs; we do believe that the number of unacceptable programs would be higher if state funds were not available.

With respect to impact on the environment, enough data are available for us to make a general assessment of whether the funds are being allocated to the "right" jurisdictions. Intuitively, we would hope to grant funds to those jurisdictions where the greatest impact on the environment is occurring, which is, in this case, where the most amount of development is occurring. We present in Table 4 the total funds granted to each major jurisdiction between 1985 and 1990 along with the total number of housing starts between 1985 and 1988. Although the grants are not tied directly to development levels, we would expect to see the funds track the development. This generally seems to be the case: the difference between the percentage of total funds received and the percentage of total housing starts in most cases is very small. We conclude the following: for those smaller jurisdictions, the percentage of funds received generally corresponds to the percentage of housing starts. However, among the larger jurisdictions, there is greater var[illegible] example, Prince George's County has received more than 22% of the total grants, although [illegible] percent of the total housing starts have

Table 4.Stormwater Grants-in-Aid and Housing Starts

COUNTIES	Program Grants TOTAL FY 1985 FY 1990	PERCENT OF TOTAL GRANTS	HOUSING STARTS 1985-1988	PERCENT OF TOTAL
Allegany	219,542	2.4%	877	0.5%
Anne Arundel	798,304	8.9%	15,429	9.3%
Baltimore	695,750	7.8%	21,222	12.8%
Calvert	197,451	2.2%	3,515	2.1%
Caroline	0	0.0%	954	0.6%
Carroll	165,049	1.8%	6,698	4.0%
Cecil	108,707	1.2%	3,252	2.0%
Charles	344,645	3.8%	6,242	3.8%
Dorchester	127,409	1.4%	721	0.4%
Frederick	75,234	0.8%	7,844	4.7%
Harford	442,359	4.9%	11,338	6.8%
Howard	309,855	3.5%	15,805	9.5%
Garrett	134,840	1.5%	1,200	0.7%
Kent	128,917	1.4%	399	0.2%
Montgomery	622,146	6.9%	30,342	18.3%
Prince George's	2010,816	22.4%	20,121	12.2%
Queen Anne	173,204	1.9%	2,182	1.3%
Somerset	8,790	0.1%	674	0.4%
St. Mary's	533,382	6.0%	3,327	2.0%
Talbot	65,751	0.7%	1,426	0.9%
Washington	0	0.0%	2,955	1.8%
Wicomico	203,862	2.3%	2,829	1.7%
Worcester	13,477	0.2%	3,730	2.3%

occurred within the County. For Baltimore, Howard, and Montgomery Counties and Baltimore City, the percentage of housing starts that have occurred in the jurisdiction is higher than the percentage of total program grants that have been awarded to the jurisdiction. Howard County is the only one of these five major jurisdictions that had an unacceptable program at the time of review. It appears that local officials in Prince George's County have been more aggressive in seeking funds than other local jurisdictions. One other program that stands out in this crude analysis is St. Mary's County. St. Mary's County has received approximately 6% of the total grants awarded, although the number of housing starts in the area comprises just two percent of the total. Despite receiving funds disproportionate to development activity, St. Mary's program was unacceptable at the time of the last review.

Stormwater Pollution Control Cost-Share Grants

Since 1984, the General Assembly has authorized approximately $5 Million for stormwater pollution control grants. The Sediment and Stormwater Administration has obligated 47 grants totalling $4.97 Million. The funds have been used to support a variety of projects, including seven infiltration facilities, 19 extended detention facilities with wetlands, two extended detention dry ponds, eight wetlands, one sand filter, and 10 other practices. The projects are at various stages of implementation.

Overall, 14 jurisdictions have received cost-share grants (11 counties and three municipalities). Of the counties that received grants, four had unacceptable stormwater programs at the time of the last review. Two of the municipalities that received grants never have been reviewed. Prince George's County has received a disproportionate share of funds (21.7%); Baltimore County has received an unexpectedly small share (3%; Table 5). Like the grants-in-aid, the cost share program is not an entitlement program. Since retrofits are not required by state law or regulation, the effort put forth at the local level to identify and rectify stormwater pollution problems varies greatly. To a significant degree, the allocation of cost-share funds to local jurisdictions reflects the sophistication of local programs.

Table 5. Stormwater Pollution Control Cost Share Grants by County.

County City	Number of Projects	Total Funds ($)	Percent of Funds
Allegany	1	65,000	1.3%
Anne Arundel	5	777,000	15.6%
Baltimore	2	147,000	3.0%
Calvert	1	24,578	0.5%
Caroline	1	25,000	0.5%
Dorchester	2	320,908	6.5%
Harford	4	416,750	8.4%
Howard	1	37,500	0.8%
Kent	1	45,000	0.9%
Montgomery	9	826,000	16.6%
Prince George's	12	1,080,000	21.7%
Baltimore City	3	628,508	12.6%
Crisfield	1	303,750	6.1%
Ocean City	4	272,400	5.5%
Total	47	4,969,394	100%

Chesapeake Bay Agreements

Regionally, implementation of the Chesapeake Bay Agreements is being coordinated through an Interstate Implementation Committee. In Maryland, The Sediment and Stormwater Administration has been designated as the lead agency for nonpoint source pollution controls. An Interagency Steering Committee has been established to coordinate all state-wide efforts to control all types of nonpoint source pollution, including nutrients, conventional pollutants, and toxics. The Committee presently is updating Maryland's Nutrient Reduction Plan, which is the best developed statement of the State's overall efforts to control pollution in the Bay. Sections of the Nutrient Reduction Plan concerning nonpoint pollution have been extracted and used to develop Maryland's nonpoint source management plan for USEPA pursuant to Section 319 of the Water Quality Act. Specific implementation activities have included extensive retrofit efforts in selected or targeted watersheds.

EPA Nonpoint Source Control Programs

While the State of Maryland has been active in stormwater management, direct federal support for implementation of related nonpoint source management programs has evolved more recently. The State of Maryland has redefined existing programs to control nonpoint pollution in the Bay, particularly the Chesapeake Bay nutrient reduction plan, to fit into the framework outlined by EPA pursuant to Section 319 of the Clean Water Act. In March, 1990, the State of Maryland received its first nonpoint source implementation grant. Projects, activities, and items funded include:

1. One staff position to coordinate nonpoint source programs;
2. Two staff positions to implement stormwater utilities;
3. One stormwater retrofit project manager;
4. Four agricultural soil conservation planners;
5. Groundwater modeling study;
6. Demonstration wetlands joint use project;
7. Cooperative Extension Service nonpoint source conference.

These projects were identified by a statewide, interagency task force that was created to guide implementation of projects funded by EPA. As is evident from the projects, about half of the programs are for projects related to urban nonpoint source programs. The coordinator position will be based in the Sediment and Stormwater Administration to strengthen existing programs. The staff to assist with utilities will build on ongoing technical assistance activities to help local jurisdictions identify adequate financing for programs, and the stormwater retrofit project manager will improve the existing cost-share program by strengthening management capabilities, including capabilities for project evaluation. At this time, we anticipate that funds will be available under Section 319 for the next three or four years and that in years hence funds will be used increasingly for implementation of capital and educational projects.

NPDES Permits for Stormwater Discharges

EPA expects to issue final regulations for implementation of the permit system in late July or August of 1990. The State of Maryland has determined that municipal permits will be issued by the Sediment and Stormwater Administration; industrial permits will be issued by the Hazardous and Solid Waste Management Administration. While details of the permitting program have not been developed, it is clear that implementation of the program will require substantial effort and resources not presently available to the Administration.

Administration

Primary responsibility for implementation of the Stormwater Management Act initially was delegated to the Sediment and Stormwater Division within the Maryland Department of Natural Resources (DNR). In 1984, the Division included only three staff members. In 1987, a new Department of the Environment (MDE) was created, and programs were transferred from DNR to

LESSONS LEARNED

To sum up, the State has made significant investments in managing stormwater. Since 1984, the State has awarded $9 Million in program grants-in-aid and about $5 Million for pollution control cost share projects. We estimate that the annual costs to administer these programs (including stormwater regulatory reviews) is about $1 Million annually. We believe these investments have resulted in significant progress. all the counties have implemented programs. Literally thousands of best management practices (BMPs) have been built in Maryland. Most of these are functioning, though perhaps not as designed. With respect to existing programs, we need to improve in a number of areas, both at the local and state levels. The pending stormwater regulations have the potential to significantly impact the Administration's current operations and budget. We are not optimistic that implementation of new federal permit requirements will proceed smoothly. For example, the draft regulations specify that, to obtain a permit, local governments must have water quality monitoring and modeling programs as well as stormwater management programs, sediment and erosion control programs, retrofit programs similar to those already in place in Maryland. These will require significant new resources. We would like to share the following observations.

* State law and regulations are making a difference. On-site controls are helping to mitigate the effects of urbanization. With respect to pollution control, however, these controls simply slow the rate of pollution. BMPs are not 100% effective. Regulators and stormwater managers should be emphatic about the limitations of the practices that are being used.

* Effective stormwater management requires a commitment by elected decision makers at the local level. Despite the existence of state regulations and technical assistance activities, a number of programs at the local level in Maryland are not acceptable. We believe that this results, in large part, from the failure of local officials to allocate adequate resources to the programs. This is particularly a problem in moderately populated jurisdictions that now are experiencing significant growth.

* Given that BMPs have limitations in their ability to control pollutants, growth management must be viewed as a key element of nonpoint source control efforts. Planning at the watershed scale to mitigate against nonpoint source pollution will be required for efficient allocation of scarce resources. For example, major, yet-to-be defined elements of Maryland's Nutrient Reduction Plan involve definition of growth management objectives through watershed planning processes.

* The State's plans for implementation of the federal NPDES program are not well developed. We do not know at this time exactly what the regulations will require or the number of people that will be required to administer the permit system -- even though, according to timetables set forth by EPA, implementation should be occurring.

* Finally, the Maryland experience suggests that evolution of programs will be required to control urban nonpoint source pollution effectively. Despite the existence of path breaking regulations and significant financial and technical assistance, there have been problems with implementation. Recognition of the pervasiveness of the nonpoint source problem and the limitations of even innovative structural approaches leads to the conclusion that growth management approaches are essential; Maryland's program must evolve to incorporate these. Responding to federal regulatory requirements will require additional new elements in the State's stormwater programs. Continual evaluation and reevaluation will be essential to achievement of objectives.

MDE. The Division was elevated to the Sediment and Stormwater Administration (SSA), an organizational leap of two steps. The Administration now includes three programs: (1) the Policy and Evaluation Program, which is responsible for local program reviews, (2) the Construction Management Program, which administers the two State grant programs, and (3) the Compliance Program, which is responsible for sediment and erosion control inspection and enforcement and is the largest program. Table 6 includes a summary of the Administration budget and number of staff for Fiscal Years 1987 through 1991. The budget remained relatively constant between FY 1987 and FY 1989, but increased significantly between FY 1989 and FY 1991. The growth primarily has been for more inspectors to strengthen the erosion and sediment control inspection and enforcement. The Compliance Program is by far the largest in the Administration, accounting for over two-thirds of the staff (in FY 1990), very few of whom have any involvement with stormwater management. The Construction Management Program is the second largest in terms of budget and personnel. The FY 1991 budget figures for this program include, however, about $1.6 Million for the Stormwater Program Grants-in-Aid, about 89% of the Program budget. The Policy and Evaluation Program, which has primary responsibility for review of local stormwater programs, is the smallest of the three Program, accounts for fewer than 10% of the Administration employees and about 12% of the Administration Budget. The Division responsible for review of local programs presently includes only three staff members.

Excluding administrative and clerical staff, approximately five to six technical staff (planners and engineers) actually work to administer stormwater regulations and grant programs. No new positions have been authorized to the Administration specifically for development of programs to achieve the 40% reductions in nutrients in urban nonpoint source loadings to the Bay, although the sediment and erosion control initiatives work towards this goal. The Sediment and Stormwater Administration has been designated the lead agency in Maryland to administer EPA's nonpoint source programs; the 319 grant will fund four additional staff people in the SSA. The SSA also has been assigned responsibility for development and administration of the NPDES system; however, no positions have been authorized to assist with development of the program.

Table 6. Sediment and Stormwater Administration, Staff and Budget.

Fiscal Year	1987	1988	1989	1990	1991
Budget (Million $)					
Policy and Evaluation					0.6
Construction Management					1.8
Compliance					1.4
Other Grants and Administration					1.1
Total Budget	3.3	3.2	3.4	4.1	4.9
Permanent Positions					
Policy and Evaluation					5
Construction Management					8
Compliance					39
Other Grants and Administration					6
Permanent Positions	46	44	43	58	58

Stormwater Management in Maryland
An Administrative Evaluation of Local Programs

June, 1992

MDE

Maryland Department of the Environment
Water Management Administration

2500 Broening Highway
Baltimore, Maryland 21224

The Sediment and Stormwater Administration (SSA) was incorporated into the Water Management Administration (WMA) in October, 1992. For additional information concerning this publication, please contact WMA (410) 631-3543.

INTRODUCTION

Since 1984, the Maryland Department of the Environment (MDE), has been mandated by law to periodically, but at least once every three years, inspect and review county and municipal stormwater management programs. All 23 counties have been formally evaluated at least once. To help meet the statutory requirements for stormwater management program review, the MDE's Sediment and Stormwater Administration (SSA) developed a data form designed to routinely provide a comprehensive description of local programs. The data form is used to evaluate whether a jurisdiction's procedures are adequate to administer an effective stormwater management program. The first data form requested information for the years 1985-90 and was sent to the counties in March, 1990. All but one form has been received by the SSA. A sample data form is attached (Appendix 1). The results of the administrative evaluations are summarized below and provide an overview of how well the State's stormwater management program is being implemented.

PROGRAM REVIEW CRITERIA

According to State Stormwater Management Regulations (COMAR 26.09.02.), to be found acceptable, a stormwater management program must have: an Administration approved ordinance; planning and approval processes that provide stormwater management for all development subject to the ordinance and information necessary to review proposed facility construction and maintenance measures; and inspection and enforcement procedures that ensure proper construction and maintenance of facilities. The data form was designed to provide specific information regarding these program elements. Additional information regarding program activity (e.g., number of plan reviews, inspections, enforcement actions, personnel, and budget information) was also requested.

EVALUATION OF THE LOCAL PROGRAMS

Ordinance, Regulation, and Policy

Maryland's Stormwater Management Act (Environment Article, Title 4, Subtitle 2) required counties and municipalities to adopt ordinances necessary to implement effective stormwater management programs by July, 1984. Each local ordinance is required to provide for: submission and approval of stormwater management plans; exemptions and waivers; criteria and procedures for stormwater management; proper implementation of stormwater management in accordance with approved plans; maintenance responsibilities and requirements including periodic inspection; and penalties for noncompliance. All County stormwater management ordinances received State approval by 1985. However, five jurisdictions were found to have unacceptable ordinances during the recent administrative evaluations. In one instance, a Zoning Ordinance was being used to administer the individual locality's stormwater management program. Many of the required provisions, as stated above, were missing from the ordinances determined to be unacceptable. Similarly, the required construction and/or maintenance inspection and enforcement provisions were missing in 7 ordinances. Although 7 jurisdictions reported pending changes to their ordinances, 12 additional ordinances require minor modifications in order to maintain consistency with current State law and regulations. Proper references to State agencies and Code of Maryland Regulations (COMAR) were the typical changes needed to most of the ordinances requiring modification.

Maryland regulations require stormwater management for all development activities except: additions or modifications to existing single-family detached residential structures; developments that do not disturb over 5,000 square feet of land area; land development activities that the SSA determines will be regulated under specific State laws which provide for managing stormwater runoff; and residential developments consisting of single-family houses, each on a lot of 2 acres or greater. One jurisdiction exempts redevelopment projects provided that the site size does not exceed the original development area and that the runoff characteristics are not changed. Additionally, another jurisdiction exempts development activities on agricultural property instead of agricultural land management activities. Five ordinances contain "grandfather" clauses that set forth procedures for exempting stormwater management for projects approved prior to the adoption of the local jurisdiction's ordinance. These provisions may have been warranted as a transitional mechanism during the onset of local stormwater management programs, however, their continuation is inappropriate.

Local ordinances may contain stormwater management waiver policies for individual developments, provided that they have been approved by the SSA. The SSA will approve local waiver policies if they ensure that developments, based on a case-by-case review, will not adversely impact stream quality due to channel erosion, pollution, sedimentation, and local flooding. Typical waiver provisions that are approved by the SSA include: developments that do not generate more than a 10 percent increase in the 2-year pre-development peak discharge rate; sites that are completely surrounded by existing developed areas which are served by an existing network of public storm drainage systems of adequate capacity to accommodate the runoff from the additional development; or when provisions to control direct outfall to tidewater are provided. A development may be eligible for a waiver of stormwater management quantitative control if the applicant can conclusively demonstrate that the first one-half inch of runoff can be managed according to the infiltration standards and specifications promulgated by the SSA. The SSA typically recommends that alternate water quality facilities should be provided when the required soils tests eliminate infiltration as a viable practice.

Only four jurisdictions specifically require quality control in their ordinances. Two additional jurisdictions require quality control in a directives document used for the administration of their stormwater management programs. Two jurisdictions waive stormwater management requirements if project development occurs in watersheds less than 5 acres or on lots of 2 acres or less provided that an adequate storm drain system exists. Similarly, one jurisdiction allows stormwater management to be waived for residential developments consisting of single-family houses on lots of 40,000 square feet or greater while another allows waivers for residential subdivisions that do not create new streets and has frontage on any county maintained road. From a conceptual standpoint, complete development of a watershed could occur without benefit of stormwater management if these waiver provisions are widely applied.

Furthermore, one jurisdiction grants waivers on the basis of high groundwater conditions. Infiltration may not be practicable for stormwater management in this instance, however, shallow marshes, wetland ponds, or other alternative measures may be possible. Another waiver provision used by a local jurisdiction, termed "rapid release", is predicated on the notion that a particular site's peak discharge can be passed prior to the overall watershed's peak discharge. This timed discharge could in fact be proven true at a specific point of investigation, however, somewhere downstream the adverse effects of not implementing stormwater management may be realized. The SSA believes that the intent of the State's stormwater management program is being subjugated by all of these exemption and waiver provisions. Typical recommendations made to localities included eliminating these provisions and a significant effort will be made during future triennial evaluations to ensure that all waiver policies are acceptable and appropriate.

<u>Administrative Procedures</u>

Stormwater management program implementation is typically administered by the local Department of Planning and Zoning, Department of Public Works, or Department of Engineering. In one jurisdiction, the County Highway Department administers implementation of the stormwater management program. Others use various County Departments of the Environment. Written policies, guidelines, or checklists outlining the planning and regulatory requirements are an important component for the proper implementation and administration of local stormwater management programs. In addition to their stormwater management ordinance, 12 jurisdictions supplement their program implementation by use of procedural guidance documents. Design manuals, standard operating procedures, and plan submission packages are the most common types of guidance used. These documents reiterate the requirements contained in local ordinances and often establish additional minimum requirements for plan development and submittal. Comprehensive and consistent implementation of local programs can be obtained by clarifying the multitude of procedures that may be required to address appropriate project development. Accordingly, the SSA recommended that the remaining jurisdictions develop and implement written policies and procedures for plan submittal and permit issuance to provide guidance to the development and engineering communities, as well as local staff. As required by State law, building or grading permits are to be issued only after stormwater management plan approval has occurred. Procedurally, all jurisdictions reported that building and grading permits are not issued until stormwater management plan approval has occurred.

Plan Review and Approval

Stormwater management plan review is typically administered by the local Department of Public Works, Department of Engineering, or Soil Conservation District. Only 9 jurisdictions were found to have complete and adequate procedure documents for the plan review process. Statewide, a total of 225,960 building permits were issued for FY85-89. Figure 1 shows that 13,110 of the building permits issued required submittal of stormwater management plans for review.

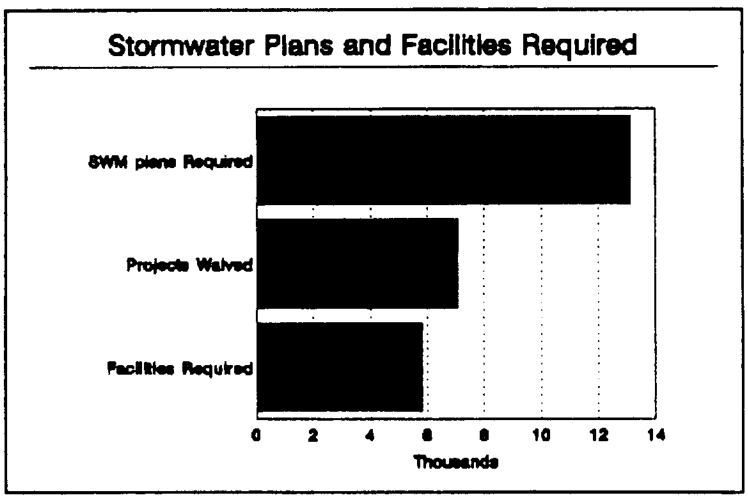


Figure 1

Minor development (house additions, pools, decks, etc.) typically accounts for the majority of building permits issued by local jurisdictions. Additionally, out of the 13,110 projects requiring stormwater management plan review, 7,103 were granted waivers. Statewide, approximately 75% of the requests for stormwater management waivers have been granted. Seven jurisdictions reported that they have granted each and every waiver requested. The number of waivers granted (7,103) greatly outnumber the stormwater management facilities that have been required (5,856).

Many requests for quantity control waivers may be granted if a local jurisdiction allows waivers for projects that generate less than a 10% increase in the 2-year pre-development peak discharge. In an attempt to reduce the number of waivers for quantity control, three jurisdictions have restricted the way that pre-development runoff conditions are computed. One jurisdiction requires pre-development runoff to

R0073209

be computed using a "meadow" land use condition making the difference between pre-development and post-development peak discharges more pronounced. Similarly, two jurisdictions require the pre-development curve number to be averaged over the three year period preceding development. The SSA recommends that pre-development land use conditions be specified in jurisdictions where waivers are granted liberally.

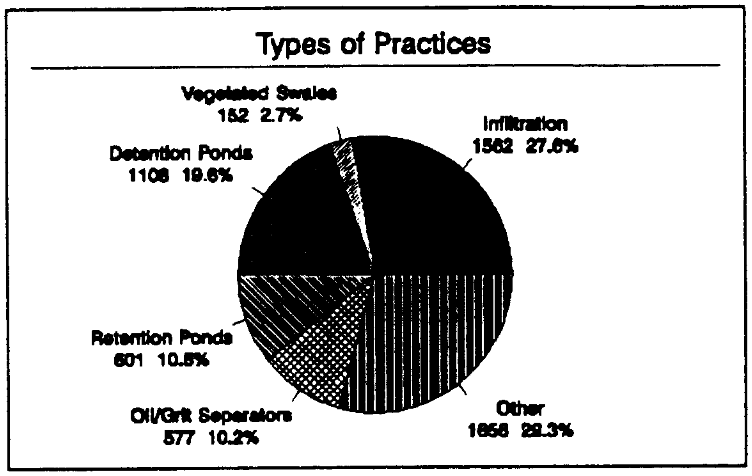


Figure 2

Maryland's regulations require that stormwater management be implemented according to the following order of preference: on-site infiltration of runoff; flow attenuation by use of open vegetated swales and natural depressions; retention structures; and detention structures. The preferred order of facilities is related to the water quality benefits of each practice. As shown in Figure 2, 1,562 (28%) of the 5,656 required stormwater management facilities have been infiltration practices. Vegetated swales account for 152 (3%) of the 5,656 facilities required for stormwater management. Additionally, 1,108 (65%) of the 1,709 ponds have been detention or extended detention structures while 601 (35%) have been wetland/shallow marshes or retention structures. A total of 1656 (29%) of the structures were reported as *Other* stormwater management facilities.

Inspection and Enforcement

For the most part, local Departments of Public Works are responsible for inspection and enforcement of stormwater management construction and maintenance. In two jurisdictions, the County Highway Department is responsible for inspection and enforcement and the Department of Planning and Zoning in two others. As stated in the ordinance section of this report, seven of the local ordinances do not contain the required stormwater inspection and enforcement provisions. These requirements are to provide for the proper implementation of stormwater management in accordance with the approved plan; maintenance responsibilities and requirements including periodic inspection; and penalties for noncompliance with the ordinances including suspension of construction activities when appropriate. Policies and procedures for guidance of stormwater management facility inspection and enforcement requirements were found to be adequate in 5 of the 22 jurisdictions reviewed.

The local jurisdiction or a registered professional engineer licensed in Maryland is required to conduct inspections at specific stages during stormwater management facility construction. Although 18 jurisdictions reported that they conduct periodic construction inspections, 15 do not require engineering certification at specific stages of stormwater facility construction. Four of the 15 jurisdictions that do not require engineering certification also reported that they do not conduct regular stormwater facility construction inspections. Furthermore, one of these 4 jurisdictions and 6 others do not require as-built final plans upon completion of the stormwater facility. A total of 3,122 (55%) of the 5,656 required stormwater facilities have been constructed for the period 1985-90. A total of 1,431 facilities were reported to be under construction during FY90. This leaves 1,203 facilities that are unaccounted for. A total of 35,898 inspections have been conducted as a result of past and current construction activities. This results in an average of 8 construction inspections for each completed facility.

According to State stormwater regulations, inspection and preventive maintenance is to be ensured by local jurisdictions for all infiltration systems, retention, and detention structures. Inspections are to be conducted during the first year of facility operation and at least once every three years thereafter. Five jurisdictions reported that they do not conduct the required maintenance inspections and an additional eight did not report any history of maintenance inspections. A total of 1,637 maintenance inspections of privately owned and 756 inspections of publicly owned stormwater management facilities have been performed. Typically, the local agency responsible for construction inspection also conducts maintenance inspections. However, one particular program segregates the responsibility for maintenance inspection between two separate local agencies. One agency inspects publicly owned facilities while the other inspects privately owned facilities.

Noncompliance with provisions of local stormwater management ordinances are subject to penalties including suspension of construction activities when appropriate. Criminal action, civil action, or injunctive relief are the typical penalties specified in local ordinances. Documentation of enforcement efforts was not reported for 13 jurisdictions. A total of 793 (2%) of the 35,898 construction inspections resulted in enforcement action. A total of 256 (16%) of the 1637 maintenance inspections of privately owned facilities have resulted in enforcement action.

Personnel and Budgets

Adequate personnel and financial resources are essential components of any successful stormwater management program. As reported in the data forms received, a total of 152 full time positions are allocated for stormwater management program administration (see Figure 3). On a statewide basis, this is an average of 7 full-time positions in each County.

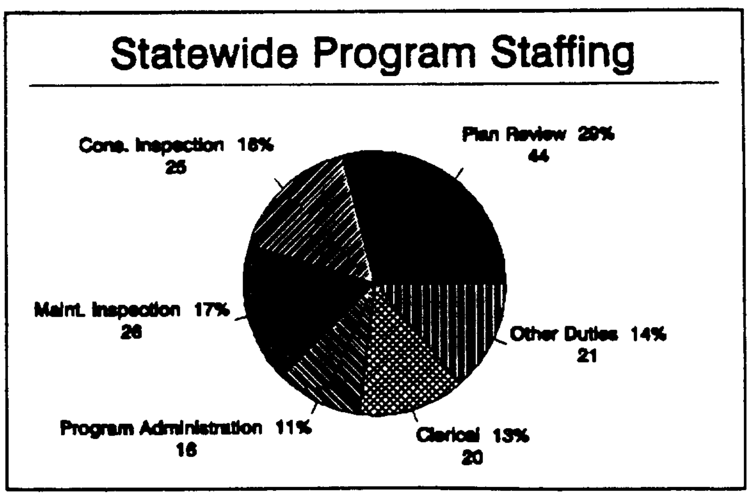


Figure 3

Only 4 jurisdictions reported that they include separate line items in their budget for stormwater management related expenditures. Totals from the data forms indicate that the estimated annual operating expenses for stormwater management in 1990 was $3,939,476.00. This includes expenses for administration, plan review, inspection, and maintenance.

R0073211

Capital improvement expenditures were estimated to be $13,235,500.00 for 1990. This would include expenses for land acquisition (including easements and rights-of-way), and the study, engineering, design, purchase, construction, expansion, repair, maintenance, landscaping, and inspection of public stormwater management systems. The total expenditures for stormwater management was $17,174,976.00 for 1990.

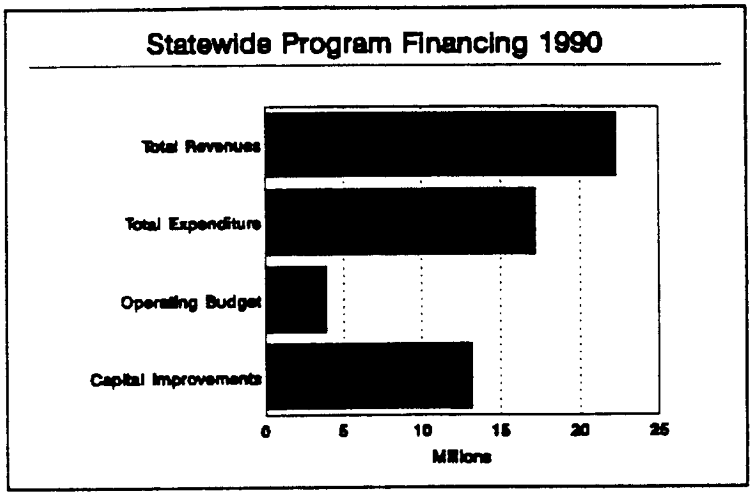


Figure 4

Total revenues generated to finance stormwater management were reported to be $22,324,827.00 for 1990. These revenues include property taxes, plan review fees, inspection fees, fees-in-lieu of providing on-site stormwater facility construction, state grants, special assessments, and other sources (see Figure 5). This leaves a surplus balance of $4,050,654.00 without consideration for the expenditures needed for off-site stormwater facility construction that will be necessary as a result of collecting fees-in-lieu. The annual expenditures for capital improvements for stormwater management has averaged $6,320,250.00 since 1987.

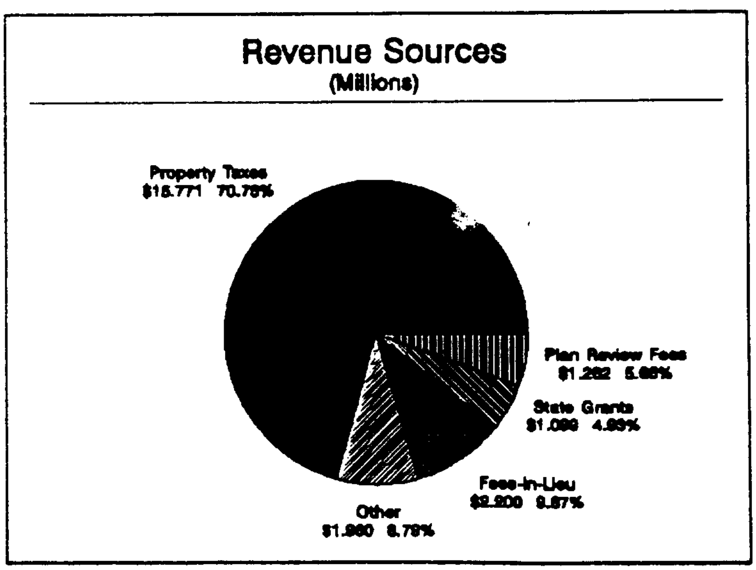


Figure 5

Seven jurisdictions reported that they require plan review fees and one requires an inspection fee. The combined revenue from both of these sources in 1990 was $1,406,813.00. The total revenue generated from plan review and inspection fees accounts for 6% of the total revenue required to support local stormwater management programs.

SUMMARY

Five programs were found to be unacceptable during the recent administrative evaluations. On an individual basis, 5 of the 22 jurisdictions were found to have adequate policies and procedures to effectively implement an acceptable stormwater management program. Three programs required only minor improvements to be considered acceptable while nine were in need of major improvements. As stated above, the required construction inspection, maintenance inspection, and enforcement provisions are missing in many ordinances. Without these provisions it is unlikely that the local jurisdiction would have an adequate foundation for successful legal action in the event improper stormwater facility construction or maintenance occurs.

Application and procedural documents need to be developed that ensure consistent and comprehensive administration of local programs. Water quality goals for stormwater are being addressed by only a few jurisdictions. Similarly, construction and maintenance inspections are not being conducted as required by State regulations or local ordinances. This failure to ensure proper facility construction and maintenance could result in jeopardizing public safety. Furthermore, the lack of documentation regarding maintenance inspection and enforcement efforts indicates that these program elements have not been a priority for local jurisdictions.

Present staffing levels appear to be adequate to administer effective stormwater management programs. However, current revenues are less than the needed expenditures required to sustain the current operating expenses for local stormwater management programs. The local jurisdictions need to acquire additional sources of revenue to cover the cost of the services they provide.

The administrative evaluations of the data forms indicate that program deficiencies exist in many local jurisdictions. Implementation of the SSA's recommendations for program improvement will result in meeting State and local stormwater management goals. As a result of these administrative evaluations, the findings can serve as a guide for the triennial review process. Review personnel will know what information needs to be verified and also be aware of any procedural deficiencies. Hopefully, this will result in a more timely review process and it is anticipated that the SSA will be able to maintain its review per the required frequency. Additionally, the SSA can tailor the review process to provide the information and education necessary for each jurisdiction to initiate the needed program improvements.

APPENDIX I

MARYLAND DEPARTMENT OF ENVIRONMENT
SEDIMENT AND STORMWATER ADMINISTRATION

DATA FORM FOR LOCAL STORMWATER MANAGEMENT PROGRAM REVIEWS

Jurisdiction **22 of the 23 Counties have reported** Date **February 14, 1992**

Bold numbers in parenthesis or small numbers equal the number of jurisdictions indicating a response [eg. (00),(03), 02, 11].

Small, bold type in the narrative sections of the data form indicates a representative response of various local jurisdictions.

Local liaison for program review

Name ______________________________

Title ______________________________

Address ______________________________

____

____

Phone ______________________________

INCLUDE PROGRAM REVIEW ATTACHMENTS FOR YOUR JURISDICTION:

1. Ordinance, Regulation, and Policy
2. Administrative Procedures
3. Plan Review and Approval Procedures
4. Construction Inspection and Enforcement Procedures
5. Maintenance Inspection and Enforcement Procedures
6. Program Activity (including an organizational chart)

Each of these attachments will be used to evaluate whether the jurisdiction's stormwater management program is acceptable pursuant to stormwater management regulations (COMAR 26.09.01 - 26.09.10). To be found acceptable, a stormwater management program shall have:

(a) an Administration-approved ordinance in effect (1);
(b) planning and approval processes that provide stormwater management for every development subject to the ordinance and information necessary to review proposed facility construction and maintenance measures (2,3); and
(c) inspection and enforcement procedures that ensure proper construction and maintenance of facilities (4,5,6).

The numbers in parentheses following the regulatory requirements refer to the numbers of the program attachments listed above. The program attachments have been cross-referenced with the regulatory requirements so that it is clear why the information is being requested.

d. How does your jurisdiction evaluate stormwater management requirements, approve plans, and conduct construction and maintenance inspections for its own capital projects?

Same process as privately owned/constructed stormwater management systems.

3. PLAN REVIEW AND APPROVAL PROCEDURES

a. Are checklists used to guide plan reviews?

01 NO **(07)** ===> Why not? **Ordinance is used to provide plan review guidance.**

02 YES **(15)** ===> Enclose copies.

b. Describe plan review procedures.

<u>For subdivision plans:</u>
Preliminary plans submitted through XXX to YYY for concept review.
Comments on the submittal are presented to the applicant at weekly subdivision review meetings.
When the comments are satisfied, YYY will issue a Stormwater Management concept plan approval through the XXX.

<u>For non-subdivision plans:</u>
Development plans are submitted directly to YYY for Stormwater Management concept review and approval.

<u>Plan review for permit issuance</u>:
Plans are reviewed for compliance with local, state, and federal criteria and the approved Stormwater Management concept.
Various checklists are used.
Incomplete plans are returned for correction and resubmission.
The procedures are repeated until the plan is acceptable and approved for permit issuance.

(Attach additional sheets if necessary)

c. How do procedures for plan review require developers to document reasons for departures from the state priority list for stormwater management practices for each project?

Documentation based on soils, engineering feasibility, public safety, economics, and environmental analysis.

d. Does the jurisdiction allow fees-in-lieu to be paid in exchange for waivers for on-site stormwater controls?

01 NO (19)
02 YES (03) ===> Explain system, and attach a fee schedule.

Approved requests for waivers must demonstrate an insignificant increase in runoff, conflicting peaks, or joint stormwater management participation. Once a waiver is granted, an estimate is submitted to YYY according to the adopted fee schedule. Once the amount is approved, the waiver fee is collected prior to the issuance of any grading or building permits.

e. Do procedures require developers to submit data to document how adequacy of facility/dam construction has been ensured?

01 NO (07) ===> How do you ensure minimum construction standards are met?
02 YES (15) ===> Describe data that are required.

A registered engineer must sign and seal a certification on the as-built plans stating that the pond has been constructed per the approved plans and specifications. The construction stages per the inspection and construction control schedule specified on the approved stormwater management plan must be inspected and certified.

f. Do procedures require developers to submit data which document how existing and future downstream hazards for dams have been addressed?

01 NO (09) ===> Why not?
02 YES (13) ===> Describe data that are required.

At the stormwater management concept review, any proposed development will be required to submit a Dam Breach analysis for proposed dams and also evaluate the downstream impact of their proposed stormwater management facilities. The following information is required:

1. **Information on the proposed dam; storage volume, dam height, etc.**
2. **Dam Breach analysis using HEC-1, Hec-2, Dambrk, TR-66, or other appropriate models.**
3. **Topographic map showing the Danger Reach section, its associated cross-sections and WSELs.**

R0073218

g. Submit typical sequences of construction for the following types of facilities:

* Infiltration trench;
* Retention pond (including dam construction);
* Detention pond;
* Artificial wetland or marsh;
* Oil-grit separator.

h. Does your jurisdiction ever impose stream improvement or conveyance conditions when stormwater management waivers are granted?

01 NO **(08)** ===> Why Not?
02 YES **(14)** ===> Explain Procedures

Waivers of stormwater management requirements are rarely given. Modifications of the requirements may be granted and these modifications may include various stream improvements or retrofit of existing stormwater management facilities.

i. Are stormwater management maintenance easements and covenants/agreements required for each stormwater management facility prior to plan approval?

01 NO **(02)** ===> How is maintenance assured?
02 YES **(20)**

j. How does your jurisdiction ensure that information about facilities including maintenance agreements is conveyed or communicated to the future owners of the property?

Easements and maintenance covenants are required for all structures on private property. These convey if/when the property is transferred. A typical title search should provide the future owners of their obligations for facility maintenance.

4. CONSTRUCTION INSPECTION AND ENFORCEMENT PROCEDURES

a. How does your jurisdiction ensure that stormwater management requirements are implemented in the field? (Circle all that apply.)

NO	YES	Administrative Measure
01 **(02)**	02 **(20)**	Regular stormwater construction inspections
01 **(15)**	02 **(07)**	Developer's engineer required to submit certification of construction approval for each stage of construction
01 **(06)**	02 **(16)**	Developer's engineer required to submit as-built drawings
01 **(01)**	02 **(21)**	Developers required to post construction bonds
01 **(05)**	02 **(05)**	Other (please describe) **(12 = no response)**

b. Are checklists used to guide construction inspections?

01 NO **(08)** ===> Explain how inspections are documented.
02 YES **(14)** ===> Enclose copies.

c. Do inspectors complete daily written logs for each construction inspection?

01 NO **(09)** ===> Why not?
02 YES **(13)** ===> Enclose representative copy.

d. Describe construction inspection procedures for stormwater management facilities. Note inspection frequency. Explain how the jurisdiction responds to complaints.

A pre-construction meeting with the permittee, contractor, and inspector is mandatory. Mandatory notification and inspection points are identified. The inspector makes mandatory inspections and spot checks. The design engineer is responsible for construction inspection, materials certification, and final certification. Inspection frequency varies with the type of structure and the scope of work. The inspector investigates complaints, responds to complaints, and takes enforcement action as appropriate.

e. Are soil compaction tests required for construction of dams?

01 NO **(08)**
02 YES **(14)** ===> What type of test?

See MD. 378 pond design criteria. AASHTO: T-99 Method A.

f. How are soil conditions verified when infiltration facilities are being constructed?

Inspection by County staff and certification of a geotechnical soils engineer.

g. Have infiltration facilities ever been rejected in favor of other types of stormwater management facilities based on data obtained in field inspections?

01 NO **(13)**
02 YES **(09)** ===> Submit an example.

h. Describe enforcement procedures for stormwater construction activities, including the sequence in which enforcement tools are used if violations continue. Explain how inspectors define a "violation' and "stop work."

The inspector issues a Notice of Violation if a violation of the approved plan occurs. Construction may not proceed to the next phase when visual observation or review of the engineer's reports indicate a discrepancy. If those measures fail to obtain compliance, a stop work order and/or civil citation is issued. A stop work order stops work associated with the stormwater facility and, if necessary, all building construction.

i. Enclose copies of a violation notice and a stop-work order.

j. Are as-built drawings required for stormwater management facilities after they have been built?

01 NO **(05)**
02 YES **(17)** ===> Summarize procedures (or attach copies).

k. Does your jurisdiction have a formal acceptance process for ownership of stormwater facilities?

01 NO **(10)** ===> Why not?
02 YES **(12)** ===> Summarize procedures.

5. MAINTENANCE INSPECTION AND ENFORCEMENT PROCEDURES

State regulations require that each jurisdiction maintain an inventory of, and records of maintenance inspections for, all facilities built pursuant to the Stormwater Management Act. The inventory shall include, at minimum, the following:

1. Facility name;
2. Facility owner;
3. Facility location;
4. Facility type;
5. Maintenance responsibility (public or private);
6. Drainage area served by the facility;
7. Date of plan approval;
8. Date construction completed;
9. Date of last maintenance inspection.
10. General condition of facility.

a. How does your jurisdiction maintain its inventory of stormwater management facilities?

Y	N	O		Method used to Maintain Inventory
12	**09**	**01**	01	Information is kept, unassembled, in project files
03	**18**	**01**	02	Information is kept in index card file
13	**07**	**02**	03	Information is computerized in data base program*
04	**16**	**02**	04	Other (describe below)

____

____

* attach copy if available

b. Do you use checklists to guide maintenance inspections?

01 NO **(06)**
02 YES **(16)** ===> Enclose copies.

c. How frequently are maintenance inspections conducted?

Private Facilities	Public Facilities	Frequency
01 **(01)**	01 **(02)**	2 times/year
02 **(07)**	02 **(06)**	1 time/year
03 **(04)**	03 **(02)**	1 time/2 years
04 **(06)**	04 **(05)**	1 time/3 years
05 **(01)**	05 **(01)**	When time is available
06 **(02)**	06 **(02)**	Only in response to complaints
07 **(01)**	07 **(01)**	Have never been done
00 **(00)**	00 **(03)**	**No Response**

d. Describe stormwater facility maintenance procedures. State clearly whether your jurisdiction prefers public or private ownership and maintenance, who is responsible for inspection, and who actually performs necessary maintenance of both public and private facilities. Explain procedures used to respond to complaints.

The County prefers private ownership of stormwater facilities but does construct and own some public facilities. Structural maintenance and dredging of publicly assisted projects is provided by the County. Maintenance of private facilities is provided by the owners; but there is a strongly stated interest among homeowner associations (HOA) that the County take over major maintenance responsibilities. In all cases, aesthetic maintenance is provided by the owner.

Current resource levels do not allow for periodic maintenance inspections of stormwater facilities. Complaints are responded to by inspection. Where maintenance is required, the entity obligated by the recorded maintenance agreement is instructed to make the specified corrective actions.

6. PROGRAM ACTIVITY

This section of the report requires you to record information that provides an indication of the overall level of activity in your program. You must record the number of projects that you are tracking, the number of plan reviews and approvals, the number and type of facilities that have been required, the number of construction inspections and violations, the number of maintenance inspections, and related information.

The categories below may not be consistent with the categories that you use in your record keeping. The following definitions should help make clear the types of information we want in each category. If the data in your records cannot be adjusted to match these categories, explain the differences in the place for comments at the end of this section.

Definitions

a. Building Permits -- Record the total number of building permits issued by your jurisdiction, regardless of whether stormwater management was required.

b. Project -- A project is a proposed development on a specific site or geographic area. There may be more than one point of investigation and more than one stormwater management plan for a project. In addition, a project may be developed in stages. For purposes of classification, use the following conventions:

1. If all plans and computations for the total area of a development site are submitted at the same time (regardless of the number of points of investigation or number of plans), count the submittal as a single project.

2. If plans and computations are submitted by section of the total development over a period of time, count the submittals as separate projects.

Projects exempt from stormwater management are those that qualify for one or more of the exemptions listed in your ordinance or in the Stormwater Management Act.

c. Plan Reviews -- Plan review refers to the administrative tasks of reviewing concept and sketch plans, detailed site plans, and revisions of site plans. For individual projects that require stormwater management, there may be several plans and probably will be multiple plan reviews. For purposes of classification, count each time each set of plans and computations is submitted for review as a separate review. For example, if a developer submits a sketch plan, a final plan, and revisions to a final plan, you should count three plan reviews.

d. Waivers -- For any given project, you may receive one or more requests for waivers. In addition, developers may request a waiver for both quantity controls and quality controls. Thus, for a single project with a single plan, you could receive two requests for waivers: one for a quantity controls and one for quality controls. Count each request for each type of waiver separately, regardless if they are for the same project or the same plan.

e. Fees-in-lieu -- Fees-in-lieu are distinct from waivers. Waivers are granted because developers are able to meet one or more criteria in an ordinance that establish conditions when controls are not necessary. Fees-in-lieu are paid in situations where controls are necessary but will be provided off-site. Record the total number of times that a fee-in-lieu was granted instead of on-site controls.

f. Plan Approvals -- Plan approvals may be granted for final plans for each point of investigation on a project. Thus, the number of plans approvals could be greater than the number of projects but would be less than the number of plan reviews.

g. Number of Facilities Required -- There may be several facilities required for a single project or on a single plan. Record here the total number of individual facilities that have required on all plans that have received final approved.

h. Number of Facilities Completed -- This refers to the number of facilities that have received as-built approval.

i. Acres of Land Developed -- List the total number of acres of land developed in your jurisdiction during the year. Also list the total number of acres served by stormwater management facilities.

j. Construction Inspections -- Each visit to a construction site for purposes of stormwater management should be counted as a separate inspection. The number of inspections should match the number of inspection reports in your files.

k. Maintenance Inspections -- The number of maintenance inspections should match the number of maintenance inspection reports in your files.

l. Complaints -- Record here only those complaints that concern stormwater management facilities. For example, count complaints that concern the need for maintenance of a facility. Include complaints about drainage as a separate category. Do not count complaints about sediment control violations or about sewer backups.

m. Staff Positions -- Record here the number of staff involved in each aspect of your program. If a single person has responsibilities in more than one function (e.g., plan review and approval and construction inspection), record the percentage of time that the individual spends on each function.

n. Jurisdictions Served -- Some counties are responsible for implementation of stormwater programs within incorporated municipalities. List all incorporated jurisdictions that are served by your jurisdiction's stormwater management program.

PROGRAM ACTIVITY

	1985	1986	1987	1988	1989
a. # Building Permits Issued	26311 (17)	46999 (18)	49553 (18)	50166 (18)	52931 (19)
b. Projects					
# Projects Exempt From SWM	1447 (07)	2694 (11)	3348 (12)	3176 (12)	3290 (13)
# Projects for which SWM Plans were reviewed	1198 (12)	2036 (15)	2291 (18)	3360 (18)	4225 (18)
c. # of Plan Reviews	2567 (14)	3778 (16)	4825 (19)	6382 (19)	8318 (20)
d. SWM Waivers					
# Requested	1280 (12)	1699 (15)	1577 (14)	2290 (15)	2636 (17)
# Denied	398 (05)	580 (06)	459 (07)	670 (07)	886 (10)
# Waivers Granted					
For Quantity (Qn) Control	306 (11)	539 (14)	637 (14)	848 (14)	1018 (16)
For Quality (Ql) Control	274 (07)	349 (09)	358 (09)	525 (09)	574 (09)
Total (Qn + Ql)	924 (13)	1221 (17)	1265 (17)	1784 (17)	1909 (19)
e. Fees-in-lieu					
# Approved	449 (02)	841 (01)	396 (02)	484 (02)	715 (02)
Total $ collected	615000 (01)	819000 (01)	2249908 (02)	3447982 (03)	3036620 (03)
f. # of Plan Approvals	1095 (15)	1770 (17)	2457 (20)	3033 (20)	3235 (21)

g. # of SWM Facilities Required on Approved Plans

Infiltration Facilities	192	12	194	15	320	14	309	17	547	18	1562	19
Retention Ponds	35	08	92	11	136	13	128	13	170	17	561	18
Detention Ponds	111	11	180	12	130	15	206	16	345	17	972	19
Extended Detention	0	00	3	01	21	03	42	04	70	05	136	07
Vegetated Swales	12	04	16	03	22	04	25	03	77	06	152	06
Wetlands/Shallow Marshes	1	01	3	02	11	03	12	03	13	05	40	05
Oil/Grit Separators	23	02	47	02	104	03	134	04	269	08	577	09
Other	197	04	235	04	336	05	481	06	407	07	1656	07
Total Required	571	13	770	15	1080	18	1337	19	1898	21	5656	21
h. Total Number of Facilities Completed	196	10	357	14	705	17	843	17	1021	18	3122	

R0073227

	Total	1985	1986	1987	1988	1989
i. Acres of Land Developed in Jurisdiction	(83025) (12)	14399 (09)	14428 (09)	15418 (09)	14183 (08)	24597 (11)
Acres of Land Served by Stormwater Management Facilities	(22043) (10)	3417 (07)	3949 (08)	3499 (09)	4611 (09)	6567 (10)

j. Construction Inspection and Enforcement

	Total	1985	1986	1987	1988	1989
# of Facilities Under Construction						1431 (12)
# of Construction Inspections completed	(35898) (09)	1899 (09)	3333 (12)	7087 (16)	10738 (17)	12841 (18)
# of Violation Notices/ Stop Work Orders Issued	(793) (09)	14 (03)	95 (04)	131 (05)	275 (06)	278 (09)

k. Maintenance Inspections and Enforcement

	Total	1985	1986	1987	1988	1989
# of Inspections of Private Facilities	(1637) (10)	79 (04)	607 (07)	414 (07)	250 (08)	287 (10)
# of Orders to Enforce Maintenance Agreements on Private Facilities	(256) (06)	16 (02)	124 (03)	66 (03)	28 (03)	22 (05)
# of Times Owners of Private Facilities Were Assessed to Pay for Maintenance Done By Jurisdiction	(1) (01)	0 (00)	0 (00)	0 (00)	0 (00)	1 (01)
# of Inspections of Public Facilities	(756) (07)	20 (02)	59 (04)	40 (04)	84 (05)	553 (07)
Total Expenditures on Maintenance of Public SWM Facilities	(555658) (05)	10000 (01)	10000 (01)	13302 (03)	10530 (03)	511826 (05)
l. # of Complaints	(2494) (13)	51 (05)	60 (06)	63 (06)	69 (07)	2251 (12)

Comments to clarify any of the numbers submitted above.
(Attach additional pages if necessary.)

The acreage of land developed and served by stormwater management facilities is currently not being kept. Number of inspections and number of complaints are approximate. This information will be automated in the near future.

m. Staff Positions -- Circle answers for each position of each type. Use blank positions below for additional personnel. Attach additional sheets if necessary. Include and organizational chart and identify positions.

Position Type	Approximate Percent of Time Spent on Function				
Plan Review **43.45 w/ average 1.98 person/county**					
Position 1	25%	50%	75%	100%	
Position 2	25%	50%	75%	100%	
Position 3	25%	50%	75%	100%	**Response - 21**
Position 4	25%	50%	75%	100%	
Position 5	25%	50%	75%	100%	
Construction Inspection and Enforcement **25.35 w/average 1.15**					
Position 1	25%	50%	75%	100%	
Position 2	25%	50%	75%	100%	
Position 3	25%	50%	75%	100%	**Response - 19**
Position 4	25%	50%	75%	100%	
Position 5	25%	50%	75%	100%	
Maintenance Inspection and Enforcement **26.0 w/average 1.18**					
Position 1	25%	50%	75%	100%	
Position 2	25%	50%	75%	100%	
Position 3	25%	50%	75%	100%	**Response - 15**
Position 4	25%	50%	75%	100%	
Position 5	25%	50%	75%	100%	
Administrators (list title) **16.36 w/average 0.74**					
Position 1	25%	50%	75%	100%	
Position 2	25%	50%	75%	100%	
Position 3	25%	50%	75%	100%	**Response - 18**
Position 4	25%	50%	75%	100%	
Position 5	25%	50%	75%	100%	
Clerical Support **20.35 w/average 0.93**					
Position 1	25%	50%	75%	100%	
Position 2	25%	50%	75%	100%	
Position 3	25%	50%	75%	100%	**Response - 18**
Position 4	25%	50%	75%	100%	
Position 5	25%	50%	75%	100%	
Other (list position types) **20.75 w/average 0.94**					
________________	25%	50%	75%	100%	
________________	25%	50%	75%	100%	
________________	25%	50%	75%	100%	**Response - 04**
________________	25%	50%	75%	100%	
________________	25%	50%	75%	100%	

n. Jurisdictions Served (list)

Jurisdiction	Contact Person	Telephone
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

(attach additional sheets if necessary)

o. If data necessary to complete portions of this form are unavailable, or if you were unable to complete any sections of it, please explain why.

ADDITIONAL PROGRAM INFORMATION

a. Does your jurisdiction include separate line items in its budget for expenditures for the stormwater management program?

01 NO **16**
02 YES **04** ===> Attach copy of 1990 budget (if 1990 budget has not been completed, attach 1989 budget).
00 No Response 02

b. Estimate annual expenditures for stormwater management.

Budget Item	1987	1988	1989	1990
Operating Expenses* (9076710) **(17)**	1149131 **(14)**	1212529 **(14)**	2775573 **(15)**	3939476 **(17)**
Capital Improvements (25281000) **(05)**	1358000 **(02)**	1882000 **(02)**	8805500 **(03)**	13235500 **(05)**

* include all expenses for stormwater management (e.g., administration, plan review, inspection, and maintenance) except capital improvements.

c. What sources of revenues are used to finance operating expenses for stormwater management?

NO	YES	SOURCE OF REVENUES	AMOUNT	No Response
01 **(12)**	02 **(10)**	PROPERTY TAXES	15771257	**14**
01 **(13)**	02 **(09)**	PLAN REVIEW FEES	1261733	**15**
01 **(19)**	02 **(03)**	INSPECTION FEES	145080	**21**
01 **(21)**	02 **(01)**	FEES-IN-LIEU	2200000	**21**
01 **(04)**	02 **(18)**	STATE GRANTS	1099197	**05**
01 **(21)**	02 **(01)**	SPECIAL ASSESSMENTS	27000	**21**
01 **(16)**	02 **(06)**	OTHER ____________	1959537	**18**
		TOTAL REVENUES	22324827	**06**

The revenue amounts listed above are for Fiscal Year ____________

d. Has your jurisdiction considered stormwater utility charges to pay for maintenance of facilities?

01 YES **14**
02 NO **08** ===> Would you like information about utilities?

01 YES
02 NO

e. What is the total area of your jurisdiction?

8,956
_______________ square miles **20 responses**

f. Has your jurisdiction undertaken watershed planning?

01 NO **14**
02 YES **08** ===> continue

What is the total area included in watershed plans that have been prepared?

690.3
_______________ square miles **08 responses**

Briefly explain your jurisdiction's watershed planning process.

Determine flood elevations based on both existing and ultimate land use conditions
Delineate floodplain boundary so that flood prone structures can be identified
Select and evaluate flood management solutions to solve problems of all flood prone structures
Identify existing and potential water quality problem areas
Identify retrofit sites and point sources
Recommend regional water quality basins
Delineate wetland boundary and identify potential sites for wetland banking
Implement flood management and water quality improvement recommendations
Participate and coordinate the EPA's NPDES program

g. Are your files readily available to the public for review?

01 YES **22** ===> Describe procedures or attach procedures if available. **ALL COUNTIES**
02 NO **00**

Copies of files must be obtained from our main office and they must be requested in person. There are fees assessed for copies of files and plans ($1.50 for plans and $.15 for letter and legal size paper). We require that the requester review the files and plans first before requesting copies to ensure that only the information needed is copied.

h. Does your jurisdiction provide educational and/or training materials concerning stormwater and urban nonpoint pollution to the public?

01 YES **11** ===> List types below.
02 NO **11**

Subject	Video Tape	Audio Tape	Movie	Slide Show	Staff Presentation	Brochure/ Pamphlet	Other
Urban Pollution	01	02	03	04	05	06	07
Stormwater Management	01	02	03	04	05	06	07
Stormwater Management Inspection	01	02	03	04	05	06	07
Dam Safety	01	02	03	04	05	06	07
Nonpoint Source Pollution Solutions	01	02	03	04	05	06	07
Floodplain Management	01	02	03	04	05	06	07

Please include copies of printed education

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

May 25, 2000

Xavier Swamikannu
Storm Water Program
California Regional Water Quality Control Board – LA Region
320 W. 4th Street, Suite 200
Los Angeles, CA 90013

Elizabeth Jennings, Esq.
Office of Chief Counsel
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Mr. Swamikannu and Ms. Jennings:

This is in response to Mr. Swamikannu's e-mail correspondence to me dated May 19, 2000. In that correspondence, Mr. Swamikannu asked for responses to nine questions. Enclosure #1 provides responses from Ann Wessel and me to those questions. Ms. Wessel and I work on stormwater management issues for the Washington Department of Ecology (Ecology) in the Program Development Services Section of the Water Quality Program.

Because our time is limited, we have not elaborated in detail but have tried to give you enough information to satisfy your needs. In addition, I have enclosed a summary of the thresholds and minimum requirements for new development and redevelopment (Enclosure #2) from Ecology's 1992 *Stormwater Management Manual for the Puget Sound Basin.* I have also referenced other documents that are available to you, if you prefer.

Finally, Mr. Swamikannu should have received a draft of Volume 1 of the 1999 Dept. of Ecology Stormwater Manual for Washington State as an attachment to an e-mail message. Please note that the draft has no legal standing, as it has not been formally promulgated by the state. It could significantly change prior to its publication.

If you need a clarification of these responses or any additional information, please feel welcome to contact us. You have my e-mail address. My telephone number is 360/407-6438. Ann Wessel's e-mail address is awes461@ecy.wa.gov; her telephone number is 360/407-6457.

Sincerely,

Ed O'Brien

Ed O'Brien, P.E.
Program Development Services Section
Water Quality Program

EO:pc
2 Enclosures

cc: Ann Wessel

R0073234

Enclosure #1

Response to Questions Posed by Xavier Swamikannu

1) Why did your state elect to have requirements on new development and redevelopment?

Response:

The state first became involved in developing requirements for new development and redevelopment as a result of the 1987 Puget Sound Water Quality Management Plan (The Plan). The Plan was developed as a comprehensive conservation and management plan under section 320 of the federal Clean Water Act. The Plan recognized that urban stormwater was a major contributor to the degradation of Puget Sound water and sediments, and its biological health. Consequently, The Plan specified a number of "program elements," or actions, to manage urban stormwater. One of the actions called for the Washington Department of Ecology (Ecology) to develop a manual to be used by local jurisdictions in stormwater management.

The Plan requires the manual to include: BMP's for controlling erosion from construction sites; hydrologic analysis procedures, including selection of design storms and runoff estimates; design, operation and maintenance standards for public and private structural facilities; and techniques for reducing or eliminating pollutants in runoff from problem land uses.

Subsequently, Ecology published its first *Stormwater Management Manual for the Puget Sound Basin* in February 1992. The Plan requires local governments to adopt requirements that are substantially equivalent to those in Ecology's manual.

In 1995, Ecology issued its first NPDES municipal stormwater permits. Because the permittees were all in the Puget Sound Basin, and so were already required by The Plan to have a "Comprehensive Stormwater Management Program," including a manual equivalent to Ecology's, Ecology issued permits that required permittees to develop and implement (Special Condition S.7.B.8.a.):

> A program to control runoff from new development, redevelopment and construction sites that discharge to the municipal separate storm sewers owned or operated by the permittee. The program must include: ordinances, minimum requirements, and best management practices (BMP's) equivalent to those found in Volumes I-IV of Ecology's Stormwater Management Manual for the Puget Sound Basin (1992 edition, and as amended by its replacement), permits, inspections, and enforcement capability. The program must also include a process to make available copies of the "Notice of Intent for Construction Activity" and/or copies of the "Notice of Intent for Industrial Activity" to representatives of proposed new development and redevelopment."

2) Does your state have design standards and performance standards for treatment control BMPs for new development/redevelopment?

Response:

A) 1992 Stormwater Manual
Washington State has design standards in its stormwater manual that are applicable to the Puget Sound Basin

and NPDES Phase I municipal permittees. The standards are not adopted into a state regulation. They are required by the Puget Sound Plan and by NPDES Phase I municipal stormwater permits.

The treatment design standard is the following:

> All projects shall provide treatment of stormwater. Treatment BMP's shall be sized to capture and treat the water quality design storm, defined as the 6-month, 24-hour return period storm. The first priority for treatment shall be to infiltrate as much as possible of the water quality design storm, only if site conditions are appropriate and ground water quality will not be impaired. Direct discharge of untreated stormwater to ground water is prohibited. All treatment BMP's shall be selected, designed, and maintained according to an approved manual.
>
> Stormwater treatment BMP's shall not be built within a natural vegetated buffer, except for necessary conveyance systems as approved by the local government. An adopted and implemented basin plan (Minimum Requirement #9) may be used to develop runoff treatment requirements that are tailored to a specific basin.

The following statements are offered for clarification:

The manual allows residential roof runoff to be infiltrated without having received treatment.

For most areas of the Puget Sound Basin, the 6-month, 24-hour storm is greater than the 90^{th} percentile, 24-hour rainfall amount.

Volume I of the manual provides a BMP selection process to determine which BMP is most appropriate for the development site. Volume II of the manual specifies hydrologic procedures for determining the runoff flow rates and volumes for the water quality design storm. Volume III specifies design criteria for each treatment BMP listed in the manual.

B) The Draft 1999 Stormwater Manual

The draft of the 1999 manual lists the same water quality design storm as described in the 1992 manual. However, the draft also includes a list of options for defining a new water quality design storm event and asks for recommendations. Volume I of the draft manual is available upon request.

The 1999 draft also distinguishes between pollution-generating surfaces and non-pollution generating surfaces. Runoff from non-pollution generating surfaces does not have to receive treatment if it is discharged without mixing with runoff from pollution-generating surfaces. The draft manual includes definitions for pollution-generating impervious surfaces and pollution-generating pervious surfaces. Non-pollution generating surfaces would include: residential roofs, commercial roofs that do not accumulate pollutants from vents and fugitive emissions, isolated bicycle lanes, other ground surfaces that are not subject to vehicular use.

The draft manual also suggests that Ecology establish performance criteria for treatment BMP's. A performance criterion for basic water quality treatment BMP's is likely to be established in the manual. The criterion is likely to be a specified percent removal of total suspended solids given certain conditions (e.g., influent TSS, flow rate or volume). The criterion will likely not be used to determine site-by-site compliance, but will be used as the standard against which to judge whether new BMP designs will be accepted for use in new and redevelopments.

The draft 1999 also includes:

- A proposal to have discharges into receiving waters that have a phosphorus related water quality problem, to use treatment BMP's that are more able to remove phosphorus.

- A proposal to have discharges from high volume traffic intersections (25,000/15,000 ADT) and "high use sites" (Average daily trips of 15 vehicles per parking space per day; or, commerical or industrial sites subject to petroleum storage and transfer in excess of 1,500 gallons/year; or, commercial/industrial sites subject to use, storage or maintenance of a fleet of 25 or more diesel vehicles that are over 10 tons gross weight) to use an oil removal BMP in addition to applying a "basic" or "enhanced" treatment BMP.

- A proposal to require "enhanced" treatment BMP's for discharges that are likely to violate water quality standards, despite the application of a "basic" treatment BMP, because of a lack of available dilution in the receiving water. The pollutants in question are dissolved copper, zinc, and lead.

3) Do you have thresholds for new development and or redevelopment (impervious area; size, etc) for requirements to apply?

Response:

A) 1992 Stormwater Manual
We have established thresholds that determine the set of requirements that apply to projects. I will fax a summary of the thresholds and corresponding minimum requirements. In brief:

Large Parcels:
Projects that disturb 1 acre or more of land have to meet all eleven of the Large Parcel Minimum Requirements.

Medium Parcels:
Development that disturbs less than 1 acre of land but adds or creates 5,000 ft2 or more of impervious surface, are subject to Large Parcel Minimum Requirements #2 through #11, and the Small Parcel Minimum Requirements for erosion control.

Small Parcels:
Construction of an individual single family residence or duplex; or, construction that adds or creates less than 5,000 ft2 of impervious area and disturbs less than 1 acre are only subject to the small parcel minimum requirements.

Redevelopment projects have some additional thresholds. I will fax a summary of the redevelopment requirement also.

B) The Draft 1999 Stormwater Manual
The draft 1999 manual has similar requirements to the 1992 manual, but there are some significant proposed changes:

- Single family residential projects could be subject to large parcel requirements if they exceed certain thresholds.

- The Small Parcel Requirements may be expanded to include onsite design requirements to maximize infiltration and flow dispersion and treatment without construction of structural facilities.

- All projects, regardless of size, will have to comply with all of the erosion and sediment control requirements or explain why a requirement is not necessary for the site (e.g., no silt fence around a site that is flat or is a closed depression).

- The Large Parcel Requirements allow use of Small Site Requirements for small isolated drainage areas of larger projects.

- The proposed Redevelopment thresholds are significantly changed. They are:

All redevelopment projects in which the total of *new plus replaced* impervious surfaces is 5,000 square feet or more must comply with Large Parcel Minimum Requirements #1 and #3 for the project site.

Redevelopment projects that add 5,000 square feet or more of *new* impervious surface must comply with all the Large Parcel Minimum Requirements for the new impervious surfaces. If the runoff quantity from the new surfaces is not separated from runoff from other surfaces prior to treatment or flow control, the stormwater facilities must be sized for the entire flow. Alternatively, the local government may allow the Large Parcel Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site.

All redevelopment projects in which the total of new plus replaced impervious surfaces is 5,000 square feet or more, and whose valuation of proposed improvements – including interior improvements - exceeds 50% of the assessed value of the existing site improvements shall comply with all the Large Parcel Minimum Requirements for the entire site.

Local governments may exempt redevelopment projects from compliance with Large Parcel Minimum Requirements #4, #5, and/or #6 if they have adopted a plan that fulfills those requirements in regional facilities that will discharge to the same receiving water, AND if they have an implementation plan and a schedule for construction of those facilities. Redevelopment projects for public roads may be exempted from meeting Large Parcel Minimum Requirements #4, #5, and/or #6 for the entire site (i.e., the exemption does not extend to new surfaces that add impervious area) if there is an adopted Capital Improvement Program for retrofitting existing road surfaces.

4) What development categories do the requirements apply to (i.e., commercial; parking lots; residential, etc.)?

Response:

Washington's requirements for water quality treatment and flow control apply to impervious surface and to land disturbance (clearing and grading) regardless of the type of land use. Generally, the source control requirements specified in our Volume IV of the manual apply only to commercial and industrial operations.

5) How long have such requirements been in place? Are they statewide or region-specific?

Response:

In 1992 we adopted the Stormwater Management Manual for the Puget Sound Basin. The manual was guidance for the approximately 115 municipalities in the Puget Sound Basin that are required to adopt either the Ecology manual or a manual containing substantially equivalent technical standards. The requirement to adopt the manual was contained in a statute establishing the Puget Sound Water Quality Authority, and development of the Puget Sound Plan. The statute stated that local governments "*must evaluate, and incorporate as applicable, subject to the availability of appropriated funds or other funding sources, the provisions of the plan, including any guidelines, standards and timetables contained in the plan.*" The deadline in the plan for adopting the manual was 1994, however, given the weak statutory requirement and lack of consequences for failing to adopt a manual, few municipalities met the deadline. Regardless, many municipalities began amending and adopting ordinances to incorporate at least part of the requirements, and stormwater controls for new development are accepted practice.

Outside of Puget Sound, the 1992 Stormwater Management Manual was applied as best available science in permitting decisions made by Ecology and other State Agencies.

In 1995 we issued our first municipal stormwater NPDES permits covering the five largest municipalities and Washington State Department of Transportation (WSDOT). This permit established a requirement for adoption and implementation of technical standards and BMPs equivalent to those in the Ecology manual during the term of the permit.

We are currently updating the Ecology manual, and expanding it to a statewide manual. As soon as possible after completion of the new manual, we will reissue the municipal stormwater permit requiring updating of local ordinances and manuals. When we issue phase 2 permits we will also require adoption of the new manual.

6) Have the design standards and performance standards unduly burdened cities and builders with unsupportable costs? Has compliance been difficult? Has change been for the better or have you seen none? Any noticeable improvements in water quality?

Response:

There are substantial costs to implementing stormwater controls for new development and redevelopment, but they are incremental to existing development and permit review costs. The single largest cost driver for developers is land value, so vaults and other underground BMPs tend to prevail in the downtown core areas. Local governments struggle with adequate enforcement, but seem to manage costs through combinations of general fund, permit fee, and stormwater utility revenues. Given the pace of development in Puget Sound, even in the municipalities where stormwater controls for new development are more stringent than what is in the Ecology manual, stormwater controls have not proven to be an obstacle to development.

As for noticeable improvements in water quality, we have not been monitoring to specifically address this question. We are in the process now of developing monitoring requirements for the next permit term that will address the question of effectiveness of programs to control both quantity and quality of runoff from new development. We have anecdotal evidence of reduced sediment loads from erosion and sediment control programs at construction sites (our requirements go beyond the federal 5-acre minimum to require erosion control for all land disturbing activities). Also, data on sediment contamination in urban bays is showing some improvement that could be attributed to stormwater controls.

7) Typically, what is your estimate of the range in additional cost (in percent of project cost) that the requirements have imposed on builders?

Response:

A) 1992 Stormwater Manual
We have not run cost estimates as a percentage of construction. We developed cost estimates for compliance with our 1992 manual using three different types of development (residential, small and large commercial), and assuming infiltration was possible and not possible. For each instance, we developed cost estimates for erosion and sediment control during construction, for the permanent water quality treatment and flow control facilities, and for operation and maintenance.

Ecology did not consider the costs as unreasonable. Let me know if you want a copy of the cost analyses.

One of our Phase I NPDES municipal permittees developed a cost factor for determining whether it was reasonable to make a redevelopment site retrofit treatment BMP's to the entire site (even though only part of the site may be redeveloped). If the treatment BMP retrofit would increase total project costs by 10% or more, the county would allow a reduction in the area being treated in order to stay below the 10% threshold. But in any case, the runoff from the redeveloping portion of the site has to receive treatment. The state accepted this redevelopment requirement.

B) The Draft 1999 Stormwater Manual
We have not done cost estimates on our proposed treatment, flow control, source control, and other minimum requirements. Where those requirements do not substantially change from our 1992 manual, we do not think it is necessary to re-justify them. Through the previous cost analyses and because they have been implemented for eight years throughout Puget Sound, they are considered reasonable requirements.

We have two areas in which our updated requirements could impose significant new costs: 1) the proposed flow duration standard for discharges to streams; and 2) the possible requirement for BMP's to remove significant amounts of dissolved metals in discharges to small receiving waters. We intend to develop costs for these instances. However, costs may not be a factor in these decisions. Both of these proposed requirements are water-quality based. That is, they will be required in those situations where they are determined necessary to maintain beneficial uses and not violate water quality standards. Water-quality based requirements are not subject to cost reasonableness analyses. In addition, both of these requirements are already in effect in significant areas of King County (i.e., the Seattle metropolitan area) for almost two years. The application of these requirements to ongoing development projects could also speak to their cost reasonableness.

8) How have municipalities ensured that the post-construction BMP's operation and maintenance has been provided and/or BMP's are properly maintained?

Response:

The municipal stormwater NPDES permit requires adoption of an ordinance that requires maintenance of privately owned stormwater facilities that discharge into municipal separate storm sewers (ms4) owned or operated by the permittee. The permit also requires the permittee to inspect facilities draining to the ms4 for proper operation and maintenance, and to have enforcement capability.

9) What are the policy goals that the standards are intended to achieve (reverse impairment; hold the line, etc)?

Response:
The goal of the technical standards for new development is to hold the line. The goal of the standards applied to redevelopment is to begin to reverse impairment.

Enclosure #2

Stormwater Management Manual for the Puget Sound Basin
Minimum Requirements
(Chapter I-2)

SMALL PARCEL MINIMUM REQUIREMENTS:

- Individual single-family residences and duplexes, or
- <5,000 sf of new impervious surface area, and

<One acre of land disturbing activity

Compliance through Small Parcel Erosion and Sediment Control Plan to include the following:

Small Parcel Minimum Requirement #1 - Construction Access Route

- Construction vehicle access shall be, whenever possible, limited to one route. Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.

Small Parcel Minimum Requirement #2 - Stabilization of Denuded Areas

- From 10/1 to 4/30, unstabilized not more than 2 days.
- From 5/1 to 9/30, unstabilized not more than 7 days.

Small Parcel Minimum Requirement #3 - Protection of Adjacent Properties

- Adjacent properties shall be protected from sediment deposition.

Small Parcel Minimum Requirement #4 - Maintenance

- All ESC BMPs shall be regularly inspected and maintained.

Small Parcel Minimum Requirement #5 - Other BMPs

- As needed other BMPs shall be required by the local government.

MEDIUM AND LARGE PARCEL MINIMUM REQUIREMENT:

Large parcel development:

- Development which includes ≥1 acre of land disturbing activity, or
- ≥5,000 sf of new impervious surface area, and ≥ 1 acre

Compliance through

- Large Parcel Erosion and Sediment Control Plan (ESC minimum requirements 1-15). and
- Large Parcel Stormwater Quality Control Plan (large parcel minimum requirements #1-11)

Medium Parcel Development:

- Development which includes ≤1 acre of land disturbing activity, but ≥5,000 sf new impervious surface area

Compliance through:

- Small Parcel Erosion and Sediment Control Plan (small parcel minimum requirements 1-5), and
- Large Parcel Stormwater Quality Control Plan (large parcel minimum requirements #2-11)

R0073242

Minimum Requirement #1 - Erosion and Sediment Control (large parcel development only)

ESC Requirement #1 - Stabilization and Sediment Trapping

- From 10/1 to 4/30, unstabilized not more than 2 days.
- From 5/1 to 9/30, unstabilized not more than 7 days.

ESC Requirement #2 - Delineate Clearing and Easement Limits

- Mark clearing limits, easements, buffers, sensitive areas, trees and drainage courses.

ESC Requirement #3 - Protection of Adjacent Properties

- Adjacent properties shall be protected from sediment deposition.

ESC Requirement #4 - Timing & Stabilization of Sediment Trapping Measures

- Construct sediment trapping BMPs first; must be functional before land disturbing activities take place.
- Stabilize in accordance with ESC Requirement #1.

ESC Requirement #5 - Cut and Fill Slopes

- Design and construct to minimize erosion.
- Stabilize in accordance with ESC Requirement #1.

ESC Requirement #6 - Controlling Off-site Erosion

- Protect downstream properties from erosion due to increases in volume, velocity and peak flow rate of stormwater runoff from the site.

ESC Requirement #7 - Stabilization of Temporary Conveyance Systems

- Prevent erosion from the expected velocity of flow from the developed condition 2-year, 24-hour storm.
- Outlets, etc. must be stabilized to prevent erosion.

ESC Requirement #8 - Storm Drain Inlet Protection

- Runoff must be treated to remove sediment before entering an inlet.

ESC Requirement #9 - Underground Utility Construction

- Where feasible, do not open up >500 ft. of trench at one time.
- Where possible, excavated material shall be placed on the uphill side of a trench.
- Trench dewatering must discharge into a sediment trap or pond.

ESC Requirement #10 - Construction Access Routes

- Minimize the transport of sediment onto paved roads.
- When it occurs, clean the road daily.
- Do not use street sweeping until sediment has been cleaned up first.

ESC Requirement #11 - Removal of Temporary BMPs **R0073243**

- Remove within 30 days of final site stabilization or after they are no longer needed.
- Remove or stabilize trapped sediment.
- Disturbed soil areas resulting from removal shall be permanently stabilized.

ESC Requirement #12 - Dewatering Construction Sites

- Dewatering devices shall discharge into a sediment trap or pond.

ESC Requirement #13 - Control of Pollutants Other Than Sediment on Construction Sites

- Handle and dispose of these pollutants in a manner which will not cause contamination of stormwater.

ESC Requirement #14 - Maintenance

- Maintain and repair all ESC BMPs as needed to assure continued performance of their intended function.
- Conduct maintenance and repair in accordance with an approved manual.

ESC Requirement #15 - Financial Liability

- Bonding or other appropriate financial instruments shall be required for all projects.

Minimum Requirement #2 - Preservation of Natural Drainage Systems

- Maintain natural drainage patterns and discharge at the natural location to the maximum extent practicable.

Minimum Requirement #3 - Source Control of Pollution

- Apply source control BMPs to all projects to the maximum extent practicable.
- Select, design, and maintain according to an approved manual.
- An adopted and implemented basin plan may be used to tailor BMPs to a specific basin; source control BMPs are always required for every site.

Minimum Requirement #4 - Runoff Treatment BMPs

- All projects shall provide stormwater treatment.
- Treatment BMPs should be sized to capture and treat the 6-month, 24-hour return period storm.
- Infiltration shall be emphasized wherever it is appropriate.
- Direct discharge of untreated stormwater to ground water is prohibited.
- Select, design, and maintain BMPs according to an approved manual.
- Treatment BMPs shall not be built within a natural vegetated buffer except for necessary approved conveyance systems.
- An adopted and implemented basin plan may be used to tailor BMPs to a specific basin.

Minimum Requirement #5 - Streambank Erosion Control

- Applies in addition to MR #4 if there is direct or indirect discharge to a stream (large water bodies, regional detention, and streams with >1000 cfs.)
- Control streambank erosion by limiting the peak rate of runoff to 50% of the existing condition 2-year 24-hour design storm, and maintaining the existing condition peak runoff rate for the 10-year and 100-year, 24-hour design storms.
- Infiltration shall be emphasized wherever it is appropriate.
- Select, design, and maintain BMPs according to an approved manual.
- Treatment BMPs shall not be built within a natural vegetated buffer except for necessary approved conveyance systems.
- An adopted and implemented basin plan may be used to tailor BMPs to a specific basin.

Minimum Requirement #6 - Wetlands

- Applies in addition to MR #4 if there is direct or indirect discharge to a wetland.
- Discharges to wetlands must be controlled and treated to the extent necessary to meet the state surface water and ground water quality standards.
- Discharges to wetlands shall maintain the hydroperiod and flows of existing site conditions to the extent necessary to protect the characteristic uses of the wetland.
- Wetlands created for mitigation cannot be used for stormwater treatment.
- Constructed wetlands must be built on a non-wetland site and managed for stormwater treatment.
- Treatment BMPs shall not be built within a natural vegetated buffer except for necessary approved conveyance systems.
- An adopted and implemented basin plan may be used to tailor BMPs to a specific basin.

Minimum Requirement #7 - Water Quality Sensitive Areas

- If a local government determines that the Minimum Requirements do not provide adequate protection of sensitive areas, more stringent controls shall be required to protect water quality.
- Treatment BMPs shall not be built within a natural vegetated buffer except for necessary approved conveyance systems.
- An adopted and implemented basin plan may be used to tailor BMPs to a specific basin.

Minimum Requirement #8 - Off-Site Analysis and Mitigation

- All development projects shall conduct an analysis of off-site water quality impacts resulting from the project and shall mitigate those impacts. The analysis shall extend a minimum of ¼ mile downstream and shall evaluate and mitigate for existing or potential impacts including but not limited to excessive sedimentation, streambank erosion, discharges to ground water contributing or recharge zones, violations of water quality standards and spills or discharges of priority pollutants.

Minimum Requirement #9 - Basin Planning

Note: This MR may be different because the intent of this one is to give local governments the flexibility to use basin plans to modify the other MR's. In other words, don't be surprised if it includes a list of adopted and implemented basin plans, for example.

- Adopted and implemented basin plans can be used to modify the MR's provided that the level of protection for surface or ground water achieved by the basin plan will equal or exceed that which would be achieved by the MR's otherwise.
- Basin plans shall evaluate and include as necessary retrofitting of BMPs for existing development and/or redevelopment.

Minimum Requirement #10 - Operation and Maintenance

- An O&M schedule shall be provided for all proposed facilities and BMPs and the party(ies) responsible for O&M shall be identified.

Minimum Requirement #11 - Financial Liability

- Performance bonding or other appropriate financial instruments shall be required for all projects to ensure compliance with these standards.

R0073245

Redevelopment Requirements

A. Where redevelopment of ≥ 5,000 ft2 occurs:

Minimum Requirements #1 - #11 apply to the redeveloped site

Source Control BMPs shall apply to the entire site

A stormwater site plan shall be prepared

B. Where one of the following conditions apply, a schedule for implementing the Minimum Requirements to the maximum extent practicable is required for the entire site:

1. Sites > 1 acre with ≥ 50% impervious surface

2. Sites discharging to waters with documented WQ problems. Subject to local priorities, this includes waterbodies that:

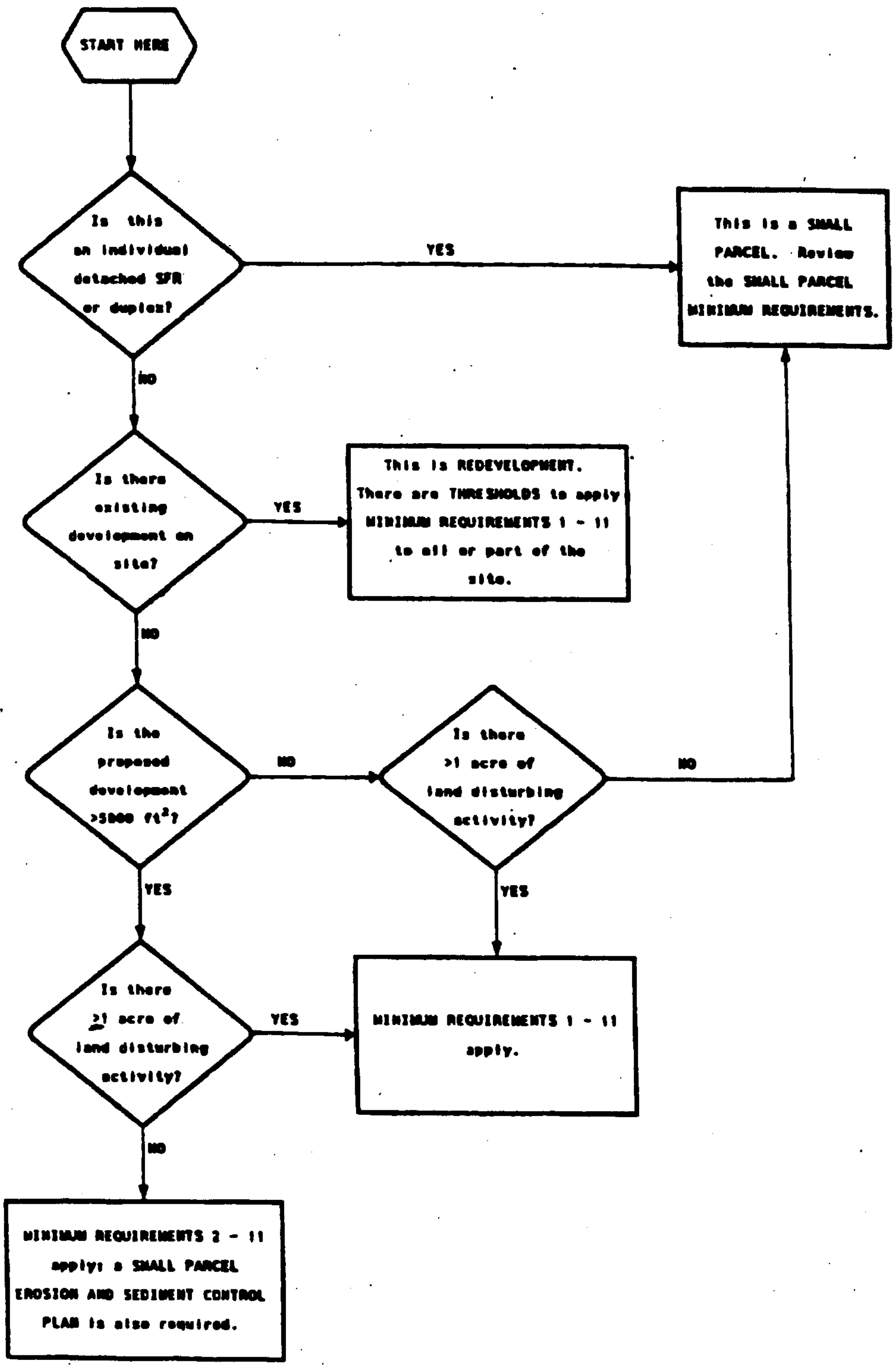
    (i) Are listed in reports required under Section 305(b) of the Clean Water Act, and designated as not supporting beneficial uses

    (ii) Listed under Section 304(l)(1)(A)(I), 304(l)(1)(A)(ii), or 304(l)(1)(B) of the Clean Water Act as not expected to meet water quality standards or goals

    (iii) Listed in Washington State's Nonpoint Source Assessment required under Section 319(a) of the Clean Water Act that, without additional action to control nonpoint sources of pollution cannot reasonably be expected to attain or maintain water quality standards.

3. Sites where the need for additional stormwater control measures have been identified through a basin plan, the watershed ranking process under Ch. 400-12 WAC, or through Growth Management Act planning.

Figure I-2.1 Flowchart Demonstrating Minimum Requirements



R0073247

Figure I-4.3 Summary of Steps for BMP Selection Process

PRELIMINARY STEP: Review Chapter I-2 prior to starting the BMP selection process.

STEP 1: Determine Stormwater Control Scenario from Table I-4.2

STEP 1A: Determine if Oil/Water Separator BMPs are Required based on Land Use Type

STEP 1B: Determine if Nutrient Control is Required *in addition* to Treatment of Conventional Pollutants

STEP 1C: Determine if Streambank Erosion Control is Required

STEP 1D: Determine Final Stormwater Control Scenario from Table I-4.2

STEP 2: Select Source Control BMPs

STEP 2A: Select Source Control BMPs based on Land Use Type

STEP 2B: Select Source Control BMPs for Nutrient Control, if required, as determined from Step 1B

STEP 2C: Prepare Final Source Control BMP List

STEP 3: Select Runoff Treatment and Streambank Erosion Control BMPs

STEP 3A: Select type of Oil/Water Separator, if required, as determined in Step 1A

STEP 3B: Determine initial order of preference of runoff treatment BMPs from Table I-4.4

STEP 3C: Determine initial order of preference of streambank erosion control BMPs from Table I-4.5

STEP 3D: Screen BMPs based on Comparative Stormwater Benefits and Restrictions using Table I-4.6

STEP 3E: Screen Runoff Treatment and Streambank Erosion Control BMPs based on Other Physical Factors

STEP 3F: Prepare Modified BMP List

STEP 3G: Prepare Final BMP List

STEP 4: Complete Stormwater Site Plan

STEP 4A: Complete Permanent Stormwater Quality Control Plan

STEP 4B: Review other Stormwater Site Plan requirements

STEP 4C: Complete Stormwater Site Plan

STEP 5: Submit Final Stormwater Site Plan to the Plan Approval Authority

R0073248

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Stormwater Management in Washington State

Volume I
Minimum Technical Requirements

August 1999
(Draft)

Publication No. 99-11
(A revised portion of Publication No. 91-75)

R0073250

Stormwater Management in Washington State

Volume I
Minimum Technical Requirements

Prepared by:

Washington State Department of Ecology
Water Quality Program

August 1999
Publication No. 99-11
(A revised portion of Publication No. 91-75)

printed on recycled paper

R0073251

How to Get Printed Copies of the Stormwater Manual

The manual, which is close to 700 pages, is now divided into five volumes. Three volumes are now available for review, the remaining two volumes will be done by the end of September, 1999.

To order printed copies of the first three available volumes of the stormwater manual, send check or money order for $25.50 (delivery in the state of Washington) or $26.50 (delivery outside the state of Washington) payable to "Department of Printing" at the following address:

Department of Printing
P.O. Box 798
Olympia, WA 98507-0798

Make sure you include your name, address (no P.O. Boxes), phone number, and the name of the publication (Stormwater Manual, Volumes I, II an IV). Allow about two weeks for delivery.

How to Find the Stormwater Manual on the Internet

The first three volumes of the Stormwater Manual are also available on Ecology's Home Page. The internet address for Water Quality Program publications is:

http://www.wa.gov/ecology/biblio/wq.html

Contact Information

If you have any questions on the proposed schedule or public review process, please e-mail Tony Barrett at tbar461@ecy.wa.gov or call him at (360) 407-6467. If you have technical questions or comments, you can contact the technical leads directly. The technical leads for each volume are:

Volume I - Minimum Technical Requirements
Ed O'Brien at eobr@ecy.wa.gov, phone (360) 4076438
Volume II - Construction Stormwater Pollution Prevention
Stew Messman at smes461@ecy.wa.gov, phone (425) 649-7070 and
Lisa Austin at lzin461@ecy.wa.gov, phone (425) 649-7276
Volume III - Hydrologic Analysis
Foroozan Labib at flab461@ecy.wa.gov, phone (360) 407-6439
Volume IV - Source Control BMPs
Stan Ciuba at sciu461@ecy.wa.gov, phone (360) 407-6435
Volume V - Runoff Treatment BMPs
Stan Ciuba and Lisa Austin (see contact information above)

Ecology is an equal opportunity agency. If you have special accommodation needs, please call Donna Lynch at (360) 407-7529 (Voice) or (306) 407-6006 (TDD). E-mail may be sent to dlyn461@ecy.wa.gov

Objective of the Manual

The objective of this manual is to provide guidance on the measures necessary to control the quantity and quality of stormwater produced by new development and redevelopment, such that they comply with water quality standards and protect beneficial uses of the receiving waters.

Development and Geographic Scope of This Manual

The Ecology stormwater manual was originally developed for the Puget Sound Basin in response to a directive of the Puget Sound Water Quality Management Plan. The technical manual was intended to provide technical guidance and to define minimum requirements for implementing local stormwater management programs.

The original 1992 manual was prepared by Ecology staff, with significant contributions from advisory committee members from local government public works and planning officials, representatives from other state agencies, and other affected parties including industry and tribes. This update was prepared in much the same manner. There were five separate advisory committees, with over 70 members representing a broad range of expertise and interests. Their insights and practical knowledge gained from years of experience in the field have been particularly valuable.

What is Driving the Revisions to the Manual?

There are several drivers behind the revisions to the manual. First, the manual was written in 1990-1991, drawing from research done in the 1980's and from existing manuals prepared by King County and by communities in other states. Even as the manual was published, deficiencies and shortcomings were evident. In addition, lessons learned from applying the manual and information from current research all point out additional deficiencies and errors in the manual. Second, funding has been provided under the Puget Sound Plan for the past two biennia to update the manual. Third, actual and proposed listing under the Endangered Species Act (ESA) call for significant changes in the way we manage urban runoff. Updating the technical manual to include new information and standards that are more protective will likely be an essential element in managing urban runoff under the ESA.

With this update of the manual, Ecology is seeking to broaden the applicability of the manual to the entire state. In that effort, we have found that the concepts developed originally for the Puget Sound Basin are applicable throughout western Washington. In addition, most of the minimum requirements and the BMPs are equally applicable in eastern Washington. It will probably be necessary to make adjustments in the minimum requirements for flow control and treatment, in some BMP design criteria, and in specifying which BMPs are applicable in some eastern Washington environments.

Organization of This Manual

The manual is organized into five volumes. The volumes will be published as separate documents to make it easier for the user to find needed information and to make it easier to publish future revisions. However, most users will find it necessary to have a complete set of all five volumes. We have tried to strike a balance between bouncing the user back and forth between volumes and unnecessary replication of material.

Unfinished Business (The Text Boxes – a Call for Action)

Although we are inviting comments and recommendations on the manual as a whole, there are some specific issues or questions where we want public comment, information or assistance. We have elected to use "Text Boxes" to highlight these issues. To comment, contact technical leads listed earlier.

The Process and Schedule for Completing the Revisions

Ecology will conduct public workshops, from early October to about mid-November, at both eastside and westside locations. We anticipate separate workshops on Volume I (Minimum Requirements and overall policy issues), Volume II (Construction Stormwater Pollution Prevention), and Volumes III – IV (Hydrologic Analysis, Source Control BMPs, and Runoff Treatment BMPs).

The comment period on the Public Review Draft will end December 15, 1999 and we anticipate publishing a Final Draft by mid-February 2000. We will conduct public meetings on the Final Draft during March and expect to publish a revised manual by the end of April 2000.

Table of Contents

R0073256

TABLES

FIGURES

Acknowledgments

The individuals listed below volunteered their time and knowledge to aid in the update of this volume of the Department of Ecology's Stormwater Manual. The department thanks the members of the Volume 1 committee for their efforts and advice.

Name	Affiliation
Lisa Austin	Department of Ecology
Mark Blosser	Olympia Public Works Department
Bert Bowen	Washington Department of
Transportation	
Paul Bucich	Pierce County Surface Water
Management	
Dana Carlisle	Geoengineers, Inc.
Michelle Cramer	Washington Department of Fisheries
Peter Birch	Washington Department of Fisheries
Doug Hennick	Washington Department of Fisheries
Bruce Dodds	Dodds Consulting Engineers
Darla Elswick	Seattle Public Utilities
Nathan Graves	Kennedy/Jenks Consultants
Julie Howell	Kennedy/Jenks Consultants
Tom Holz	SCA Engineering
Robert Johns	Reed McClure
Gary Kenworthy	City of Port Angeles
Nancy Malmgren	Carkeek Park Watershed
Dan Mathias	Everett Public Works Department
Ralph Nelson	Entranco, Inc.
John Rogers	CH2M Hill
Jeffrey Stern	King Co. Department of Development and Environmental Services
Steve Worley	Spokane County Public Works
Bruce Wulkan	Puget Sound Water Quality Action Team

R0073260

CHAPTER 1 - Introduction

1.1 Effects of Urbanization

1.1.1 Background Conditions

Prior to the Euro-American settlement, western Washington primarily was forested in alder, maple, fir, hemlock and cedar. The area's bountiful rainfall supported the forest and the many creeks, springs, ponds, lakes and wetlands. The forest system provided protection by intercepting rainfall in the canopy, reducing the possibility of erosion and the deposition of sediment in waterways. The trees and other vegetative cover evapotranspirated at least 40% of the rainfall. The forest duff layer absorbed large amounts of runoff releasing it slowly to the streams through shallow ground water flow. Forest ecosystems in eastern Washington provided similar hydrologic functions though not always to the same extent. The shrub-steppe and grasslands of eastern Washington also had their own natural hydrologic rhythms.

1.1.2 Hydrologic Changes

As settlement occurs and the population grows, trees are logged and land is cleared for the addition of impervious surfaces such as rooftops, roads, parking lots, and sidewalks. Maintained landscapes that have much higher runoff characteristics typically replace the natural vegetation. The natural soil structure is also lost due to grading and compaction during construction. Roads are cut through slopes and low spots are filled. Drainage patterns are irrevocably altered. All of this results in drastic changes in the natural hydrology, including:

- Increased peak surface runoff volumetric flow rates;
- Increased volume of surface runoff;
- Decreased time for runoff to reach a natural receiving water;
- Reduced ground water recharge;
- Increased frequency and duration of high stream flows and reduced stream flows during dry weather;
- Greater stream velocities; and
- Increased frequency and duration of wetlands inundation and reduced water elevations during the dry season.

R0073261

As a consequence of these hydrology changes, stream channels are eroded by high flows and can lose summertime base flows. Increased flooding occurs. Habitat is degraded and receiving water species composition is altered as explained below.

Figure 1.1 (Booth and Jackson, 1997)[1] illustrates the relationship between the level of development in a basin, the changes in the recurrence of high stream flows, and the resultant streambank instability and channel erosion.

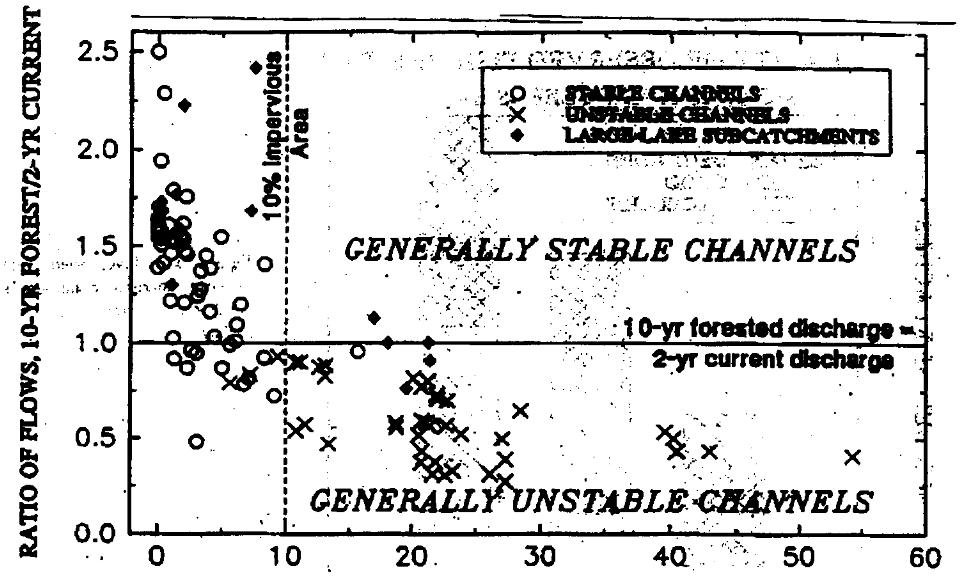


Figure 1.1: Channel Stability and Land Use:
Hylebos, East Lake Sammamish, Issaquah Basins

1.1.3 Water Quality Changes

Urbanization also causes an increase in the types and quantities of pollutants in surface and ground waters. Runoff from urban areas has been shown to contain many different types of pollutants, depending on the nature of the activities in those areas. Table 1.1 from an Analysis of Oregon Urban Runoff Water Quality Monitoring Data Collected From 1990 to 1996 (1997)[2] shows mean concentrations for a limited number of pollutants from different land uses.

The runoff from roads and highways is contaminated with pollutants from our vehicles. Oil and grease, polynuclear aromatic hydrocarbons (PAH's), lead, zinc, copper, cadmium, as well as sediments (soil particles) and road salts are typical pollutants in road runoff. Runoff from industrial areas typically contains even more types of heavy metals, sediments, and a broad range of man-made organic pollutants, including phthalates, PAH's, and other petroleum hydrocarbons. Residential areas contribute the same road-based pollutants as well as herbicides, pesticides, nutrients (from

fertilizers), bacteria and viruses (from animal waste) to runoff. All of these contaminants can seriously impair beneficial uses of receiving waters.

Regardless of the eventual land use conversion, the sediment load produced by a construction site can turn the receiving waters turbid and be deposited over the natural sediments of the receiving water.

The pollutants added by urbanization can be dissolved in the water column or can be attached to particulates that settle in streambeds, lakes, wetlands, or marine estuaries. A number of urban bays in Puget Sound have contaminated sediments due to pollutants associated with particulates in stormwater runoff.

Urbanization also tends to cause an increase in water temperature. Heated stormwater from impervious surfaces and exposed treatment and detention ponds discharges to streams with less riparian vegetation for shade.

Table 1.1: Land Uses Mean Concentrations for Selected Pollutants[2]

Land Use	TSS mg/l	Total Cu mg/l	Total Zn mg/l	Dissolved Cu mg/l	Total P mg/l
In-pipe Indus.	194	0.053	0.629	0.009	0.633
Instream Indus.	102	0.024	0.274	0.007	0.509
Transportation	169	0.035	0.236	0.008	0.376
Commercial	92	0.032	0.168	0.009	0.391
Residential	64	0.014	0.108	0.006	0.365
Open	58	0.004	0.025	0.004	0.166

R0073263

1.1.4 Biological Changes

The hydrologic and water quality changes result in changes to the biological systems that were supported by the natural hydrologic system. In particular, aquatic life is greatly affected by urbanization. Habitats are drastically altered when a stream changes its physical configuration and substrate due to increased flows. Natural riffles, pools, gravel bars and other areas are altered or destroyed. These and other alterations produce a habitat structure that is very different from the one in which the resident aquatic life evolved. For example, spawning areas, particularly those of salmonids, are lost. Fine sediments imbed stream gravels and suffocate salmon redds. The complex food web is destroyed and is replaced by a biological system that can tolerate the changes. However, that biological community is typically not as complex, is less desirable, and is unstable due to the ongoing rapid changes in the new hydrologic regime.

Significant and detectable changes in the biological community of Puget Sound lowland streams begins early in the urbanization process. May et al (1997)[3] reported changes in the 5-10% total impervious area range of a watershed. Figure 1.2 from May et al (1997) shows the relationship observed between the Benthic Index of Biotic Integrity (B-IBI) developed by Kleindl (1995)[4] and Karr (1991)[5], and the extent of watershed urbanization as estimated by the percentage of total impervious area (% TIA). Also shown in the figure is the correlation between the abundance ratio of juvenile coho salmon to cutthroat trout (Lucchetti and Fuerstenberg 1993)[6] and the extent of urbanization.

The biological communities in wetlands are also severely impacted and altered by the hydrological changes. Relatively small changes in the natural water elevation fluctuations can cause dramatic shifts in vegetative and animal species composition.

If the hydrological changes don't knock out a species, the toxic pollutants in the water column such as pesticides, soaps, and metals can have immediate and long-term lethal impacts. Toxic pollutants in sediments can yield similar impacts with the lesions and cancers in bottom fish of urban bays serving as a prime example.

R0073264

A rise in water temperature can have direct lethal effects. It reduces the maximum available dissolved oxygen and may cause algae blooms that further reduce the amount of dissolved oxygen in the water.

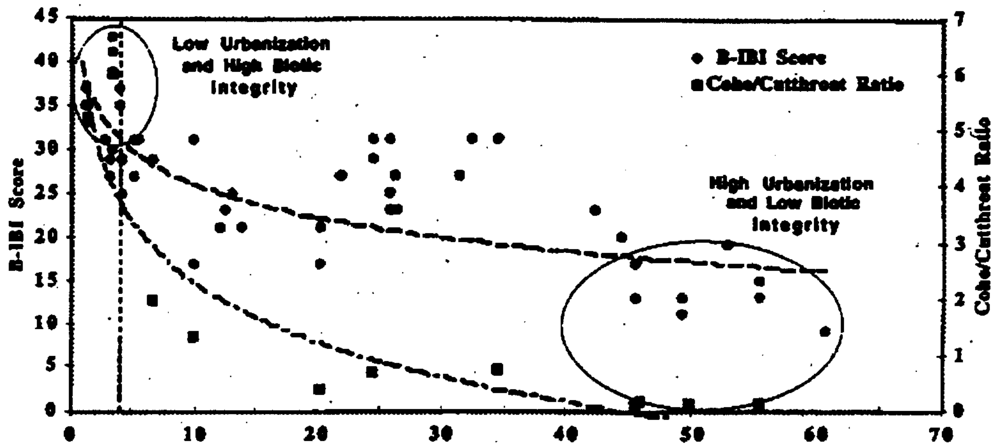


Figure 1.2: Relationship Between Basin Development and Biotic Integrity in Puget Sound Lowland Streams

1.1.5 The Role of Land Use and Our Lifestyles

The engineered stormwater conveyance, treatment, and detention systems advocated by this and other stormwater manuals can reduce the impacts of development to water quality and hydrology. But they cannot replicate the natural hydrologic functions of the natural watershed that existed before development, nor can they remove sufficient pollutants to replicate the water quality of pre-development conditions. Ecology understands that despite the application of appropriate Best Management Practices identified in this manual, we will continue to degrade our urban and suburban receiving waters and continue to lose some beneficial uses due to development. This is because land development, as we practice it today, is incompatible with the achievement of sustainable ecosystems. Unless we adopt development methods that cause significantly less disruption of the hydrologic cycle, we will inevitably degrade and lose more beneficial uses of our waters as we develop more areas.

In recent years, researchers (May et al, 1997)[3] and regulators (e.g., Issaquah Creek Basin and Nonpoint Action Plan, 1996)[7] have speculated on the amount of natural land cover and soils that would have to be maintained in a watershed in order to retain sufficient hydrologic conditions to prevent stream channel degradation and maintain base flows. There is some agreement that preserving a high percentage (50%? 65%?) of the land cover

R0073265

and soils in an undisturbed state is necessary to preserve hydrology.

It is not clear what other combinations of measures are also necessary to preserve beneficial uses. Clearly, we must improve our stormwater detention, treatment, and source control technologies. This manual is the Department of Ecology's latest effort to apply updated knowledge in these areas. We must also improve the operation and maintenance of our engineered systems so that they function as well as possible. Changing public attitudes toward chemicals use, preferred housing, and transportation modes are also necessary.

A dramatic reduction is necessary in the amount of impervious surfaces and artificially landscaped areas we create to accommodate our preferred housing, play, and work environments, and most significantly, our transportation choices. It is estimated that 65% of the impervious surfaces are created to provide "car habitat." Therefore to make appreciable progress in reducing impervious surfaces in a watershed, we must reduce the density of our road systems, alter our road construction standards, reduce surface parking, and rely more on transportation systems that do not require such extensive impervious surfaces (rail, bicycles, walking).

In short, we must implement drastic changes in where and how we develop land and how we live and move across the land if we are to achieve the goals we set for ourselves in the federal Clean Water Act - to preserve, maintain, and restore the beneficial uses of our nation's waters.

1.2 Objective

The objective of this manual is to control the quantity and quality of stormwater produced by new development and redevelopment such that they comply with water quality standards and protect beneficial uses of the receiving waters. Application of appropriate minimum requirements and BMP's identified in this manual are necessary but sometimes insufficient measures to achieve those goals.

To accomplish the objective, the manual establishes minimum requirements for projects of all sizes and provides guidance concerning how to prepare and implement stormwater site plans. These plans are required for new development and redevelopment on both large and small parcels, and must meet the applicable minimum requirements contained in Chapter 2. These requirements are, in turn, satisfied by the application of

BMPs from Volumes II through V. Projects that follow this approach will apply reasonable, technology-based BMPs to reduce the adverse impacts of stormwater.

It is important to understand that compliance with this manual does not ensure compliance with water quality standards. State and local permitting authorities with jurisdiction can require more stringent measures that are deemed necessary to meet locally established goals, state water quality standards, or other established natural resource or drainage objectives.

The manual can also be helpful in identifying options for retrofitting BMPs to existing development. Retrofitting stormwater BMPs into existing developed areas will be necessary in many cases to meet federal Clean Water Act and state Water Pollution Control Act (Chapter 90.48 RCW) requirements.

Ecology does not have guidance specifically for retrofit situations (not including redevelopment situations). We encourage application of BMPs from this manual when it is feasible to do so. However, there are typically site constraints that make the application infeasible.

Application to Retrofit Situations

Ecology is inviting comment on how and under what circumstances to modify these BMPs for retrofit situations.

Ecology is also inviting comment on the use of BMPs not included in the manual for retrofit situations.

1.3 Development and Geographic Scope of This Manual

The Ecology stormwater manual was originally developed in response to a directive of the Puget Sound Water Quality Management Plan (Plan).[8] The Puget Sound Water Quality Authority (since replaced by the Puget Sound Water Quality Action Team, PSWQAT) recognized the need for overall guidance for stormwater quality improvement. It incorporated requirements in its Plan to implement a cohesive, integrated stormwater management approach through the development and implementation of programs by local jurisdictions, and the development of rules, permits, and guidance by Ecology.

One of the plan's stormwater elements (SW-3.1) requires Ecology to develop a stormwater technical manual for use by local jurisdictions. The Plan specifies aspects that the manual is to include.

With this update of the manual, Ecology is seeking to broaden the applicability of the manual to the entire state. In that effort, we have found that the concepts developed originally for the Puget Sound Basin are applicable throughout western Washington. In addition, most of the concepts, minimum requirements and BMPs are equally applicable in eastern Washington. Adjustment in the minimum requirements for flow control and treatment, adjustment of some BMP design criteria, and specification of the types of BMPs applicable in some eastern Washington environments seem appropriate.

1.4 Development of Best Management Practices to Improve Water Quality

1.4.1 Best Management Practices (BMPs)

The primary method by which the manual controls the adverse impacts of development and redevelopment is through the application of Best Management Practices

Best Management Practices are defined as schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants to waters of Washington State. The types of BMPs are source control, runoff treatment, and flow control.

The primary purpose of using BMPs is to protect beneficial uses of water resources through the reduction of pollutant loads and concentrations, and through reduction of discharges (volumetric flow rates) causing stream channel erosion. If it is found that, after the implementation of BMPs advocated in this manual, beneficial uses are still threatened or impaired, then additional controls may be required.

1.4.2 Source Control BMPs

Stormwater management programs should keep in mind that it is generally more cost effective to **prevent** impacts using source control than using runoff treatment to remove pollutants. However, since source controls cannot prevent all impacts, some combination of measures will always be needed.

R0073268

Source control BMPs, as the term implies, aim to **prevent** pollution, or other adverse effects of stormwater, from occurring. Ecology further classifies source control BMPs as operational or structural. Examples of source control BMPs include methods as various as using mulches and covers on disturbed soil, putting roofs over outside storage areas, berming areas to prevent stormwater run-on and pollutant runoff.

1.4.3 Treatment BMPs

Runoff treatment BMPs include facilities that remove pollutants by simple gravity settling of particulate pollutants, filtration, biological uptake, and soil adsorption. Runoff treatment BMPs can accomplish significant levels of pollutant load reductions if properly designed and maintained.

1.4.4 Flow Control BMPs

Flow control BMPs typically control the rate, frequency, and flow duration of stormwater surface runoff releases. The need to provide flow control BMPs depends on whether a development site discharges to a stream system or wetland, either directly or indirectly. Stream channel erosion control can be accomplished by BMPs that detain runoff flows and also by those which physically stabilize eroding streambanks. Both types of measures may be necessary in urban watersheds. Only the former is covered in this manual.

Construction of a detention pond is the most common means of meeting flow control requirements. The concept of detention is to collect runoff from a developed area and release it at a slower rate than it enters the collection system. The reduced release rate requires temporary storage of the excess amounts in a pond with release occurring over a few hours or days. The volume of storage needed is dependent on 1) the size of the drainage area; 2) the extent of disturbance of the natural vegetation, topography, and soils and creation of effective impervious surfaces (surfaces that drain to a stormwater collection system); and 3) how rapidly the water is allowed to leave the detention pond, i.e., the target release rates.

The 1992 Ecology manual focused primarily on controlling the peak flow release rates for recurrence intervals of concern – the 2, 10, and 100-year rates. This level of control did not adequately address the increased duration at which those high flows occur because of the increased volume of water from the developed condition as compared to the pre-developed conditions. To protect stream channels from increased erosion, it is necessary to control the durations over which a stream channel experiences geomorphically significant flows such that the energy imparted to the stream channel does not increase significantly. Geomorphically significant flows are those that are capable of moving sediments. This target will translate into lower release rates and significantly larger detention ponds than the previous Ecology standard. The size of such a facility can be reduced by changing the extent to which a site is disturbed.

In regard to wetlands, it is necessary to not alter the natural hydroperiod . This means control of flows from a development such that the wetland is within certain elevations at different times of the year. If the amount of surface water runoff draining to a wetland is increased because of land conversion from forested to impervious areas, it may be necessary to bypass some water around the wetland in the wet season. If however, the wetland was fed by local ground water elevations during the dry season, the impervious surface additions and the bypassing practice may cause variations from the dry season elevations. Estimations of what should be done to maintain the natural hydroperiod requires the use of a continuous runoff model. It remains to be seen whether the continuous runoff models we have available are sufficiently accurate to determine successful flow management strategies. And even if the modeling approaches are sufficient, it will be a challenge to simulate pre-development hydrology once you have significant development around and draining to or through a wetland.

1.5 Organization of This Manual

The manual is organized into five volumes

Volume I provides an introduction and overview, establishes thresholds for determining whether to apply small or large parcel minimum requirements, establishes the minimum requirements for large and small parcels, and provides guidance on preparation of a stormwater site plan. A glossary is included at the back of Volume I.

Volume II covers stormwater pollution prevention at construction sites with a primary focus on erosion and sediment control. The volume provides an overview of erosion and sedimentation, summarizes various regulatory requirements, describes how to prepare a Construction Stormwater Pollution Prevention Plan, and details the standards and specifications for BMPs.

Volume III covers hydrologic analysis methods for estimating pre- and post-developed runoff quantities and flow rates, and details of detention facility design, construction, and maintenance. It provides general information in regard to infiltration and constructed wetlands with references to Volume V for further details. It provides reference to the use of natural wetlands for stormwater. We have deleted the chapter on conveyance design, and encourage the use of other references.

Volume IV addresses control of runoff pollution produced by urban land uses with a primary emphasis on source control BMPs. Source control BMPs for specific types of activities are described in detail. Extensive appendices provide guidance on BMPs applicable to business types and helpful information concerning other related regulatory requirements and recycling, disposal, and treatment options for waste materials.

Volume V provides the details of treatment BMP design, construction, and maintenance. It is organized by treatment BMP types and details how to select BMPs according to the requirements and the needs of the site.

1.6 Users of This Manual

The users of this manual will be engineers, planners, environmental scientists, plan reviewers, and inspectors from local government and private industry. Local government officials may adopt and apply the requirements of this manual directly or adopt and apply the requirements of an equivalent manual. Local government staff will use this manual, or their own manual, as a reference for reviewing stormwater site plans, checking BMP designs, and for providing technical advice in general. Private industry will use the manual for information on how to develop and implement stormwater site plans, and as a reference for technical specifications of BMPS.

Where permits, such as the Baseline General Permit for Industrial Activities, references BMPs in this manual, affected industries shall use the manual for specifics concerning how to comply with their permits.

1.7 How to Use This Manual

Development project proponents will want to take the following steps:

- Read Chapter 2 in Volume I to determine the minimum requirements that apply to the project;
- Use Chapter 4 of Volume I to help select permanent BMPs for the project;
- Reference Volumes III through V for BMP design criteria;
- Use Chapter 3 of Volume I to help develop your stormwater site plan; and
- Use Volume II to plan your construction activities, including:
  - check your regulatory responsibilities in chapter 2;
  - use chapter 3 to develop your Construction Stormwater Pollution Prevention Plan; and
  - use chapter 4 to select and specify BMPs.

Businesses which need to comply with their industrial stormwater permit or a local requirement to apply source control BMPs should reference Volume IV.

1.8 Regulatory Status of the Manual

This manual has been developed by Ecology to represent the latest developments in technology-based management of urban stormwater. The manual itself has no independent regulatory authority. Its requirements and BMPs only become required through:

- ordinances and rules established by local governments; and,
- permits and other authorizations issued by local, state, and federal authorities.

1.9 Relationship of this Manual to Federal, State, and Local Regulatory Requirements

The Ecology manual is one cog in the efforts to manage and reduce the impacts of urban stormwater discharges. This section will explain the relationship of the manual to each of the various programs, permits, and planning efforts described below.

1.9.1 The Puget Sound Water Quality Management Plan

The Puget Sound Water Quality Management Plan (The Plan) requires all cities and counties in the Puget Sound Basin to implement stormwater management programs. Element SW-1.1 states that those programs are to include:

Ordinances for all new development and redevelopment which address control of off-site water quality and quantity effects; the use of source control BMPs; the effective treatment of the water quality design storm; the use of infiltration where appropriate; the protection of stream channels, fish and shellfish habitat, and wetlands; erosion and sediment control at construction project, and local enforcement of these stormwater controls.

Element SW-1.3 states that:

> "In conjunction with the runoff control ordinances for new development and redevelopment, each jurisdiction shall adopt a stormwater management manual containing best management practices. A local government may adopt the manual prepared by Ecology under element SW-3 or prepare its own manual as long as it has substantially equivalent technical standards to those in Ecology's manual. Ecology shall review alternative manuals of local governments for substantial consistency with the Plan and Ecology's manual and guidance."

Element SW-2.4 of the Plan requires that:

> "Each urban stormwater program shall seek to control the quality and quantity of runoff from public facilities and industrial, commercial and residential areas, including streets and roads, consistent with manuals and guidance provided by Ecology…"

Element SW-3.1 requires Ecology to:

> "…maintain a technical manual that implements the requirements in elements SW-1 and SW-2 for use by local jurisdictions in stormwater planning."

Ecology publishes this manual to fulfill its responsibilities under the Plan. Cities and counties are to adopt ordinances and manuals that are substantially equivalent. Ecology published guidance ("Guidance for Local Governments When Submitting Manuals and Associated Ordinances for Equivalency Review," 3/94, Publication #94-45) that listed the following criteria that Ecology uses to determine equivalency:

1. The Minimum Requirements *(in Chapter 2 of Volume I)* for new development and redevelopment now in the model ordinance *(also published by Ecology)* and the technical manual or their equivalents must be included in the ordinance adopted by the local government. More stringent requirements may be used, and/or the Minimum Requirements may be tailored to local circumstances through the use of basin plans.
2. The thresholds for and definitions of new development, redevelopment, land disturbing activities, and existing conditions should provide equivalent protection of receiving waters or equivalent levels of pollution treatment as those provided by Ecology's criteria.
3. The substantially equivalent manual must include BMP selection and site planning processes that have outcomes that provide equivalent or greater protection to those in Ecology's technical manual.
4. BMPs equivalent to those contained in Volumes II through IV *(corresponding to proposed Volumes II through V of this update)* of Ecology's manual must be included in the local government's version of the manual.
5. An exceptions or variance process similar in content to Section I-2.16 *(Section 2.8 of Volume I in this update)*, Exceptions, must be included.

Manual Equivalency Criteria

As part of this manual update, Ecology will update the equivalency criteria. Ecology invites comments on this section.

The text in Chapter 2 of Volume 1 that is in **bold print** are those concepts that Ecology will require local governments to incorporate or to have equivalent concepts that provide an equal or greater level of protection or treatment.

1.9.2 Phase I NPDES and State Waste Discharge Stormwater Permits for Municipalities

Ecology has issued joint NPDES and State Waste Discharge permits to regulate the discharges of stormwater from the municipal separate storm sewer systems operated by the following cities and counties:

Clark County, King County, Pierce County,

Snohomish County, Seattle, and Tacoma.

The Washington Department of Transportation is also a Phase I municipal stormwater permittee for its stormwater discharges within the jurisdictions of the above cities and counties.

As a condition (Special Condition S7.b.8.a.) of the permits issued in July, 1995, these entities are required to implement stormwater programs that must include:

> "... ordinances (except WSDOT's program), minimum requirements and best management practices (BMPs) equivalent to those found in Volumes I-IV of Ecology's *Stormwater Management Manual for the Puget Sound Basin* (1992 edition, and as amended by its replacement)...."

These entities have until the end of the permit terms, July, 2000 to comply with this requirement.

Ecology will reissue the Phase I permits in July, 2000. At that time we will add whatever additional municipalities are required by federal law to have an NPDES Phase I municipal stormwater permit. We also intend to continue to retain the above special condition with a reference to the year 2000 edition of the Ecology stormwater manual. Ecology may also add a deadline or deadlines within the term of the permit for compliance with the condition.

1.9.3 Phase II NPDES and State Waste Discharge Stormwater Permits for Municipalities

The U.S. Environmental Protection Agency (EPA) intends to promulgate its Phase II stormwater regulations in October, 1999. Those rules will identify additional municipalities as subject to NPDES municipal stormwater permitting requirements. An initial estimate is that 76 municipalities will be subject to the requirements, and 13 additional municipalities may be subject to the requirements depending upon an analysis that Ecology must perform. Unless the dates change in the final rule, the Phase II permits must be issued by November 2002. The Phase II communities must submit their stormwater programs to comply with permit requirements by January 2003.

The proposed regulations specify minimum requirements for the stormwater programs developed to comply the Phase II permits.

One of those requirements is the adoption of a program for "post-construction stormwater management in new development and redevelopment." Another is a program for "construction site stormwater runoff control."

To at least partially fulfill these requirements, Ecology intends to require the Phase II municipalities to adopt ordinances, minimum requirements, and BMPs equivalent to those in this updated manual. Essentially, this would be the same permit condition as required of the Phase I municipalities. However, a different schedule for compliance may be necessary for some municipalities. Municipalities within the Puget Sound Basin should have already completed these tasks as required by the Puget Sound Water Quality Management Plan, and as encouraged by the State's strategy for salmon recovery.

1.9.4 Municipalities Not Subject to the Puget Sound Water Quality Management Plan nor NPDES Stormwater Permits for Municipalities

Municipalities not subject to the Puget Sound Plan nor NPDES stormwater permits for municipalities are encouraged to adopt stormwater programs at least equivalent to the Puget Sound Basic Stormwater Program. This would include adoption of ordinances, minimum requirements, and BMPs equivalent to those in Ecology's manual. Any municipalities in areas where urban stormwater has been identified as a limiting factor to salmon recovery are expected to have an equivalent stormwater manual as part of a Comprehensive Stormwater Program as defined by the Puget Sound Water Quality Management Plan.

1.9.5 The NPDES and State Waste Discharge Baseline General Permit for Stormwater Discharges Associated With Industrial Activities (a.k.a., industrial stormwater permit)

Businesses subject to the Baseline General Permit for Stormwater Discharges Associated With Industrial Activities have to prepare and implement a Stormwater Pollution Prevention Plan in accordance with the terms of that permit. The permit issued in November 1995 requires a description and implementation of generic "operational BMPs" (the same category of BMPs referred to as operational source control BMPs in this manual), and "source control BMPs" (the same category of BMPs referred to as "structural source control" BMPs in this manual) from Volume IV of the 1992 Puget Sound Stormwater Manual. Additionally, application of erosion and sediment control BMPs, flow control BMPs and treatment BMPs from the 1992 manual and other published guidance is required if necessary to address an erosion, flow, or pollution problem.

The existing industrial stormwater permit expires in November 2000. Ecology intends to redraft the permit conditions and reissue the permit by that date. As a condition of the reissued permit, Ecology anticipates that it will require industrial stormwater permittees to implement the BMPs in this updated stormwater manual. Ecology will consider retaining the statement in the existing permit that allows businesses to implement alternative BMPs as long as they can demonstrate that it will result in equal or better quality of stormwater discharge.

1.9.6 The NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated With Construction Activity (a.k.a., construction stormwater permit)

Projects covered by the construction stormwater permit must select BMPs from Volume II of this manual if the date of the BMP selection process for the project is 120 days or more after the issue date of the manual.

Construction sites that will disturb five acres or more and will have a discharge of stormwater from the project site to a surface water must apply for Ecology's construction stormwater permit. The permit requires application of stabilization and structural practices to reduce the potential for erosion and the discharge of sediments from the site. The stabilization and structural practices cited in the permit are very similar to the 15 minimum requirements for sedimentation and erosion control in Volume I of the 1992 Puget Sound stormwater manual. The permit also requires construction sites within the Puget Sound basin to select BMPs from Volume II of **the most recent version of the Ecology stormwater manual that has been available at least 120 days prior to the BMP selection.** Sites outside the basin are required to select BMPs from the manual, from the Erosion and Sediment Control Handbook, by Goldman et al, or to select other appropriate BMPs. The permit also states that where Ecology has determined the local government requirements for construction sites to be at least as stringent as Ecology's, Ecology will accept compliance with the local requirements.

The construction stormwater permit issued in November 1995 expires in November 2000. Ecology intends to reissue a new permit by the latter date. We anticipate that the reissued permit will require compliance with the construction stormwater pollution prevention elements cited in Large Parcel Minimum Requirement #1, and listed in Chapter 3 of Volume II. We also anticipate that the permit will require selection of BMPs from Volume II of this manual, and that it will allow use of BMPs from local government manuals where they have been determined to be equivalent.

The proposed EPA Phase II stormwater regulations would require construction sites of 1 acre and larger to apply for an NPDES stormwater permit. If that regulation is adopted as proposed, Ecology will likely require all such sites to apply for coverage under its reissued construction stormwater permit.

1.9.7 The Endangered Species Act: Section 4(d) Rules, Section 7 Consultations, Section 10 Habitat Conservation Plans

With the listing of multiple species of salmon as threatened or endangered across much of Washington State, and the probability of more listings in the future, implementation of the requirements of the Endangered Species Act will have a dramatic effect on urban stormwater management. The manner in which that will occur is still evolving.

Under Section 4(d) of the statute, the federal government issues regulations to provide for the conservation of the species. A 4(d) rule may require new development and redevelopment to comply with specific requirements. It remains to be seen whether the federal government will cite the requirements of this manual in a 4(d) rule.

Under Section 7 of the statute, all federal agencies must insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species (or a species proposed for listing), nor result in the destruction or adverse modification of designated critical habitat. The responsibility for determining whether jeopardy is likely to occur rests with the "action" agency. If an action "may affect" a listed species, the "action" agency must consult with the National Marine Fisheries Service (NMFS), or the U.S. Fish and Wildlife Service (F &WS) depending on the species involved, to determine whether jeopardy is likely to occur. Where NMFS or F&WS believes that jeopardy would result, it must specify reasonable and prudent alternatives to the action that would avoid jeopardy if any such alternatives are available. If the "action" agency rejects these, the action cannot proceed. This manual may play a role in these jeopardy decisions and the alternatives cited to avoid jeopardy.

Under Section 10 of the ESA, through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit an "incidental take" of individuals of that species as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). This new provision of the ESA is designed to resolve conflicts between development pressures and endangered species protection. A "Habitat Conservation Plan" (HCP) is an example of this type of agreement. Under an HCP, the applicant's plan must:

- outline the impact that will likely result from the taking;
- list steps the applicant will take to minimize and mitigate such impacts, and funding available to implement such steps; and
- include alternative actions the applicant considered and reasons alternative acts are not being used.

The federal government may grant a permit if it finds that the taking will be incidental; the applicant will minimize and mitigate impacts of taking; and the applicant will ensure that adequate funding for the conservation plan will be provided. This manual may play a key role in any proposed Habitat Conservation Plans.

1.9.8 Section 401 Water Quality Certifications

For projects that require a fill or dredge permit under Section 404 of the Clean Water Act, Ecology must certify to the permitting agency, the U.S. Army Corps of Engineers, that the proposed project will not violate water quality standards. In order to make such a determination, Ecology may do a more specific review of the potential impacts of a stormwater discharge from the construction phase of the project and from the completed project. As a result of that review, Ecology may condition its certification to require:

- application of the minimum requirements and BMPs in this manual; or
- application of more stringent requirements.

1.9.9 Hydraulic Project Applications (HPAs)

Under Chapter 75.20 RCW, the Hydraulics Act, the Washington State Department of Fish and Wildlife has the authority to require actions of projects whose stormwater discharges would change the natural flow or bed of state waters. The implementing mechanism is

the issuance of an Hydraulics Project Approval (HPA) permit. In exercising this authority, Fish and Wildlife may require:

- compliance with the provisions of this manual; or
- application of more stringent requirements that they determine are necessary to meet their statutory obligations to protect fish and wildlife.

1.9.10 Aquatic Lands Use Authorizations

The Department of Natural Resources (DNR), as the steward of public aquatic lands, may require a stormwater outfall to have a valid use authorization, and to avoid or mitigate resource impacts. Through its use authorizations, which are issued under authority of Chapter 79.90 through 96, and in accordance with Chapter 332-30 WAC, DNR may require:

- compliance with the provisions of this manual; or
- application of more stringent requirements that they determine are necessary to meet their statutory obligations to protect the quality of the state's aquatic lands.

1.9.11 Requirements Identified through Watershed/Basin Planning or Total Maximum Daily Loads (TMDL's, a.k.a., Water Clean-up Plans)

A number of the requirements of this manual can be superseded by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans. Local governments may initiate their own watershed or basin planning processes to identify more stringent or alternative requirements. They may also choose to develop a watershed plan in accordance with the Watershed Management Act (ESHB 2514) that includes the optional elements of water quality and habitat. They may also choose to develop a basin plan in accordance with Chapter 400-12 WAC. As long as the actions or requirements identified in those plans and implemented through local or state ordinances or rules comply with the intent of applicable state and federal statutes (e.g., The federal Clean Water Act and the Endangered Species Act), they can supersede the requirements in this manual. The decisions concerning whether such locally derived requirements comply with the intent of federal and state statutes rest with the regulatory agencies responsible for implementing those statutes.

The requirements of this manual can also be superseded through the adoption of actions and requirements identified in a Total Maximum Daily Load that is approved by the EPA.

1.9.12 Other Local Government Requirements

Local governments have the option of applying more stringent requirements than those in this manual. They are not required to base those more stringent requirements on a watershed/basin plan or their obligations under a TMDL. Project proponents should always check with the local governmental agency with jurisdiction to determine the stormwater requirements that apply to their project.

CHAPTER 2 - Minimum Requirements For All New Development and Re-Development

2.1 Introduction

This manual, now expanded to be applicable on a statewide basis, was originally developed to comply the 1991 Puget Sound Water Quality Management Plan. That plan (as amended) requires all counties and cities within the Puget Sound drainage basin to adopt stormwater programs which include minimum requirements for new development and redevelopment set by the Plan and in guidance developed by Ecology. The programs are to include ordinances that address:

> *"... at a minimum: (1) the control of off-site water quality and quantity effects; (2) the use of best management practices for source control and treatment; (3) the effective treatment, using best management practices, of the storm size and frequency (design storm) as specified in the manual for proposed development; (4) the use of infiltration, with appropriate precautions, as the first consideration in stormwater management; (5) the protection of stream channels, fish, shellfish habitat, other aquatic habitat, and wetlands; (6) erosion and sedimentation control for new construction and redevelopment projects; and (7) local enforcement of these stormwater controls."*

Ecology considers the above description to be generic to proper stormwater management in any region within the State of Washington. There are judgements that must be made concerning appropriate technical standards for each region of the state based on differences in hydrology, soils, and underlying geology. For this edition of the manual, Ecology has identified flow control standards and water quality treatment design storms as the only requirements that justify different standards for eastern and western Washington. Ecology has also identified different Best Management Practices (BMPs) that will aid eastern Washington development sites to achieve the intent of the minimum requirements.

R0073281

There are several sets of requirements for proposed new development and redevelopment that are applied depending on the type and size of the proposed development. In general, small sites are required to control erosion and sedimentation from construction activities and to apply simpler approaches to treatment and flow control of stormwater runoff from the developed site. Controlling flows from small sites is important because the cumulative effect of uncontrolled flows from many small sites can be as damaging as those from a single large site.

Large sites must provide erosion and sedimentation control during construction, permanent control of stormwater runoff from the developed site through selection of appropriate BMPs, and other measures to reduce and control the onsite and offsite impacts of the project. Sites being redeveloped must generally meet the same minimum requirements as new development for the portion of the site being redeveloped. In addition, if the redevelopment meets certain cost thresholds, updated stormwater management for the entire site must be provided. There may also be situations in which additional controls are required for sites, regardless of type or size, as a result of basin plans or special water quality concerns.

Development sites are to demonstrate compliance with these requirements through the preparation of Stormwater Site Plans (SSP). The plans are described in detail in Chapter I-3. Two major components of these plans are a Construction Stormwater Pollution Prevention Plan (SWPPP) and a Permanent Stormwater Quality Control (PSQC) Plan. The Construction SWPPP shall identify how the project intends to control pollution generated during the construction phase only, primarily erosion and sediment. The PSQC shall identify how the project intends to provide permanent BMPs for the control of pollution from stormwater runoff after construction has been completed. Small sites must submit these plans for review by the local government only if they add or replace 5,000 square feet or more of impervious surface.

A flow chart demonstrating how to determine which set of requirements applies to a particular project is shown in Figure 2.2.

Throughout this Chapter, guidance to meet the requirements of the Puget Sound Water Quality Management Plan is written in bold and supplemental guidelines that serve as advice and other materials are <u>not</u> in bold.

R0073282

2.2 Definitions

A full listing and definition of stormwater-related words and phrases that are used in this manual is given in the glossary. A few of the key definitions are listed here for ease in understanding the requirements that follow.

Land disturbing activity Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to demolition, construction, clearing, grading, filling and excavation.

New development Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of impervious surfaces; subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. All other forest practices and commercial agriculture are not considered new development.

Impervious surface A hard surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces.

Pollution-generating impervious surface (PGIS) Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities; or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall. Erodible or leachable materials, wastes, or chemicals are those substances which, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage. Metal roofs are also considered to be PGIS unless they are treated to prevent leaching.

R0073283

A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced firelanes, diesel equipment storage yards, and airport runways.

The following are not considered regularly-used surfaces: road shoulders primarily used for emergency parking, paved bicycle pathways, bicycle lanes adjacent to unpaved or paved road shoulders primarily used for emergency parking, fenced firelanes, and infrequently used maintenance access roads.

Pollution-generating pervious surfaces (PGPS) Any non-impervious surface subject to use of pesticides and fertilizers or loss of soil.

Project site That portion of a property or properties subject to proposed project improvements including those required by this manual.

Redevelopment On an already developed site, the creation or addition of impervious surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity; land disturbing activities associated with structural or impervious redevelopment; and any change in use that has the potential to release new pollutants from the site. New pollutants means a pollutant that was not discharged at that location immediately prior to the change in use, as well as a pollutant that was discharged in less quantities immediately prior to the change in use.

Replaced impervious surface For structures, the removal and replacement of any exterior surfaces or foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement, excluding impervious surfaces removed for the sole purpose of installing underground utilities.

Site The legal boundaries of a parcel or parcels of land that is (are) subject to new or redevelopment.

Small Parcel A site with less than one acre of land disturbing activity, AND ξ is a single family residential site, or a small subdivision project, that adds or replaces less than 10,000 square feet of impervious surface; or

ξ is another type of development project that adds less than 5,000 square feet of impervious surface.

Source control BMP

A BMP that is intended to prevent pollutants from entering stormwater. This manual separates source control BMPs into two types. *Structural Source Control BMPs* are physical, structural, or mechanical devices that are intended to prevent pollutants from entering stormwater. *Operational BMPs* are schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. See Volume IV for details.

Threshold Discharge Area

An onsite area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flowpath). The examples in Figure 2.1 below illustrate this definition.

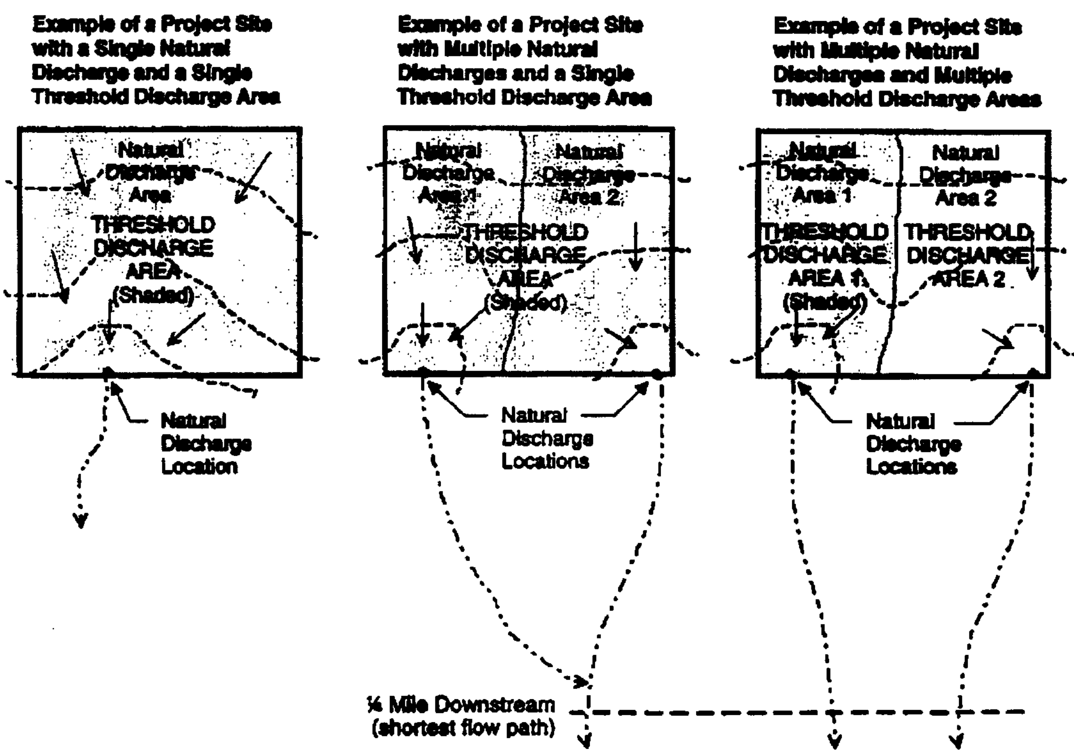


Figure 2.1. Threshold Discharge Areas

2.3 Exemptions

Commercial agriculture, and forest practices regulated under Title 222 WAC, except for Class IV General forest practices that are conversions from timber land to other uses, are exempt from the provisions of the minimum requirements. All other new development is subject to the minimum requirements.

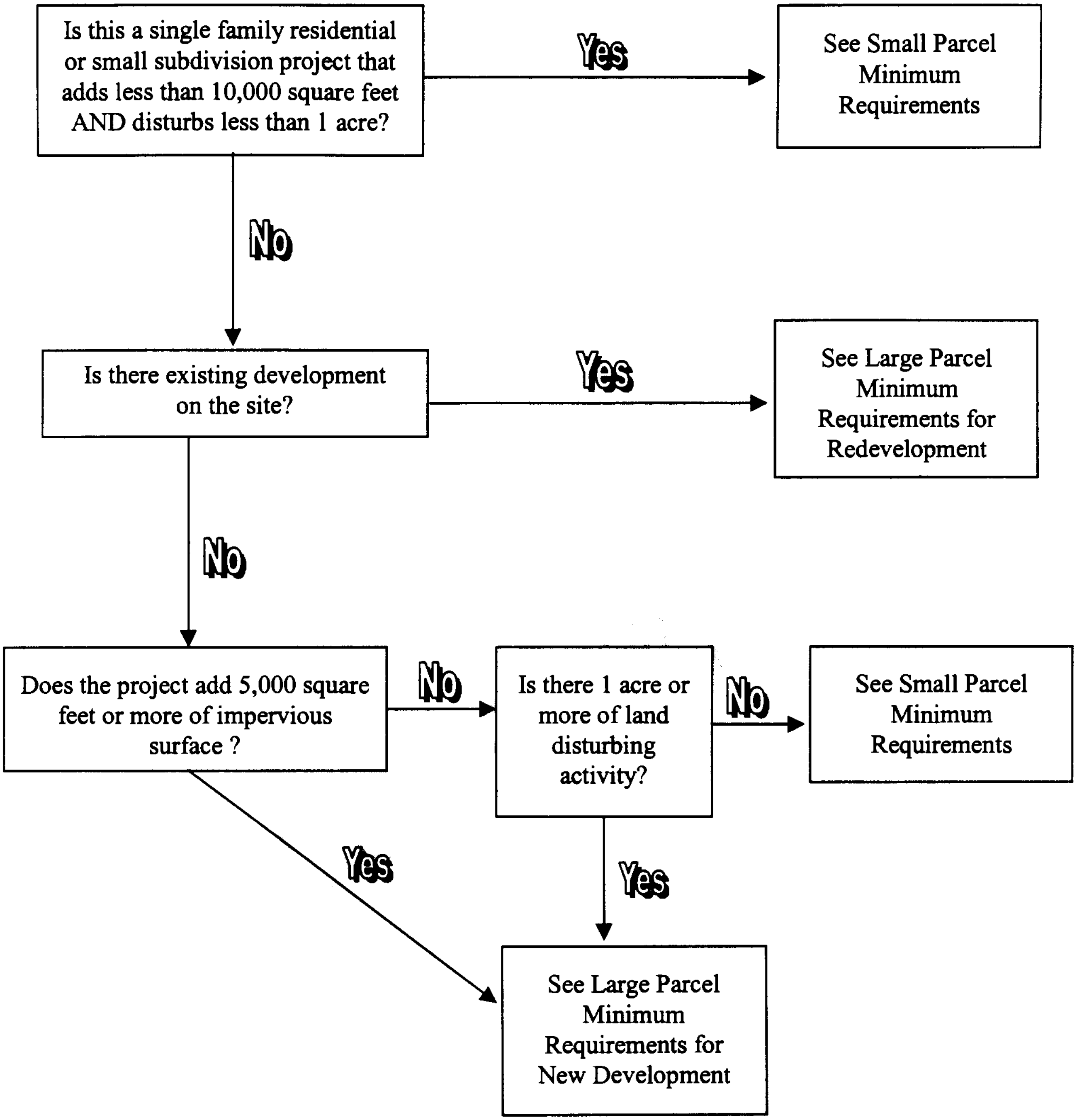


Figure 2.2: Flow Chart for Determining Applicable Requirements

R0073287

2.4 Small Parcel Requirements

A project site of a single family residence, or a small subdivision, that meets the small parcel definition is required to comply with the applicable provisions of Large Parcel Minimum Requirement #1 – Construction Stormwater Pollution Prevention (Construction SWPP) and to apply Small Site Requirements for water quality treatment and flow control. Other types of development projects that meet the definition must comply with the applicable provisions of Large Parcel Minimum Requirement #1 – Construction SWPP, Large Parcel Minimum Requirement #3 – Source Control, and apply Small Site Requirements for water quality treatment and flow control.

Small Parcels that add or replace 5,000 square feet or more of impervious surface must prepare a stormwater site plan for local government review.

Small Site Flow Control and Treatment

Ecology intends to propose small site flow control and treatment BMPs for addition to the appropriate Volumes III and V of this manual.

2.5 Large Parcel Thresholds

2.5.1 New Development

All new development, other than small parcels, that includes the creation or addition of 5,000 square feet, or greater, of new impervious surface area, and/or land disturbing activity of one acre or greater, shall comply with Large Parcel Minimum Requirements #1 through #9 and prepare a Stormwater Site Plan.

Supplemental Guidelines:

Basin planning is encouraged and may be used to tailor certain of the Large Parcel Minimum Requirements to a specific basin (see Large Parcel Minimum Requirement #8).

2.5.2 Redevelopment

All redevelopment projects in which the total of *new plus replaced* impervious surfaces is 5,000 square feet or more must comply with Large Parcel Minimum Requirements #1 and #3 for the project site.

Redevelopment projects that add 5,000 square feet or more of *new* impervious surface must comply with all the Large

Parcel Minimum Requirements for the new impervious surfaces. If the runoff quantity from the new surfaces is not separated from runoff from other surfaces prior to treatment or flow control, the stormwater facilities must be sized for the entire flow. Alternatively, the local government may allow the Large Parcel Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site.

All redevelopment projects in which the total of new plus replaced impervious surfaces is 5,000 square feet or more, and whose valuation of proposed improvements – including interior improvements - exceeds 50% of the assessed value of the existing site improvements shall comply with all the Large Parcel Minimum Requirements for the entire site.

Local governments may exempt redevelopment projects from compliance with Large Parcel Minimum Requirements #4, #5, and/or #6 if they have adopted a plan that fulfills those requirements in regional facilities that will discharge to the same receiving water, AND if they have an implementation plan and a schedule for construction of those facilities. Redevelopment projects for public roads may be exempted from meeting Large Parcel Minimum Requirements #4, #5, and/or #6 for the entire site (i.e., the exemption does not extend to new surfaces that add impervious area) if there is an adopted Capital Improvement Program for retrofitting existing road surfaces.

Application of the Exemptions

Ecology is interested in advice on the application of the exemptions listed above. Should exemptions be granted for redevelopment projects if the local government has a plan and a schedule for future construction of regional facilities, or should the exemption only apply if the regional facilities have been constructed?

Also, who determines the adequacy of plans and schedules for regional facilities or of Capital Improvement Programs? Currently, there isn't a review entity identified to ensure the quality and legal adequacy of those plans, nor if they are properly implemented and on schedule.

***Supplemental Guidelines*:** Local governments can establish criteria for allowing redevelopment projects to pay a fee in lieu of constructing water quality or flow control facilities on a redeveloped site. At a minimum, the fee should be the equivalent of an engineering estimate of the cost of meeting all applicable stormwater requirements for the project. For purposes of cost estimation, the local government may allow the applicant to presume the site does not have unusual physical constraints that would escalate stormwater costs. The local government must use such funds for the implementation of stormwater control projects that would have similar benefits to the same receiving water as if the project had constructed its required improvements. Expenditure of such funds is subject to other state statutory requirements.

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics should not be subject to redevelopment requirements.

Local governments are also encouraged to review all road projects for changes in elevations or drainage flowpath that could cause flooding, upland or stream erosion, or changes to discharges to wetlands.

2.6 Large Parcel Minimum Requirements

2.6.1 Minimum Requirement #1: Construction Stormwater Pollution Prevention (SWPP)

All new development and redevelopment shall comply with Construction SWPP Elements #1 through #12 below, and shall develop and implement a Construction Stormwater Pollution Prevention Plan (SWPPP). Each of the following twelve required elements must be included in the Construction SWPPP unless exemptions are justified in the narrative.

The following Construction Stormwater Pollution Prevention (SWPP) elements shall be met:

Element #1: Mark Clearing Limits

- **Prior to beginning earth disturbing activities, including clearing and grading, all clearing limits, easements, setbacks, sensitive areas and their buffers, trees, and drainage courses should be clearly marked to prevent damage and offsite impacts.**

Element #2: Establish Construction Access

- **Construction vehicle access and exit shall be limited to one route if possible.**
- **Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.**
- **Wheel wash or tire baths should be located on-site.**

- **If sediment is transported onto a road surface, the roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or sweeping and be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.**
- **Street wash wastewater shall be controlled by pumping back on-site, or otherwise be prevented from discharging into systems tributary to state surface waters without prior and adequate treatment.**

Element #3: Detain Flows

- **Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.**
- **Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, streambanks, bed sediment or aquatic habitat. See Volume 1, Minimum Requirement #8, for downstream analysis requirements.**
- **Stormwater detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional before other land disturbing activities take place.**

R0073291

Flow Control for Sediment Ponds

We would like to receive comment on whether the flow control achieved (as estimated by the analysis below) by the flow control release structure specified for sediment ponds in Chapter 4 is adequate for construction sites which are by their nature, temporary. Also, should flow control release structures be required for sediment traps?

The flow release structure detailed in Volume II, Chapter 4 for sediment ponds and traps will not achieve the same level of flow control as required by Minimum Requirement # 5 of Volume I. The flow control specified by Minimum Requirement # 5 is intended to protect stream channels from accelerated erosion due to increases in the duration and frequency of high stream flows.

Using a continuous runoff simulation model (King County Runoff Time Series) King County staff did a brief evaluation of the level of control achieved by the release structure specified in Chapter 4. The analysis assumed a typical sediment retention facility sized using the 2-year developed flow for a 10-acre urban residential subdivision (4 acres effective impervious area and 6 acres of grass on till soils). The performance of the facility was evaluated assuming the construction site was fully disturbed, but with no improvements (modeled as 10 acres of grass on till soils). The analysis concluded that pre-developed peak flows were at least matched up to a 5-year event. Flow durations were controlled to pre-developed rates for peak flows ranging between 70% of the 2-year and roughly a 15-year event.

Element #4: Install Sediment Controls

- **Prior to leaving a construction site, stormwater runoff shall pass through a sediment pond, sediment trap, or other appropriate sediment removal BMP.**
- **Sediment ponds and traps, vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on-site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.**
- **Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.**

Element #5: Stabilize Soils

- **All exposed and unworked soils shall be stabilized by application of effective BMPs, which protect the soil from the erosive forces of raindrop impact and flowing water.**

R0073292

- **From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at final grade or not.**
- **Applicable practices include, but are not limited to, sod and other established vegetative cover, mulching, plastic covering, and the early application of gravel base on areas to be paved.**
- **Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters.**
- **Soil stockpiles must be stabilized and protected with sediment trapping measures.**
- **Work on linear construction sites and activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall not exceed the capability of the individual contractor for his portion of the project to install the bedding materials, roadbeds, structures, pipelines, and/or utilities, and to re-stabilize the disturbed soils, meeting the timing conditions specified above in Element #5.**

Element #6: Protect Slopes

- **Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion.**
- **Consider soil type and its potential for erosion.**
- **Reduce slope runoff velocities by reducing continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.**
- **Divert upslope drainage and run-on waters from off-site with interceptors at top of slope. Off-site stormwater should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option.**
- **Contain downslope collected flows in pipes, slope drains, or protected channels.**

R0073293

- Provide drainage to remove ground water intersecting the slope surface.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Flow retention barriers shall be placed at regular intervals within trenches, which are cut down a slope.
- Stabilize soils on slopes, as specified in Element #5.

Element #7: Protect Drain Inlets

- All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- All approach roads shall be kept clean, and all sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment.
- Suggested BMPs

  BMP 220: Storm Drain Inlet Protection

Element #8: Stabilize Channels and Outlets

- All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected velocity of flow from a 2 year, 24-hour frequency storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

Element #9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and wastes present on the site.

- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted under cover and on impervious surfaces. These surfaces shall be cleaned immediately following any discharge or spill incident.

- Wheel wash, or tire bath wastewater, shall not be discharged to the storm drain, or the on-site stormwater treatment system.

- Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures.

- Management of pH-modifying sources shall prevent contamination of runoff and stormwater collected on the site. These sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

Element #10: Control De-Watering

- All foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system, prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.

- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow is less than 20 percent of the receiving water flow. These clean waters should not be routed through sediment traps or sediment ponds with stormwater.

- Highly turbid or otherwise contaminated dewatering water, such as from construction equipment

operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater at the site.

- **Other disposal options, depending on site constraints, may include: 1) sanitary sewer discharge with local sewer district approval, 2) overland infiltration, 3) transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.**

Element #11: Maintain BMPs

- **All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with BMPs.**
- **All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.**

Element #12: Manage The Project

- **Phasing of construction**
- **Seasonal work**
- **Employee training**
- **Pre-construction conference**
- **Coordination with utilities and other contractors**
- **Sub-contractor oversight**
- **Linear site special considerations**
- **Monitoring / reporting**
- **Keeping Construction SWPPP up to date**

Managing the Project

Ecology intends to add more detail to Element #12. We encourage comments concerning the completeness of the above list of sub-elements, and concerning the appropriate text for each of the sub-elements.

Objective: To control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project.

Supplemental Guidelines: If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), then the Plan Approval Authority[1] within the Local Government should require that other BMPs be implemented, as appropriate.

2.6.2 Minimum Requirement #2: Preservation of Natural Drainage Systems

Natural drainage patterns shall be maintained, and discharges from the site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downgradient receiving waters.

Objective: To preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide.

Supplemental Guidelines: Creating new discharge points can create significant stream channel erosion problems as the receiving water body typically must adjust to the new flows. Diversions can cause greater impacts than would otherwise occur by discharging runoff at the natural location. Where no conveyance system exists at the adjacent downstream property line and the discharge was previously unconcentrated flow or significantly lower concentrated flow, then measures must be taken to prevent downstream impacts. Local governments are encouraged to broaden this requirement to include protection against adverse impacts to downgradient properties and drainage systems. Drainage easements from downstream property owners may be needed and should be obtained prior to approval of engineering plans.

2.6.3 Minimum Requirement #3: Source Control Of Pollution

All known, available and reasonable source control BMPs shall be applied to all projects. Source control BMPs shall be selected, designed, and maintained according to this manual.

An adopted and implemented basin plan (Minimum Requirement #8) or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop more stringent source control requirements that are tailored to a specific basin.

---

[1]The Plan Approval Authority is defined as that department within a local government that has been delegated authority to approve erosion and sediment control plans.

Objective:

The intention of source control BMPs is to prevent stormwater from coming in contact with pollutants. They are a cost effective means of reducing pollutants in stormwater, and, therefore, should be a first consideration in all projects.

Supplemental Guidelines:

A list of many source control BMPs is provided in the BMP selection chapter of this volume. Source Control BMPs include Operational BMPs and Structural Source Control BMPs. See Volume IV for design details of these BMPs. For construction sites, see Volume II, Chapter 4.

2.6.4 Minimum Requirement #4: Runoff Treatment

Thresholds

The following require construction of stormwater treatment BMPs that are sized to treat runoff from the water quality design storm:

- **Single family or multi-family residential or subdivision projects in which the total of new plus replaced pollution-generating impervious surfaces (PGIS) is 10,000 square feet or more in a threshold discharge area of the project, or**
- **Other development projects in which the total of new plus replaced PGIS is 5,000 square feet or more in a threshold discharge area of the project, or**
- **Projects in which the total of new plus modified pollution-generating pervious surfaces (PGPS) is one acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site. Modified PGPS means any existing PGPS that is re-graded or re-contoured by the proposed project.**

Standard Requirement

Treatment BMPs shall be sized to treat runoff from the water quality design storm, defined as the 24-hour rainfall amount with a 6-month return frequency. Approved single event hydrograph methods identified in Volume III shall be used to identify runoff volumes and peak flow rates for design purposes. Alternative methods can be used if they identify volumes and flow rates that are at least equivalent.

That portion of any development project in which the above PGIS or PGPS thresholds are not exceeded in a threshold discharge area shall apply Small Site Requirements for water quality treatment.

R0073298

Table 2.1. Treatment Requirements for PGIS by Threshold Discharge Area

	SFR or MFR < 10,000 sf PGIS	SFR or MFR, ≥ 10,000 sf PGIS	Other type of development <5,000 sf PGIS	Other type of development, ≥ 5,000 sf
Large Site Treatment BMPs		✔		✔
Small Site Treatment BMPs	✔		✔	

PGIS = pollution-generating impervious surfaces
SFR = single family residence
MFR = multiple family residence
sf = square feet

Performance Criteria

A discussion on performance criteria will be included in Volume V.

R0073299

Water Quality Design Storm Event

Ecology encourages discussion of options for establishing a water quality design storm event. The options currently under consideration include the following. These are discussed in more detail in Appendix B:

1) An estimation of a 6-month, 24-hour rainfall amount.

2) Selected percentages of the 2-year, 24-hour rainfall amount, as an estimate of the 6-month, 24-hour rainfall amount.

3) Using 24-hour rainfall data, selection of a precipitation amount for which the cumulative sum of rainfall amounts of that size and smaller account for a certain percentage (e.g., 90%) of the total rainfall inches.

4) Using 24-hour rainfall data, establish a rainfall amount for the knee of the curve for a graph of increasing 24-hour rainfall amounts (y-axis) versus cumulative number of rainfall events (x-axis).

5) Use a multiple of the mean annual storm.

6) Use of continuous runoff modeling to establish: a) a runoff flow rate that is exceeded only X % of the time using the appropriate time increment for a BMP sized based on a peak flow rate, and b) a 24-hour runoff amount that is exceeded only X% of the time for BMP's based on runoff volume.

A more detailed description of each of these options and the rainfall amounts they represent for various locations around the state are found in Appendix 2 to this chapter.

Additional Requirements

Direct discharge of untreated stormwater from pollution-generating impervious surfaces to ground water is prohibited, except for that achieved by infiltration or dispersion of runoff as allowed under the Small Site Requirements. All treatment BMPs shall be selected, designed, and maintained according to a local government manual deemed equivalent to this manual.

An adopted and implemented basin plan (Minimum Requirement #8), or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop more stringent runoff treatment requirements that are tailored to a specific basin.

Treatment BMPs applied consistent with this manual are presumed to meet the requirement of state law to provide all

known available and reasonable methods of treatment (RCW 90.52.040, RCW 90.48.010). This technology-based treatment requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC, state ground water quality standards, Chapter 173-200 WAC, and state sediment management standards, Chapter 173-204 WAC. Additional treatment to meet those standards may be required by federal, state, or local governments.

Objective: The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms. When site conditions are appropriate infiltration can potentially be the most effective BMP for runoff treatment.

***Supplemental Guidelines*:** See Volume V. The water quality design storm is intended to capture and effectively treat about 90-93% of the annual runoff in western and eastern Washington, and about 80-85% of the annual runoff in Central Washington (an area east of the Cascade crest and west of the Columbia River).

Infiltration can provide both treatment of stormwater, through the ability of certain soils to remove pollutants, and volume control of stormwater, by decreasing the amount of water that runs off to surface water. Infiltration can be very effective at treating stormwater runoff but soil conditions must be appropriate to achieve effective treatment while not impacting ground water resources. Methods currently in use such as direct discharge into dry wells do not achieve adequate water quality treatment and are therefore not permitted.

2.6.5 Minimum Requirement #5: Flow Control for Discharges to Streams

__Applicability__
The requirement below applies only to situations where stormwater runoff is discharged directly or indirectly to a stream, and must be met __in addition__ to meeting the requirements in Minimum Requirement #4, Runoff Treatment BMPs.

__Thresholds__
The following require construction of detention ponds with discharge orifices that are sized to meet the applicable standard requirement for western or eastern Washington:

- **Any projects in which the total of new plus replaced impervious surfaces is 10,000 square feet or more in a threshold discharge area of the project, or**

- **Projects in which the total of land disturbing activity is one acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.**

That portion of any development project in which the above thresholds are not exceeded in a threshold discharge area shall apply Small Site Requirements for flow control.

<u>Western Washington Standard Requirement:</u>
Applies to the geographic areas designated as regions 3 and 4 in NOAA Atlas #2 (Miller et al, 1973)[9].

Stormwater discharges to streams shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. In addition, the developed peak discharge rates shall not exceed the pre-developed peak discharge rates for 2- and 10-year return periods. The applicant shall use best available information to determine whether to assume that the pre-developed condition was forested or pasture.

<u>Western Washington Alternative Requirement</u>
An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

1) **Establishment of a stream –specific threshold of significant bedload movement other than the assumed 50% of the 2-year peak flow;**

2) **Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel; or**

3) **A duration control standard is not necessary for protection, maintenance, or restoration of designated beneficial uses or Clean Water Act compliance.**

<u>Additional Requirement</u>
As the first priority, flow control BMPs shall utilize infiltration to the fullest extent practicable if site conditions

are appropriate and ground water quality is protected. Flow Control BMPs shall be selected, designed, and maintained according to a local government manual deemed equivalent to this manual.

> ### Flow Control Exemption
>
> Ecology is considering an exemption from the flow control requirement for projects that discharge directly to major receiving waters and that are within a certain flowpath distance of those receiving waters. We encourage suggestions for a definition for major receiving waters and of a flowpath distance as well as other conditions for applying such an exemption.

> ### Submerged and Intertidal Bedlands
>
> Ecology has received comments concerning the physical impacts of stormwater discharges to lakes and marine intertidal and subtidal areas. The comments are primarily in regard to the erosive effects of the discharges. Ecology is interested in hearing suggestions regarding the wording of a generic minimum requirement to discharge flows in a manner that does not cause significant impacts to submerged and intertidal bedlands.

***Objective*:** To prevent increases in stream channel erosion rates or stream channel instability by maintaining existing erosion rates. The standard intends to maintain the total amount of time that a receiving stream exceeds an erosion-causing threshold. That threshold is assumed to be 50% of the 2-year peak flow. Maintaining existing erosion rates within streams is vital to protect fish habitat and production.

***Supplemental Guidelines*:** Reduction of flows through infiltration decreases stream channel erosion and helps to maintain base flow throughout the summer months. However, infiltration should only be used where ground water quality is not threatened by such discharges

Interim Guideline: Local governments have a choice to make concerning a flow control standard to use until a flow duration standard is adopted and a continuous rainfall/runoff model is available for use. They can continue to use the peak flow standard of the 1992 Puget Sound manual, or use a peak flow standard that approximates the results that the proposed flow duration standard would achieve. By adjusting the target peak flow standard, restricting use of variables in the SBUH hydrologic analysis, and applying a volume correction factor, you can estimate the orifice sizes and detention volumes that the proposed flow duration standard would indicate. The following example is a result of adjusting the SBUH approach to obtain similar results as the output from the King County Runoff Time Series (An application of the Hydrologic Simulation Program – Fortran) with the proposed flow duration standard as the target.

Adjusted target peak flow standard:
Limit the peak rate of runoff from individual development sites to 50 percent of the pre-developed condition 2-year, 24-hour design storm. Limit the peak rate from the 10-year, 24-hour design storm to the pre-developed condition peak rate from the 2-year, 24-hour design storm. Limit the peak rate from the 100-year, 24-hour design storm to the pre-developed condition peak rate from the 10-year, 24 hour design storm.

Restricted variable assumptions:
The flow path length assumed for sheet flow runoff in the pre-developed condition calculations must not be less than 300 feet.

The Manning's effective roughness coefficient for pre-developed forested conditions should be 0.80. For pasture conditions, the coefficient should be 0.15.

In the table of curve numbers in Volume III, Chapter 1 of the 1999 manual, the curve numbers for pre-developed forest and pasture conditions must be selected from the "fair" category.

Volume correction factor:
In addition to the above, the pond volume correction factor identified in Volume III, Chapter I should be used where the pre-developed condition is modeled as pasture.

<u>Eastern Washington Standard Requirement</u>:
Applies to geographic areas designated as regions 1 and 2 in NOAA Atlas 2 (Miller et al, 1973)[10].

Stormwater discharges to streams shall control streambank erosion by limiting the peak rate of runoff from individual development sites to 50 percent of the pre-developed condition 2-year, 24-hour design storm while maintaining the pre-developed condition peak runoff rate for the 10-year, 24-hour and 100-year, 24-hour design storms. As the first priority, flow control BMP's shall utilize infiltration to the fullest extent practicable, if site condtions are appropriate and ground water quality is protected. Flow control BMP's shall be selected, designed, and maintained according to a

local government manual that is deemed equivalent to this manual.

Eastern Washington Alternative Requirement:
An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

1) **Establishment of a stream –specific threshold of significant bedload movement other than the assumed 50% of the 2-year peak flow;**

2) **Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel; or**

3) **A duration control standard is necessary for protection, maintenance, or restoration of designated beneficial uses or Clean Water Act compliance.**

Objective: To prevent increases in stream channel erosion rates or stream channel instability by maintaining existing erosion rates. The standard intends to maintain the total amount of time that a receiving stream exceeds an erosion-causing threshold. That threshold is assumed to be 50% of the 2-year peak flow. Maintaining existing erosion rates within streams is vital to protect fish habitat and production. Because of the different precipitation patterns prevalent in eastern Washington, use of a continuous runoff model to support a flow duration standard may not be necessary. Ecology has insufficient information to propose a flow duration standard for most of eastern Washington

Rainfall Regions

Figure 2.3 Rainfall Regions for Washington State from NOAA Atlas #2 to be added

R0073305

2.6.6 Minimum Requirement #6: Wetlands Protection

The requirements below apply only to situations where stormwater discharges directly or indirectly through a conveyance system into a wetland, and must be met in addition to meeting the requirements in Minimum Standard #4, Runoff Treatment BMPs.

Thresholds

The thresholds identified in Minimum Requirement #4 – Runoff Treatment, and Minimum Requirement #5 – Flow Control for Discharges to Streams shall also be applied for discharges to wetlands.

Standard Requirement

Discharges to wetlands shall maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses.

The publication, "Wetlands and Urbanization, Implications for the Future", the final report of the Puget Sound Wetland and Stormwater Management Research Program, 1997, shall be used as guidance for discharges to natural and constructed wetlands.

Additional Requirements

The standard requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC, or state ground water standards, Chapter 173-200 WAC. Additional treatment requirements to meet those standards may be required by federal, state, or local governments.

An adopted and implemented basin plan (Minimum Requirement #8), or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop requirements for wetlands that are tailored to a specific basin.

Objective:

To ensure that wetlands receive the same level of protection as any other waters of the state. Wetlands are extremely important natural resources which provide multiple stormwater benefits, including ground water recharge, flood control, and stream channel erosion protection. They are easily impacted by development unless careful planning and management are conducted. Wetlands can be severely degraded by stormwater discharges from urban development due to pollutants in the runoff and also due to disruption of natural hydrologic functioning of the wetland system. Changes in water levels and the frequency and duration of inundations are of particular concern.

Supplemental Guidelines:

See Volume V for a summary of the "Wetlands and Stormwater Management Guidelines: Managing Wetland Hydroperiod While Managing Stormwater" (draft, 1999). These management guidelines are considered the best available science to assist in meeting the state water quality standards. The guidelines were developed in part, and include, the findings of the Puget Sound Wetlands and Stormwater Management Research Program.[10]

While it is always necessary to pre-treat stormwater prior to discharge to a wetland, there are limited circumstances where wetlands may be used for additional treatment and detention of stormwater. These situations are considered in the guidelines as well.

2.6.7 Minimum Requirement #7: Off Site Analysis and Mitigation

All development projects shall submit an offsite analysis report that assesses the potential off-site water quality, erosion, and drainage impacts associated with the project and that proposes appropriate mitigation of those impacts. An initial qualitative analysis shall extend downstream for the entire flow path from the project site to the receiving water or up to 1 mile, whichever is less. If a receiving water is within one-quarter mile, the analysis shall extend within the receiving water to one-quarter mile from the project site. The analysis shall extend one-quarter mile beyond any improvements proposed as mitigation. The analysis must extend upstream to a point where any backwater effects created by the project cease. Upon review of the qualitative analysis, the local administrator may require that a quantitative analysis be performed.

The existing or potential impacts to be evaluated and mitigated shall include:

- **Upland erosion impacts**
- **stream channel erosion**
- **loss of stream channel base flow**
- **Violations of surface water quality standards as identified in a Basin Plan or a TMDL (Water Clean-up Plan); or violations of ground water standards in a wellhead protection area.**

Local governments are encouraged to expand the offsite analysis to include an assessment of the existing and potential impacts due to flooding and conveyance capacity.

Objective: To identify and evaluate offsite water quality, erosion and drainage impacts that may be caused or aggravated by a proposed project, and to determine measures for preventing impacts and for not aggravating existing impacts. Aggravated shall mean increasing the frequency of occurrence and/or severity of a problem.

Supplemental Guidelines:

Guidance for performing an initial qualitative analysis, a subsequent quantitative analysis, and for developing mitigation options is being developed. Ecology intends to include those in the next draft of the manual.

2.6.8 Minimum Requirement #8: Basin/Watershed Planning

Adopted and implemented watershed-based basin plans may be used to require equivalent or more stringent minimum requirements for source control, treatment, and wetlands protection, and alternative requirements for flow control. Basin/Watershed plans shall evaluate and include, as necessary, retrofitting of urban stormwater BMPs for existing development and/or redevelopment in order to achieve watershed-wide pollutant reduction and flow control goals that are consistent with requirements of the federal Clean Water Act. Standards developed from basin plans shall not modify any of the above minimum requirements until the basin plan is formally adopted and implemented by the local governments within the basin, and approved or concurred with by the Department of Ecology.

Objective: To promote watershed-based planning as a means to develop and implement comprehensive water quality protection measures. Primary objectives of basin planning are to reduce pollutant loads and hydrologic impacts to surface and ground waters in order to protect beneficial uses.

Supplemental Guidelines: While Minimum Requirements #3 through #6 establish general standards for individual sites, they do not evaluate the overall pollution impacts and protection opportunities which could exist at the watershed level. In order for a basin plan to serve as a means of modifying the minimum requirements it must be formally adopted by all jurisdictions that have responsibilities under the basin plan, and ordinances or regulations called for by the plan must be in effect. This is what is meant by an adopted and implemented basin plan.

Basin planning provides a mechanism by which the on-site standards can be evaluated and refined based on an analysis of an entire watershed. Basin plans are especially well-suited to develop control strategies to address impacts from future development and to correct specific problems whose sources are known or suspected. Basin plans can be effective at addressing both long-term cumulative impacts of pollutant loads and short-term acute impacts of pollutant concentrations, as well as hydrologic impacts to streams, wetlands, and ground water resources.

Examples of how Basin Planning can alter the minimum requirements of this manual is given in Appendix A.

2.6.9 Minimum Requirement #9: Operation and Maintenance

An operation and maintenance schedule that is consistent with the local government standards shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified.

Objective: To ensure that stormwater control facilities are adequately maintained and operated properly.

***Supplemental Guidelines*:** Inadequate maintenance is likely the leading cause of failure for stormwater control facilities. The description of each BMP in Volumes II, III, and V includes a section on maintenance. The Guidance Manual also includes a section on developing an operation and maintenance program and a model operation and maintenance ordinance.

2.7 Optional Guidance #1: Financial Liability

Performance bonding or other appropriate financial guarantees shall be required for all projects to ensure construction of drainage facilities in compliance with these standards. In addition, a project applicant shall post a two year financial guarantee of the satisfactory performance and maintenance of any drainage facilities that are scheduled to be assumed by the local government for operation and maintenance.

***Objective*:** To ensure that development projects have adequate financial resources to fully implement stormwater management plan requirements and that liability is not unduly incurred upon local governments.

Supplemental Guidelines: The type of financial instrument required is less important than ensuring that there are adequate funds available in the event that non-compliance occurs.

2.8 Exceptions

Exceptions to the Small Parcel Requirements and Large Parcel Minimum Requirements #1 through #9 may be granted prior to permit approval and construction. An exception may be granted following a public hearing, provided that a written finding of fact is prepared, that addresses the following:

- **The exception provides equivalent environmental protection and is in the overriding public interest; and that the objectives of safety, function, environmental protection and facility maintenance, based upon sound engineering, are fully met; AND**
- **There are special physical circumstances or conditions affecting the property such that the strict application of these provisions would deprive the applicant of all reasonable use of the parcel of land in question, and every effort to find creative ways to meet the intent of the Minimum Requirements has been made; AND**
- **That the granting of the exception will not be detrimental to the public health and welfare, nor injurious to other properties in the vicinity and/or downstream, and to the quality of waters of the state; AND**
- **The exception is the least possible exception that could be granted to comply with the intent of the Minimum Requirements.**

Public Hearing Alternatives

The above exception provision includes a requirement to hold a public hearing on the proposed exception. Ecology is interested in suggestions of an alternative to a public hearing which would give local governments more flexibility and less onerous administrative procedures in granting an exception while still protecting the interests of, and alerting interested and potentially impacted parties to the exception under consideration.

Supplemental Guidelines:

Ecology encourages the Plan Approval Authority to impose additional or more stringent criteria as appropriate for their area. Additionally, criteria which may be inappropriate or too restrictive for an area may be modified through basin planning (Minimum Requirement #8). Modification of any of the minimum requirements which are deemed inappropriate for the site may be done by granting an exception.

The exception procedure is an important element of the plan review and enforcement programs. It is intended to maintain a necessary flexible working relationship between local officials and applicants. Plan Approval Authorities should consider these requests judiciously, keeping in mind both the need of the applicant to maximize cost-effectiveness and the need to protect off-site properties and resources from damage.

R0073312

CHAPTER 3 - Preparation of Stormwater Site Plans

3.1 Introduction

The purpose of this chapter is to provide summarized guidelines on how Construction Stormwater Pollution Prevention Plan Plan (Construction SWPPP) and Permanent Stormwater Quality Control (PSQC) Plans, the plans that make up a Stormwater Site Plan (SSP) can be prepared. The thresholds and Minimum Requirements for these plans are described in detail in Chapter 2

The goal of this chapter is to provide a framework for uniformity in plan preparation. Such uniformity will promote predictability throughout the region and help secure prompt governmental review and approval. Properly drafted engineering plans and supporting documents will also facilitate the operation and maintenance of the proposed system long after its review and approval.

Please note that this chapter describes <u>how</u> to prepare a Stormwater Site Plan - the specific BMPs and design methods and standards to be used are contained in Volumes II-V. Construction SWPPPs are covered in detail in Chapter 3 of Volume II. Guidelines for selecting BMPs are given in Chapter 3 of this Volume. Note also that all plans, except small parcel plans, shall be stamped a professional engineer licensed in the State of Washington. All land boundary surveys used, and any legal descriptions prepared, except those for small parcels, must be stamped by a professional land surveyor licensed in the State of Washington.

Chapter 3 of Volume I

The text for this chapter was not completed in time for this preliminary draft of the manual. Ecology will discuss its intent for this chapter in public meetings to discuss this preliminary draft. Public comments and criticisms of this chapter in the existing manual would be helpful.

After receiving public comment, Ecology will develop this chapter with the assistance of an advisory committee for Volume 1. A draft will be included in the second draft of the manual that is scheduled for release early in 2000.

R0073313

R0073314

CHAPTER 4 - BMP Selection Process For Permanent Stormwater Quality Control Plans

Chapter 4 of Volume I

We are considering combining Chapter III and IV of Volume I of the 1992 manual and moving the details of the BMP selection process to the appropriate volume in the current manual.

R0073315

APPENDIX A - Guidance for Altering the Minimum Requirements Through Basin Planning

Basin Planning Applied to Source Control

(Minimum Requirement #3)

Basin plans can identify potential sources of pollution and develop strategies to eliminate or control these sources to the fullest extent possible. A basin plan can include the following source control strategies:

1. Detection and correction of illicit discharges to storm sewer systems, including the use of dry weather sampling and dye-tracing techniques;

2. Identification of existing businesses, industries, utilities, and other activities which may store materials susceptible to spillage or leakage of pollutants into the storm sewer system;

3. Elimination or control of pollutant sources identified in (2);

4. Identification and control of future businesses, industries, utilities, and other activities which may store materials susceptible to spillage or leakage of pollutants into the storm sewer system; and

5. Training and public education

Basin Planning Applied to Runoff Treatment

(Minimum Requirement #4)

Basin plans can develop more stringent runoff treatment requirements and performance standards to reduce pollutant concentrations or loads based on an evaluation of the beneficial uses to be protected within or downstream of a watershed. Consideration must be given to the antidegradation provisions of the Clean Water Act and implementing state water quality standards. The evaluation should include an analysis of existing and future conditions. Additional levels of control beyond Minimum Requirement #4 may be justified in order to control the impacts of future development. Requirements/performance

R0073317

standards can be developed based on an evaluation of pollutant loads and modeling of receiving water conditions.

Runoff treatment requirements/performance standards developed from a basin plan should apply to individual development sites. Regional treatment BMPs can be considered an acceptable substitute for on-site treatment BMPs if they can meet the identified treatment requirements/performance standards. A limitation to the use of regional treatment systems is that the conveyances used to transport the stormwater to the BMP must not include waters of the state that have (or had as of November, 1975) beneficial uses other than drainage.

Basin plans shall evaluate retrofitting opportunities, such as installation of extended detention outlets for existing stormwater detention facilities.

Basin Planning Applied to Flow Control

(Minimum Requirement #5)

Basin planning is well-suited to control stream channel erosion for both existing and future conditions. Flow control standards developed from a basin plan may include a combination of on-site, regional, and stream protection/rehabilitation measures. On-site standards shall be the primary mechanism to protect streams from the impacts of future conditions. Regional flow control BMPs are to used primarily to correct existing stream erosion problems. Stream protection/rehabilitation measures may be applied where stream channel erosion problems currently exist which will not be corrected by on-site or regional BMPs. However, caution is urged in the application of such measures. If the causes of the stream channel erosion problems still exist, repairs to the physical expression of those problems will be short-lived.

Basin Planning Applied to Wetlands and other Sensitive Areas

(Minimum Requirement #6)

Basin planning can be used to develop additional protection standards for wetlands and other sensitive areas, such as landslide hazard areas, wellhead protection areas, and ground water quality management areas. . These standards can include source control, runoff treatment, flow control, and stage levels, and frequency and duration of inundations.

APPENDIX B - Water Quality Treatment Design Storm Options

Ecology encourages discussion of options for establishing a water quality design storm event. The options currently under consideration include:

1. **An estimation of a 6-month, 24-hour rainfall amount.**

   This is the current water quality design storm in the Stormwater Management Manual for the Puget Sound Basin. It was originally chosen when developing the Puget Sound manual based upon a judgement of when the incremental costs of additional treatment capacity exceed the incremental benefits. In particular, the cost of providing the increased detention volume for a wet pond was not seen as cost-effective when compared with the incremental amount of annual stormwater volume that would be effectively treated. Rainfall data from Sea-Tac was used in the original analysis.

   There are at least two ways to estimate the rainfall amount of a 6-month, 24-hour storm. One way is to analyze the 24-hour rainfall records for each rainfall station. The more extensive your record, the more confidence you may have in your estimate. The rainfall amount which has a probability of being equaled or exceeded twice a year is the 6-month, 24-hour storm. The 6-month, 24-hour rainfall amounts shown for 58 stations in Table B.1 have been estimated by analyzing the daily rain gauge data obtained from CD-ROM Hydrodata, USGS Daily and Peak Values, published by Hydrosphere Data Products, Inc.[11]

   The way in which the 6-month, 24-hour estimates in table 2 are calculated is as follows. A data set containing the annual maxima series for 24-hour durations for rainfall stations throughout the state was used.to determine the 2-year, 24-hour return frequency in the first column of Table B.2. The data set was collected by Dr. Schaefer of the Washington Dept. of Ecology and is more fully described in "Regional Analyses of Precipitation Annual Maxima in Washington State,"[12] Then an algorithm was applied to convert the series to a partial duration series. Dr. Schaefer describes the conversion as follows: "A return period of 1.16 years (annual exceedance probability of 0.862) in the annual maxima data series is equivalent to a 6-month return period in the partial duration data series. The 6-month values were computed using at-site 24-hour station mean values, regional coefficients of variation (Cv) and L-skewness (tau3), and a frequency factor (K) of –0.94 which corresponds to a return period of 1.16 years. This K value of –0.94 yields 6-month estimates that are correct within 3% +/- for various Kappa distribution parameter sets for climates from arid to rainforest in Washington State." (The reader is referred to references #13 and #14.) Note that the 2-year storm values in Table B.2 differ slightly from those in Table B.1 because they are a different data set and have undergone additional statistical analysis.

A disadavantage to using a 6-month, 24-hour storm as the design storm is that we do not have isopluvials identifying 6-month, 24-hour storms statewide. We would have to produce such a map, or develop a method to estimate the volume for projects at sites not listed in a reference table of 6-month, 24-hour storms. One method to do that is listed as the second option below.

2. **72% of the 2-year, 24-hour rainfall amount for areas in western Washington and in Ferry, Stevens, Pend Oreille, Spokane, Whitman, Garfield, Walla, Walla, Columbia, and Asotin Counties of eastern Washington. Other areas of eastern Washington shall use 65% of the 2-year, 24-hour rainfall amount.**

Based upon an analysis of the rainfall record of 58 stations across the state, the 6-month, and 2-year, 24-hour rainfall amounts were calculated and compared. Those results are shown in Table B.1. Based on those results, there seemed to be a justification for establishing two different percentages for ease in estimating 6-month, 24-hour rainfall amounts across the state.

The arithmetic average of the ratio of the 6-month to the 2-year totals for 35 stations in western Washington (expressed as a percentage) was 71%. With the exception of a few stations, the percentages vary within a range of 67% to 76%. Using only four stations for the mountainous northeastern area and the far eastern areas of the state , the computed ratios were 71% to 73% with an average of 72%. A ratio of 72% is suggested for both of these areas.

Using 16 stations for an area generally described as eastern Cascades and the Columbia Basin, the ratios varied from 61.6% to 68.4% with an average of 65%.

An advantage of this approach is that updated statewide isopluvial maps for the 2-year, 24-hour design storm are expected to be available soon. By interpolation, the 2-year rainfall amount for a project site can be easily identified. Application of the percentage assigned to that area yields the estimate of the 6-month, 24-hour rainfall amount. Citing a particular percentage of the 2-year, 24-hour rainfall amount (or a 6-month, 24-hour event) means that different areas of the state will be effectively sizing treatment facilities for the runoff from storms of vastly different sizes. However, those size differences are based upon actual differences in rainfall among the sites.

Also, as mentioned above in Option 1, the original basis for 6-month, 24-hour rainfall amount was a comparison of costs to benefits based upon how much annual runoff would be effectively treated. (The assumption in these comparisons is that storm sizes crudely track relative runoff quantities). The 6-month, 24-hour storm and smaller storms constituted about 91% of the total rainfall of record at SEA-TAC. Because the % of the 24-hour rainfall volumes that the 6-month, 24-hour storm and smaller 24-hour rainfall amounts represent changes across the state (See Table B.1, column entitled, "6 month, % Rainfall Volume") the cost analysis isn't exactly the same for other areas. However, for the 58 stations computed, the 6-month storm and smaller storms represent from 93% to 82% of the total rainfall volume. Therefore, for most areas of the state, the relative cost to % of runoff effectively treated is lower than was assumed in the original analysis.

3) **Using 24-hour rainfall data, identification of a precipitation amount for which the cumulative sum of rainfall amounts of that size and smaller account for a certain percentage of the total rainfall inches.**

For example, we could choose to size a treatment BMP to effectively treat the runoff from all the 24-hour precipitation amounts that made up 90% of the total rainfall. To do that, you order all the recorded 24-hour precipitation amounts by increasing size, and sum the total precipitation as you move up the list from smaller to larger 24-hour amounts. The last 24-hour total that you have to include to bring your cumulative total to approximately 90% of the total historical rainfall amount is your water quality design storm. The rainfall amount from this storm would be used as input to your runoff calculations to estimate total runoff volume for sizing volume-sensitive BMP's, and as input to your hyetograph/hydrograph analysis to determine the estimated peak flow rates for sizing water quality treatment BMPs. Note that for BMP's designed based on runoff volumes,

R0073321

we can estimate that 24-hour rainfall amounts of lesser amount will meet the detention time design criteria. However, for treatment BMP's whose design is based on volumetric runoff rates or velocity, i.e., cubic feet per second or feet per second, we do not know how frequently, nor how much of the actual runoff occurs at flow rates below the design flow rate. This is because the design flow rate is based upon an idealized hyetograph.

The relative sizes of water quality design storms defiined in this manner are shown in Table B.1 for 90% and 95% of the total rainfall inches for 58 rainfall stations. Note that a different set of rainfall data was used in this table than in Table B.2. Also the data was managed differently. However, based upon a close correlation of computed 2-year, 24-hour return frequency storms, we would expect insignificant differences in the percentages if computed for the other data set.

The water quality design storm identified in this approach would vary across the state. Assuming a 90% goal, rainfall amounts vary from 0.54 inches at Moses Lake to 3.18 inches at Cushman Dam. Runoff amounts from these storms will also vary depending upon natural soil conditions, vegetative cover, and the % effective imperviousness of a site. Maryland has recently adopted a statewide standard of capturing and treating 90% of the annual runoff volume. Rainfall in Maryland does not vary to the extent it does in Washington.

To implement this approach, Ecology would have to publish the water quality design storm for as many rainfall stations as possible. Then we would have to identify an adjustment factor to use for the project site. The factor could be based on a ratio of 2-year, 24-hour rain amounts between the nearest or most appropriate rainfall station and the project site, or upon a ratio of mean annual precipitation for the same two sites. The 2-year, 24-hour amount or the mean annual precipitation for the project site would have to be based upon interpolation of isopluvials.

An example estimation would be as follows: 1) calculate the 2-year, 24-hour or the mean annual precipitation for a site by interpolating between the two nearest isopluvials. 2) calculate ratios of the mean annual rainfall amounts or 2-year, 24-hour amounts for the site to the nearest or most appropriate gauge for which a 90% value is published; 2) multiply the 90% rainfall amount for the gauge by the ratio.

4. **Using 24-hour rainfall data, establish the knee of the curve for a graph of increasing 24-hour rainfall amounts (y-axis) versus cumulative rainfall depth (x-axis).**

Please refer to Figures B.1 and B.2. Figure B.1 shows examples of graphing the record of 24-hour rainfall amounts versus the cumulative percent of rainfall depth for the record. So each point on the curve shows the percent of rainfall depth that is represented by the corresponding 24-hour amount and lesser amounts. Figure B.2 depicts how the knee of the curve was determined for four rain gauge sites. Note that the graphs in Figures B.1 and B.2 have the same units for the x- and y-axes, but the scales are different. The curves start out fairly straight with a gentle rise, and then begin to rise sharply for the largest rainfall amounts. In order to perform the knee of the curve analysis, two tangent lines, or asymptotes were drawn, one through the horizontal portion of the curve and the other through the rising part of the curve. The two tangent lines were then bisected and the point where the bisect line intersected the curve was considered to be the knee of the curve. The rainfall depth and percent of total rainfall represented by the knee of the curve can then be determined.

The tangent lines were drawn by choosing points that included as much of the flat horizontal portion of the curve as possible and as many points as possible to represent the sharply rising portion of the curve. Then a best-fit approach on the points was used to generate the tangent lines. Only a portion of the curves are shown in Figure B.2.

The intent of this analysis is to relate the size of the storm (and by direct relationship, treatment cost) to the percent of total runoff (by assuming runoff tracks approximately with rainfall amount) that would receive treatment within the design parameters for the selected BMP (benefit).

The results of using this approach for a number of rainfall stations are shown in Table B.2. For most stations, the rainfall amounts are substantially greater than the amounts identified in options #1 or #2 above, or the amount identified in option #3 assuming a 90% total rainfall criterion.

5. **Use a multiple of the mean annual storm.**

   The mean annual storm is defined as the total annual average precipitation amount divided by the average annual number of precipitation events. Mean annual storm values for various sites were computed based on data in The National Precipitation Databook, 1992[15], and are displayed in Table B.2.

   Other areas of the country have identified multiples of the mean annual storm as the basis for sizing water quality treatment BMPs. King Co. recently adopted a multiplier of 3x the runoff of the mean annual storm as the design basis for the volume of their "basic wetpond." The factor of three was arrived at as an estimate of the volume needed to achieve the County's design goal of 80% removal of total suspended solids.

   For BMPs sized based on volumetric flow rate or velocity, a characteristic hyetograph would be used in combination with the selected multiple of the mean annual storm to compute the peak flow rate for the time increment of interest.

6. **Use continuous runoff modeling to establish: a runoff flow rate that is exceeded only X % of the time using the appropriate time increment for a BMP sized based on a peak flow rate, and a runoff amount that is exceeded only X% of the time for BMP's based on runoff volume.**

   Using continuous runoff models allows you to obtain estimates of the probability of exceedence for flow rates and runoff volumes for the available rainfall record. This approach has probably the best statistical basis for deciding upon what your goal should be for technology-based water quality treatment volumes and flow rates. In weighing the cost reasonableness of selecting any particular percentage, we could compare the flow rates and volumes to those for which we have conducted cost analyses in the past, i.e., the current standards. The only method by which we could pursue this approach within the alloted timeframe for reissuance of this manual is to use results from King Co.'s application of HSPF, i.e., KCRTS .

Table B.1. Rainfall Amounts and Comparisons for Selected USGS Stations as Published by Hydrosphere Data Products, Inc.

Station Name	6 Month Storm Inches	6 Month % Rainfall Volume	2 Year Storm Inches	6 Month/ 2 year %	90% Rainfall Inches	95% Rainfall Inches	Mean Annual Precip.Inches
1 Aberdeen	2.47	92.58%	3.43	72.0%	2.25	2.81	83.12
2 Anacortes	0.93	90.45%	1.37	67.9%	0.91	1.22	25.92
3 Appleton	1.39	89.04%	1.96	70.9%	1.45	1.80	32.71
4 Arlington	1.28	93.42%	1.74	73.6%	1.11	1.40	46.46
5 Bellingham	1.27	90.78%	1.79	70.9%	1.23	1.63	35.82
6 Bremerton	1.87	90.75%	2.61	71.6%	1.83	2.22	49.97
7 Cathlamet	2.13	92.52%	3.47	61.4%	1.89	2.59	78.97
8 Centralia	1.49	91.81%	2.09	71.3%	1.40	1.78	45.94
9 Chelan	0.62	84.50%	0.96	64.6%	0.76	1.00	10.44
10 Chimacum	1.20	89.63%	1.73	69.4%	1.22	1.52	29.45
11 Clearwater	3.46	92.88%	4.75	72.8%	3.04	3.94	125.25
12 CleElum	1.06	86.85%	1.66	63.9%	1.20	1.64	22.17
13 Colfax	0.80	90.52%	1.07	74.8%	0.80	0.99	19.78
14 Colville	0.71	90.46%	0.97	73.2%	0.69	0.86	18.31
15 Cushman Dam	3.31	91.26%	5.29	62.6%	3.18	4.25	100.82
16 Cushman PwrH	3.17	90.81%	4.42	71.7%	3.08	4.00	85.71
17 Darrington	2.90	91.19%	4.01	72.3%	2.73	3.42	82.90
18 Ellensburg	0.50	84.63%	0.79	63.3%	0.62	0.81	8.75
19 Elwha RS	2.14	90.49%	2.80	76.4%	2.11	2.53	55.87
20 Everett	1.10	93.14%	1.46	75.3%	1.00	1.22	36.80
21 Forks	3.47	92.50%	5.07	68.4%	3.13	4.00	117.83
22 Goldendale	0.84	86.92%	1.29	65.1%	0.98	1.25	17.57
23 Hartline	0.61	84.85%	0.96	63.5%	0.77	0.97	10.67
24 Kennewick	0.46	84.10%	0.71	64.8%	0.55	0.72	7.57
25 Lk. Wenatchee	2.20	85.87%	3.16	69.6%	2.58	3.16	42.72
26 Long Beach	2.32	93.09%	3.08	75.3%	2.04	2.55	80.89
27 Longview	1.41	92.02%	1.97	71.6%	1.29	1.67	45.62
28 Mc Millin	1.31	92.24%	1.82	72.0%	1.21	1.49	40.66
29 Monroe	1.38	92.90%	1.86	74.2%	1.26	1.53	48.16
30 Moses Lake	0.47	85.32%	0.70	67.1%	0.54	0.68	7.89
31 Oakville	1.81	92.86%	2.28	79.4%	1.62	1.98	57.35
32 Odessa	0.52	87.23%	0.76	68.4%	0.56	0.72	10.09
33 Olga	1.02	90.82%	1.52	67.1%	0.99	1.30	28.96
34 Olympia	1.74	91.13%	2.51	69.3%	1.65	2.19	50.68
35 Omak	0.66	85.89%	0.98	67.3%	0.79	0.98	11.97
36 Packwood	2.41	88.70%	3.52	68.5%	2.51	3.20	55.20

R0073325

Station Name	6 Month Storm Inches	6 Month % Rainfall Volume	2 Year Storm Inches	6 Month/ 2 year %	90% Rainfall Inches	95% Rainfall Inches	Mean Annual Precip.Inches
37 Pomeroy	0.75	89.29%	1.02	73.5%	0.78	0.98	16.04
38 Port Angeles	1.12	88.39%	1.66	67.5%	1.19	1.56	25.46
39 Port Townsend	0.77	90.56%	1.14	67.5%	0.76	0.95	19.13
40 Prosser	0.48	83.82%	0.74	64.9%	0.61	0.78	7.90
41 Quilcene	2.53	88.81%	3.40	74.4%	2.61	3.15	54.88
42 Quincy	0.53	82.12%	0.81	65.4%	0.68	0.90	8.07
43 Sea-Tac	1.32	91.13%	1.83	72.1%	1.27	1.63	38.10
44 Seattle JP	1.30	92.05%	1.74	74.7%	1.20	1.49	38.60
45 Sedro Woolley	1.50	92.07%	2.01	74.6%	1.41	1.80	46.97
46 Shelton	2.15	91.49%	3.13	68.7%	2.05	2.55	64.63
47 Smyrna	0.52	83.16%	0.76	68.4%	0.63	0.75	7.96
48 Spokane	0.68	89.54%	0.96	70.8%	0.70	0.88	16.04
49 Sunnyside	0.45	82.22%	0.73	61.6%	0.63	0.76	6.80
50 Tacoma	1.21	92.18%	1.61	75.2%	1.12	1.37	36.92
51 Toledo	1.36	92.73%	2.10	64.8%	1.25	1.68	50.18
52 Vancouver	1.35	91.32%	1.93	69.9%	1.28	1.62	38.87
53 Walla Walla	0.90	88.60%	1.23	73.2%	0.94	1.18	19.50
54 Waterville	0.67	84.43%	1.04	64.4%	0.81	1.05	11.47
55 Wauna	1.82	91.37%	2.50	72.8%	1.72	2.18	51.61
56 Wenatchee	0.58	81.97%	0.92	63.0%	0.80	1.04	8.93
57 Winthrop	0.75	85.36%	1.13	66.4%	0.94	1.13	14.28
58 Yakima	0.53	81.44%	0.85	62.4%	0.72	1.03	8.16

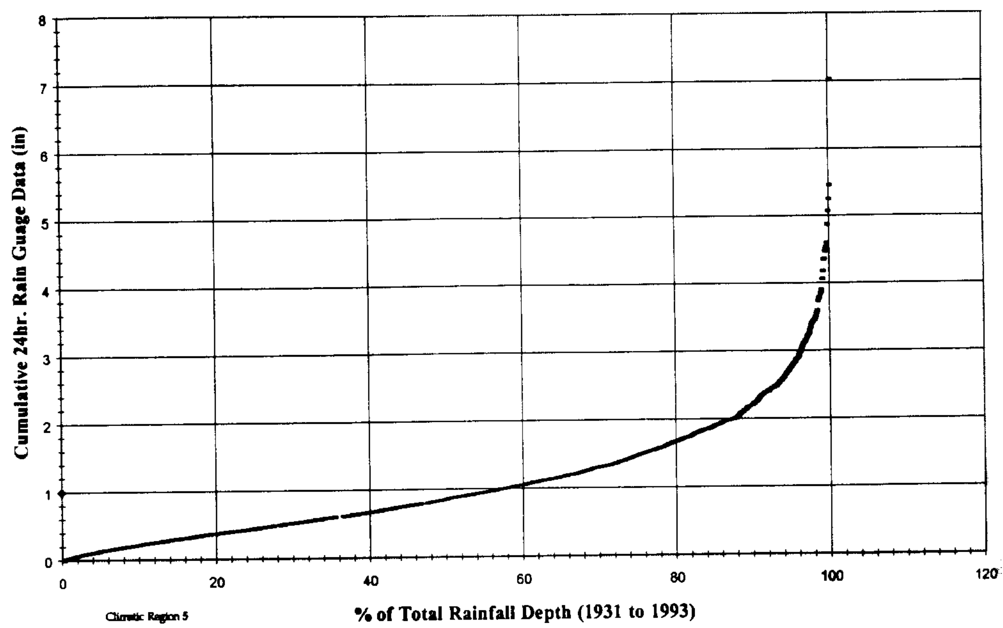
Table B.2. Rainfall Amounts and Statistics Using Data from References #12 and #15

	Return Freq		Knee-of-curve	Mean Annual Storm	Mean Annual Precip
Station Name	**2-yr.**	**6-month**	**24 hr. (in)**	**(in)**	**(in)**
ABERDEEN	3.32	2.53	2.81		83.1
ANACORTES	1.33	0.99	1.20		25.9
APPLETON	1.97	1.47	1.80		32.7
ARLINGTON	1.79	1.35	1.40		46.5
AUBURN	2.00	1.51		0.54	44.9
BATTLE GROUND	2.12	1.60			52.0
BELLINGHAM 3SSW -- F	1.70	1.27			35.0
BELLINGHAM CAA AP	1.56	1.17	1.63		35.8
BENTON CITY 2NW	0.79	0.53			8.0
BLAINE 1ENE	1.89	1.42		0.46	39.9
BREMERTON	2.31	1.74	2.22		50.0
BUCKLEY 1NE	2.09	1.58			49.0
BURLINGTON	1.75	1.31		0.40	35.0
CARNATION 4NW	1.91	1.44		0.49	47.5
CATHLAMET 6NE	3.84	2.93	2.59		79.0
CENTRALIA 1W	2.10	1.59	1.78	0.44	47.6
CHELAN	0.94	0.65	1.00		10.4
COLFAX 1NW	1.18	0.86	0.99		19.8
COLVILLE	1.02	0.74	0.86		18.3
COLVILLE WB AP	1.01	0.73		0.35	17.4
COUPVILLE 1S	1.08	0.79			21.0
CUSHMAN DAM	4.61	3.52	4.25	1.23	99.7
DARRINGTON RS	3.32	2.53	3.42	0.84	79.8
DUVALL 3NE	1.99	1.50			50.0
ELLENSBURG	0.70	0.48	0.80	0.25	9.2
ELLENSBURG WB AP	0.72	0.51			12.0
ELWHA RS	2.74	2.07	2.53		55.9
EVERETT JR. COL.	1.48	1.11	1.22	0.41	34.4
FORKS 1E	4.90	3.76	3.99		117.8
GOLDENDALE	1.12	0.81	1.25		17.6
GOLDENDALE 2E	1.31	0.95			18.0
HARTLINE	0.89	0.62	0.98		10.7
HOQUIAM AP	2.85	2.17			71.0
KENNEWICK	0.71	0.48	0.71		7.6
KENT	1.87	1.40			36.0

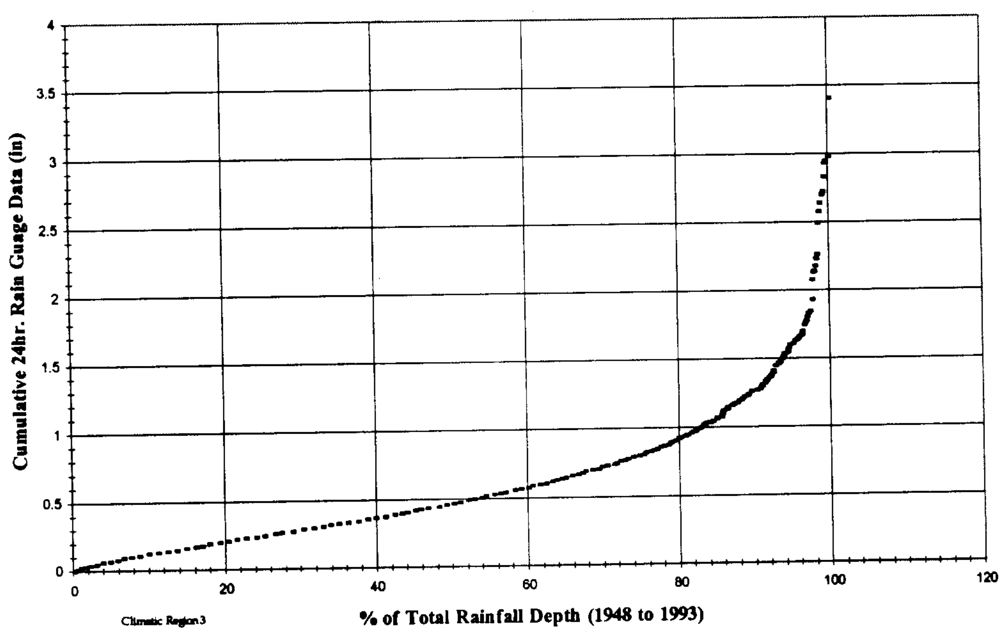
	Return Freq		Knee-of-curve	Mean Annual Storm	Mean Annual Precip
Station Name	2-yr.	6-month	24 hr. (in)	(in)	(in)
LEAVENWORTH	1.64	1.21			26.0
LONG BEACH EXP	2.99	2.28	2.54		80.0
LONGVIEW	2.20	1.66	1.67	0.48	48.1
MAZAMA 2W	1.59	1.17		0.41	22.7
MC MILLIN RESERVOIR	1.81	1.36	1.49	0.46	40.0
MILL CREEK	2.04	1.53			35.0
MONROE	1.91	1.44	1.52		48.2
MONTESANO 3NW	3.30	2.52		0.81	81.5
MOSES LAKE DEVIL FAR	0.74	0.50	0.68		7.9
MOUNT VERNON 3WNW	1.60	1.20			32.0
NEWPORT	1.41	1.05			29.0
OAKVILLE	2.46	1.86	1.99		57.4
ODESSA	0.80	0.55	0.72		10.1
OKANOGAN	0.90	0.63			12.0
OLGA 2SE	1.52	1.13	1.29		29.0
OLYMPIA WB AP	2.62	1.98	2.18	0.62	51.1
OMAK 2NW	0.99	0.70	0.98		12.0
OTHELLO 5E	0.70	0.47			8.0
PACKWOOD	2.92	2.21	3.16		55.2
POMEROY	1.10	0.79	0.97		16.0
PORT ANGELES	1.69	1.26	1.56	0.42	24.2
PORT TOWNSEND	1.11	0.81	0.95	0.35	17.6
PROSSER	0.74	0.49	0.78		7.9
PROSSER 4NE	0.72	0.48			8.0
PULLMAN 2NW	1.17	0.86		0.41	22.3
PUYALLUP 2W EXP STN	1.85	1.40			41.0
QUILCENE 2SW	3.42	2.59	3.14		54.9
QUILCENE DAM 5SW	3.84	2.92		0.77	69.4
QUINCY 1S	0.77	0.52	0.90		8.1
REPUBLIC	1.04	0.76			17.0
SEATTLE JACKSON PARK	1.49	1.12	1.49		38.6
SEATTLE TAC WB AP	1.90	1.42	1.62	0.49	37.4
SEATTLE U. OF W.	1.72	1.29			36.0
SEDRO WOLLEY 1E	2.05	1.55	1.80		47.0
SEQUIM	1.11	0.80			16.0
SHELTON	3.15	2.39	2.54		64.6
SMYRNA	0.79	0.53	0.75		8.0

	Return Freq		Knee-of-curve	Mean Annual Storm	Mean Annual Precip
Station Name	**2-yr.**	**6-month**	**24 hr. (in)**	**(in)**	**(in)**
SPOKANE	1.11	0.80	0.88		16.0
SPOKANE WB AP	0.97	0.70		0.35	17.0
SUNNYSIDE	0.76	0.50	0.76	0.30	7.4
TACOMA CITY HALL	1.70	1.28	1.37		36.9
TOLEDO	1.99	1.51	1.68		50.2
VANCOUVER 4NNE	2.01	1.51	1.62		38.9
WALLA WALLA CAA AP	1.19	0.87	1.17		19.5
WATERVILLE	1.00	0.70	1.05		11.5
WAUNA	2.15	1.63	2.18		51.6
WENATCHEE	0.95	0.65	1.04		8.9
WINTHROP 1WSW	1.19	0.85	1.13		14.3
YAKIMA WB AP	0.81	0.54	1.03	0.33	8.2

Aberdeen Stormwater Quality Design Storm

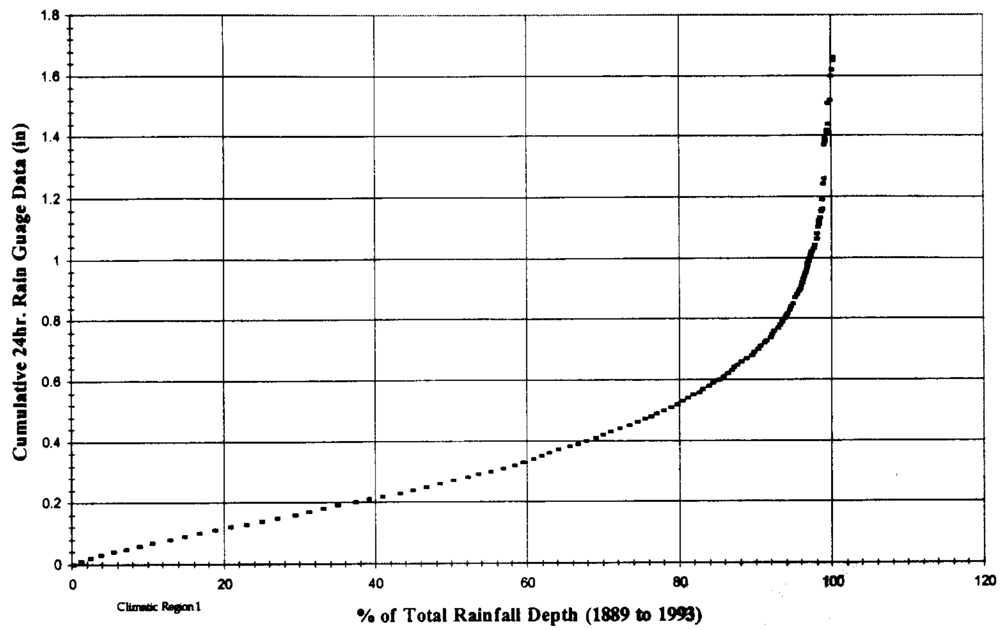


Sea-Tac Stormwater Quality Design Storm

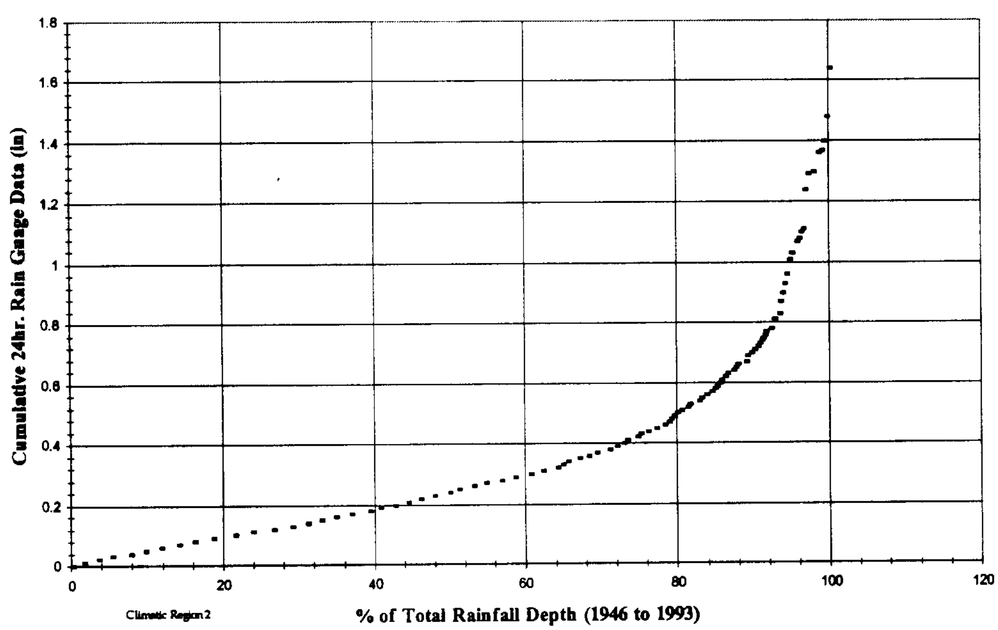


Figures B.1 and B.2: 24-hour Rainfall Amounts vs. Total Rainfall Depth

Spokane Stormwater Quality Design Storm

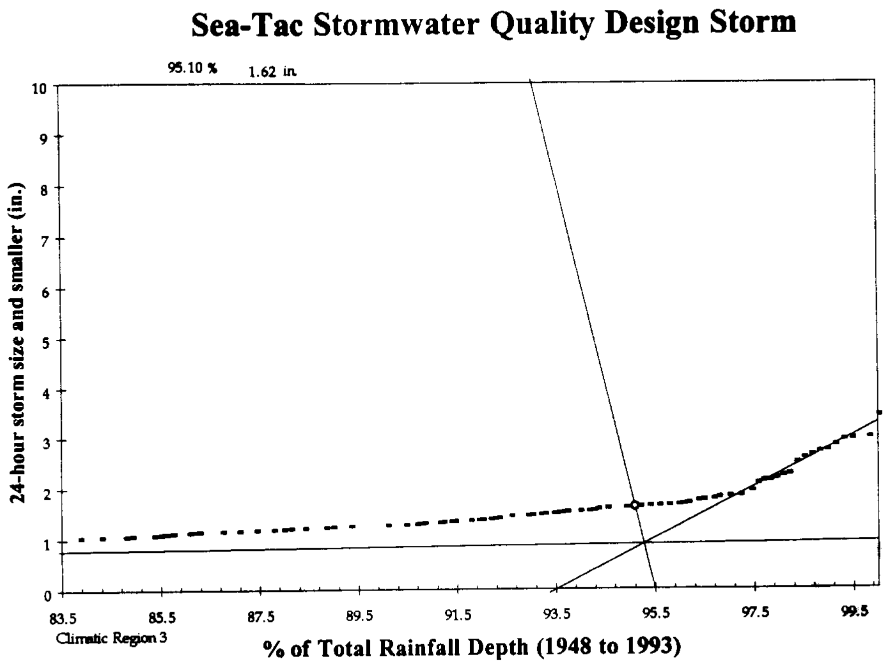


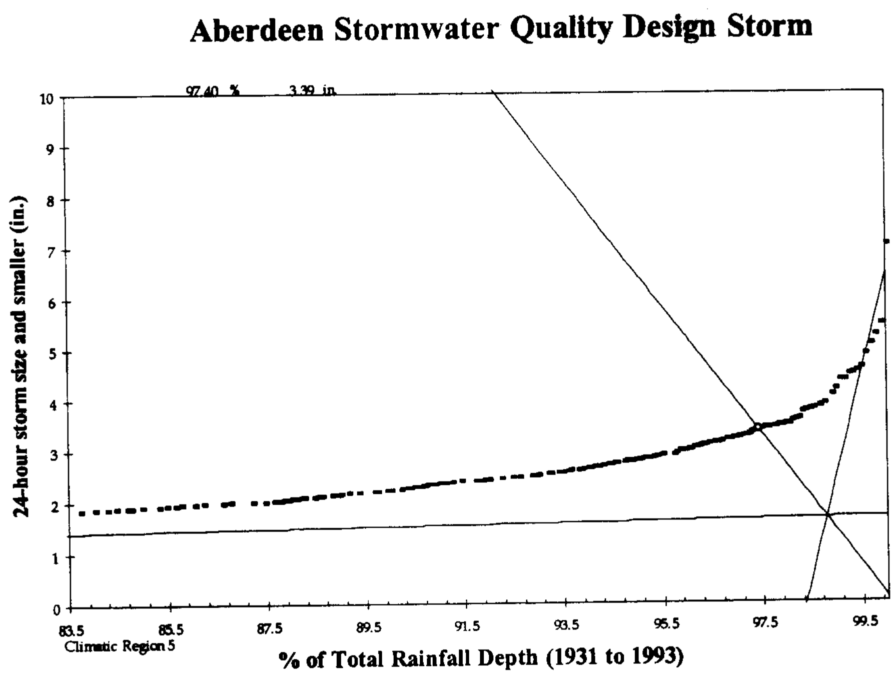
Yakima Stormwater Quality Design Storm



Figures B.3 and B.4: 24-hour Rainfall Amounts vs. Total Rainfall Depth

R0073331

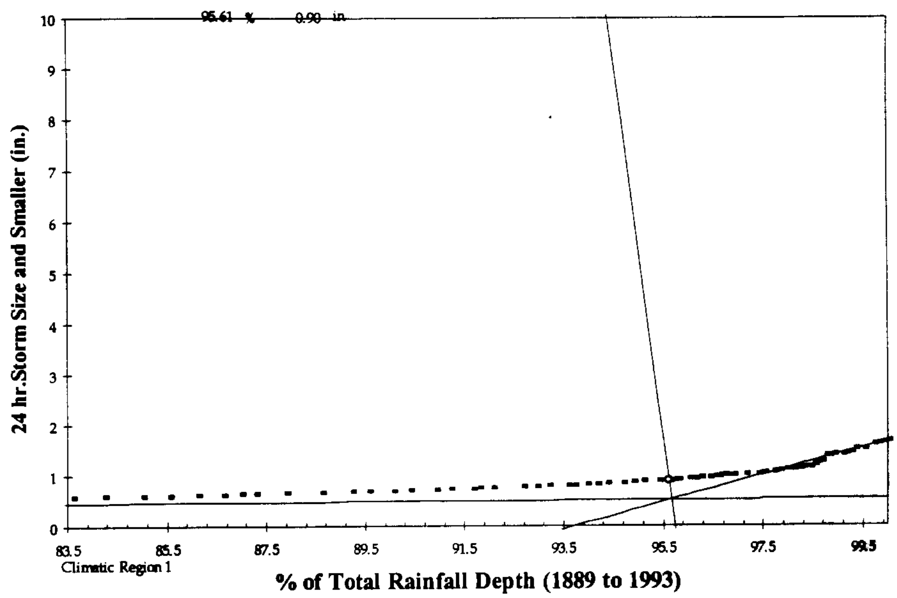




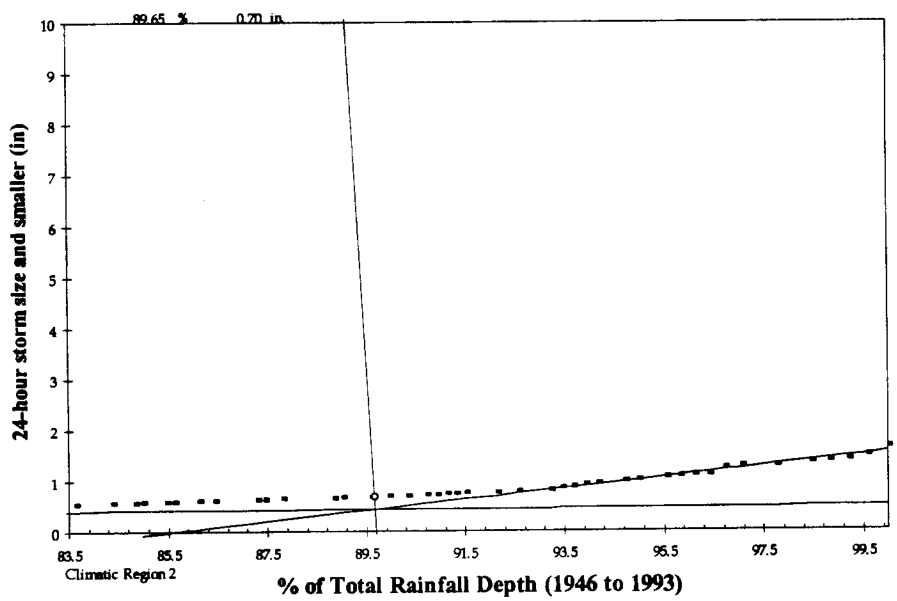
Figures B.5 and B.6: Knee of Curve Estimates

R0073332

Spokane Stormwater Quality Design Storm



Yakima Stormwater Quality Design Storm



Figures B.7 and B.8: Knee of Curve Estimates

R0073333

REFERENCES

1. Booth, Derek B., and Jackson, C. Rhett, "Urbanization of Aquatic Systems: Degradation Thresholds, Stormwater Detection, and the Limits of Mitigation." *Journal of the American Water Resources Association*, October 1997
2. Analysis of Oregon Urban Runoff Water Quality Monitoring Data Collected From 1990 to 1996 (1997), The Oregon Association of Clean Water Agencies
3. May Christopher, et al, "Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion", *Watershed Protection Techniques*, Vol. 2, No. 4, June 1997
4. Kleindl, W. 1995. A Benthic Index of Biotic Integrity for Puget Sound Lowland Streams, Washington USA, Masters Thesis, University of Washington, Seattle, Washington. 68pp.
5. Karr, J.R. 1991. "Biological Integrity: A Long-Neglected Aspect of Water Resources Management," *Ecological Applications* 1(1):66-84.
6. Lucchetti, G. and Fuerstenberg, R., 1993, "Relative Fish Use in Urban and Non-Urban Streams," In: *Proceedings of the Conference on Wild Salmon*, Vancouver, B.C.
7. Issaquah Creek Basin and Nonpoint Action Plan, Dec. 1996, King County Surface Water Management Division
8. Puget Sound Water Quality Management Plan, 1987, 1989, 1991, 1994, Puget Sound Water Quality Authority
9. Miller, J.F., Frederick, R.H. and Tracey, R.S., NOAA ATLAS 2, Precipitation - Frequency Atlas of the Western United States, Volume IX - Washington, U.S. Dept. of Commerce, NOAA, National Weather Service, Washington, D.C., 1973.
10. Azous, A.L. and Horner R.R., "Wetlands and Urbanization, Implications for the Future," Final Report of the Puget Sound Wetlands and Stormwater Management Research Program, 1997.
11. CD-ROM Hydrodata, USGS Daily and Peak Values, published by Hydrosphere Data Products, Inc.
12. Schaefer, M.G., "Regional Analyses of Precipitation Annual Maxima in Washington State", Water Resources Research, Vol. 26, No. 1 pp. 119-132, January 1990.
13. Schaefer, M.G., Technical Note 3: Design Storm Construction, Dam Safety Guidelines, Washington State Department of Ecology, publication 92-55G, April 1993.
14. Langbein, W.B., "Annual Floods and the Partial-Duration Flood Series," Transactions American Geophysical Union, Vol. 30, pp. 879-881, 1949.
15. Perrich, Jerry R., The ESE National Precipitation Databook, 1992, Cahners Publishing Co.

GLOSSARY AND NOTATIONS

The following terms are provided for reference and use with this manual. They shall be superseded by any other definitions for these terms adopted by ordinance unless they are defined in a Washington State WAC or RCW or are used and defined as part of the Minimum Requirements for all new development and redevelopment.

AASHTO classification The official classification of soil materials and soil aggregate mixtures for highway construction, used by the American Association of State Highway and Transportation Officials.

Absorption The penetration of a substance into or through another, such as the dissolving of a soluble gas in a liquid.

Adjacent steep slope A slope with a gradient of 15 percent or steeper within five hundred feet of the site.

Adsorption The adhesion of a substance to the surface of a solid or liquid; often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water-repulsing adsorbents, are used to extract oil from waterways when oil spills occur. Heavy metals such as zinc and lead often adsorb onto sediment particles.

Aeration The process of being supplied or impregnated with air. In waste treatment, the process used to foster biological and chemical purification. In soils, the process by which air in the soil is replenished by air from the atmosphere. In a well aerated soil, the soil air is similar in composition to the atmosphere above the soil. Poorly aerated soils usually contain a much higher percentage of carbon dioxide and a correspondingly lower percentage of oxygen.

Aerobic Living or active only in the presence of free (dissolved or molecular) oxygen.

Aerobic bacteria Bacteria that require the presence of free oxygen for their metabolic processes.

Aggressive plant species Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to native species in this manual.

Algae Primitive plants, many microscopic, containing chlorophyll and forming the base of the food chain in aquatic environments. Some species may create a nuisance when environmental conditions are suitable for prolific growth.

R0073335

Algal bloom	Proliferation of living algae on the surface of lakes, streams or ponds; often stimulated by phosphate over-enrichment. Algal blooms reduce the oxygen available to other aquatic organisms.
American Public Works Association or APWA	The adopted edition of the Washington State Chapter of the American Public Works Association.
Anadromous	Fishes ascending rivers from the sea for breeding.
Anaerobic	Living or active in the absence of oxygen.
Anaerobic bacteria	Bacteria that do not require the presence of free or dissolved oxygen for metabolism.
Annual flood	The highest peak discharge on average which can be expected in any given year.
Antecedent moisture conditions	The degree of wetness of a watershed or within the soil at the beginning of a storm.
Anti-seep collar	A device constructed around a pipe or other conduit and placed through a dam, levee, or dike for the purpose of reducing seepage losses and piping failures.
Anti-vortex device	A facility placed at the entrance to a pipe conduit structure such as a drop inlet spillway or hood inlet spillway to prevent air from entering the structure when the pipe is flowing full.
Applicant	The person who has applied for a development permit or approval.
Approved manual	Means a stormwater management manual approved by Ecology.
Appurtenances	Machinery, appliances, or auxiliary structures attached to a main structure, but not considered an integral part thereof, for the purpose of enabling it to function.
Aquifer	A geologic stratum containing ground water that can be withdrawn and used for human purposes.
As-built drawings	Engineering plans which have been revised to reflect all changes to the plans which occurred during construction.
As-graded	The extent of surface conditions on completion of grading.
BSBL	See Building set back line.
Background	A description of pollutant levels arising from natural sources, and not because of man's immediate activities.
Backwater	Water upstream from an obstruction which is deeper than it would normally be without the obstruction.

R0073336

Bankfull discharge A flow condition where streamflow completely fills the stream channel up to the top of the bank. In undisturbed watersheds, the discharge conditions occurs on average every 1.5 to 2 years and controls the shape and form of natural channels.

Base flood A flood having a one percent chance of being equaled or exceeded in any given year. This is also referred to as the 100-year flood.

Base flood elevation The water surface elevation of the base flood. It shall be referenced to the National Geodetic Vertical Datum of 1929 (NGVD).

Baseline sample A sample collected during dry-weather flow (i.e., it does not consist of runoff from a specific precipitation event).

Basin plan A plan and all implementing regulations and procedures including but not limited to land use management adopted by ordinance for managing surface and stormwater quality and quantity management facilities and features within individual subbasins.

Bearing capacity The maximum load that a material can support before failing.

Bedrock The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.

Bench A relatively level step excavated into earth material on which fill is to be placed.

Berm A constructed barrier of compacted earth, rock or gravel.

Best management practice (BMP) The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants to waters of Washington State.

Biochemical oxygen demand (BOD) An indirect measure of the concentration of biologically degradable materials present in organic wastes. The amount of free oxygen utilized by aerobic organisms when allowed to attack the organic material in an aerobically maintained environment at a specified temperature (20θC) for a specific time period (5 days), and thus stated as BOD_5. It is expressed in milligrams of oxygen utilized per liter of liquid waste volume (mg/l) or in milligrams of oxygen per kilogram of waste solution (mg/kg = ppm = parts per million parts). Also called biological oxygen demand.

Biodegradable Capable of being readily broken down by biological means, especially by bacterial action. Degradation can be rapid or may take many years depending upon such factors as available oxygen and moisture.

R0073337

Bioengineering Restoration or reinforcement of slopes and stream banks with living plant materials.

Biofilter A designed, vegetated treatment facility where the more or less simultaneous processes of filtration, infiltration, adsorption and biological uptake of pollutants in stormwater takes place when runoff flows over and through . Vegetation growing in these facilities acts as both a physical filter which causes gravity settling of particulates by regulating velocity of flow, and also as a biological sink when direct uptake of dissolved pollutants occurs. The former mechanism is probably the most important in western Washington where the period of major runoff coincides with the period of lowest biological activity.

Biofiltration The process of reducing pollutant concentrations in water by filtering the polluted water through biological materials.

Biological control A method of controlling pest organisms by means of introduced or naturally occurring predatory organisms, sterilization, the use of inhibiting hormones, or other means, rather than by mechanical or chemical means.

Biological magnification The increasing concentration of a substance along succeeding steps in a food chain. Also called biomagnification.

Bollard A post (may or may not be removable) used to prevent vehicular access.

Bond A surety bond, cash deposit or escrow account, assignment of savings, irrevocable letter of credit or other means acceptable to or required by the manager to guarantee that work is completed in compliance with the project's drainage plan and in compliance with all local government requirements.

Borrow area A source of earth fill material used in the construction of embankments or other earth fill structures.

Buffer The zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of fine sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.

R0073338

Building setback line (BSBL)	A line measured parallel to a property, easement, drainage facility or buffer boundary, that delineates the area (defined by the distance of separation) where buildings, or other obstructions are prohibited (including decks, patios, outbuildings, or overhangs beyond 18 inches). Wooden or chain link fences and landscaping are allowable within a building setback line. In this manual the minimum building setback line shall be 5 feet.
CIP	See Capital Improvement Project.
Capital Improvement Project or Program (CIP)	A project prioritized and scheduled as a part of an overall construction program or, the actual construction program.
Catchbasin	A chamber or well, usually built at the curb line of a street, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.
Catchline	The point where a severe slope intercepts a different, more gentle slope.
Catchment	Surface drainage area.
Channel	A feature that conveys surface water and is open to the air.
Channel, constructed	Channels or ditches constructed (or reconstructed natural channels) to convey surface water.
Channel, natural	Streams, creeks, or swales that convey surface/ground water and have existed long enough to establish a stable route and/or biological community.
Channel stabilization	Erosion prevention and stabilization of velocity distribution in a channel using vegetation, jetties, drops, revetments, and/or other measures.
Channel storage	Water temporarily stored in channels while enroute to an outlet.
Channelization	Alteration of a stream channel by widening, deepening, straightening, cleaning, or paving certain areas to change flow characteristics.
Check dam	Small dam constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel scour, and promote deposition of sediment.
Chemical oxygen demand (COD)	A measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water. The COD test, like the BOD test, is used to determine the degree of pollution in water.

R0073339

Civil engineer A professional engineer licensed in the State of Washington in Civil Engineering who is experienced and knowledgeable in the practice of soils engineering.

Civil engineering The application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works for the beneficial uses of mankind.

Clay lens A naturally occurring, localized area of clay which acts as an impermeable layer to runoff infiltration.

Clearing The destruction and removal of vegetation by manual, mechanical, or chemical methods.

Closed depression An area which is lowlying and either has no, or such a limited, surface water outlet that during storm events the area acts as a retention basin.

Cohesion The capacity of a soil to resist shearing stress, exclusive of functional resistance.

Coliform bacteria Microorganisms common in the intestinal tracts of man and other warm-blooded animals; all the aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35θC. Used as an indicator of bacterial pollution.

Commercial agriculture Those activities conducted on lands defined in RCW 84.34.020(2), and activities involved in the production of crops or livestock for wholesale trade. An activity ceases to be considered commercial agriculture when the area on which it is conducted is proposed for conversion to a nonagricultural use or has lain idle for more than five (5) years, unless the idle land is registered in a federal or state soils conservation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.

Compaction Densification of a fill by mechanical means.

Compensatory storage New excavated storage volume equivalent to the flood storage capacity eliminated by filling or grading within the flood fringe. Equivalent shall mean that the storage removed shall be replaced by equal volume between corresponding one foot contour intervals that are hydraulically connected to the floodway through their entire depth.

Compost Organic residue or a mixture of organic residues and soil, that has undergone biological decomposition until it has become relatively stable humus.

R0073340

Composting A controlled process of degrading organic matter by microorganisms. Present day composting is the aerobic, thermophilic decomposing of organic waste to relatively stable humus. Humus with no more than 25 percent dead or living organisms is stable enough not to reheat or cause odor or fly problems. It can undergo further, slower decay.

Comprehensive planning Planning that takes into account all aspects of water, air, and land resources and their uses and limits.

Conservation district A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries, usually a subdivision of state government with a local governing body and always with limited authority. Often called a soil conservation district or a soil and water conservation district.

Constructed wetland Those wetlands intentionally created on sites that are not wetlands for the primary purpose of wastewater or stormwater treatment and managed as such. Constructed wetlands are normally considered as part of the stormwater collection and treatment system.

Contour An imaginary line on the surface of the earth connecting points of the same elevation.

Conveyance A mechanism for transporting water from one point to another, including pipes, ditches, and channels.

Conveyance system The drainage facilities, both natural and man-made, which collect, contain, and provide for the flow of surface and stormwater from the highest points on the land down to a receiving water. The natural elements of the conveyance system include swales and small drainage courses, streams, rivers, lakes, and wetlands. The human-made elements of the conveyance system include gutters, ditches, pipes, channels, and most retention/detention facilities.

Cover crop A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.

Created wetland Means those wetlands intentionally created from nonwetland sites to produce or replace natural wetland habitat (e.g., compensatory mitigation projects).

Critical Areas At a minimum, areas which include wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, geologically hazardous areas, including unstable slopes, and associated areas and ecosystems.

R0073341

Critical depth	The depth which minimizes the specific energy of flow (E).
Critical Drainage Area	An area with such severe flooding, drainage and/or erosion/sedimentation conditions that the area has been formally adopted as a Critical Drainage Area by rule under the procedures specified in an ordinance.
Critical flow	Flow at the critical depth and velocity.
Critical reach	The point in a receiving stream below a discharge point at which the lowest dissolved oxygen level is reached and stream recovery begins.
Culvert	Pipe or concrete box structure which drains open channels, swales or ditches under a roadway or embankment. Typically with no catchbasins or manholes along its length.
Cut	Portion of land surface or area from which earth has been removed or will be removed by excavating; the depth below original ground surface to excavated surface.
Cut-and-fill	Process of earth moving by excavating part of an area and using the excavated material for adjacent embankments or fill areas.
DNS	See Determination of nonsignificance.
Dead storage	The volume available in a depression in the ground below any conveyance system, or surface drainage pathway, or outlet invert elevation that could allow the discharge of surface and stormwater runoff.
Dedication of land	Refers to setting aside a portion of a property for a specific use or function.
Degradation	(Biological or chemical) The breakdown of complex organic or other chemical compounds into simpler substances, usually less harmful than the original compound, as with the degradation of a persistent pesticide. (Geological) Wearing down by erosion. (Water) The lowering of the water quality of a watercourse by an increase in the pollutant loading.
Degraded (disturbed) wetland (community)	A wetland (community) in which the vegetation, soils, and/or hydrology have been adversely altered, resulting in lost or reduced functions and values; generally, implies topographic isolation; hydrologic alterations such as hydroperiod alteration (increased or decreased quantity of water), diking, channelization, and/or outlet modification; soils alterations such as presence of fill, soil removal, and/or compaction; accumulation of toxicants in the biotic or abiotic components of the wetland; and/or low plant species richness with dominance by invasive weedy species.
Denitrification	The biochemical reduction of nitrates or nitrites in the soil or organic deposits to ammonia or free nitrogen.

Depression storage	The amount of precipitation that is trapped in depressions on the surface of the ground.
Design engineer	The professional civil engineer licensed in the State of Washington who prepares the analysis, design, and engineering plans for an applicant's permit or approval submittal.
Design storm	A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff for a hypothetical storm of interest or concern for the purposes of analyzing existing drainage, designing new drainage facilities or assessing other impacts of a proposed project on the flow of surface water. (A hyetograph is a graph of percentages of total precipitation for a series of time steps representing the total time during which the precipitation occurs.)
Detention	The release of stormwater runoff from the site at a slower rate than it is collected by the stormwater facility system, the difference being held in temporary storage.
Detention facility	An above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility system. There is little or no infiltration of stored stormwater.
Detention time	The theoretical time required to displace the contents of a stormwater treatment facility at a given rate of discharge (volume divided by rate of discharge).
Determination of Nonsignificance (DNS)	The written decision by the responsible official of the lead agency that a proposal is not likely to have a significant adverse environmental impact, and therefore an EIS is not required.
Development	Means new development, redevelopment, or both. See definitions for each.
Discharge	Outflow; the flow of a stream, canal, or aquifer. One may also speak of the discharge of a canal or stream into a lake, river, or ocean. (Hydraulics) Rate of flow, specifically fluid flow; a volume of fluid passing a point per unit of time, commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, gallons per day, or millions of gallons per day.
Dispersed discharge	Release of surface and stormwater runoff from a drainage facility system such that the flow spreads over a wide area and is located so as not to allow flow to concentrate anywhere upstream of a drainage channel with erodible underlying granular soils.
Ditch	A long narrow excavation dug in the earth for drainage with its top width less than 10 feet at design flow.

R0073343

Divide, Drainage The boundary between one drainage basin and another.

Drain A buried pipe or other conduit (closed drain). A ditch (open drain) for carrying off surplus surface water or ground water.

(To) Drain To provide channels, such as open ditches or closed drains, so that excess water can be removed by surface flow or by internal flow. To lose water (from the soil) by percolation.

Drainage Refers to the collection, conveyance, containment, and/or discharge of surface and stormwater runoff.

Drainage basin A geographic and hydrologic subunit of a watershed.

Drainage channel A drainage pathway with a well-defined bed and banks indicating frequent conveyance of surface and stormwater runoff.

Drainage course A pathway for watershed drainage characterized by wet soil vegetation; often intermittent in flow.

Drainage easement A legal encumbrance that is placed against a property's title to reserve specified privileges for the users and beneficiaries of the drainage facilities contained within the boundaries of the easement.

Drainage pathway The route that surface and stormwater runoff, leaving any part of the site, follows downslope.

Drainage review An evaluation by Plan Approving Authority staff of a proposed project's compliance with the drainage requirements in this manual or its technical equivalent.

Drainage, Soil As a natural condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation; for example, in well-drained soils the water is removed readily but not rapidly; in poorly drained soils the root zone is waterlogged for long periods unless artificially drained, and the roots of ordinary crop plants cannot get enough oxygen; in excessively drained soils the water is removed so completely that most crop plants suffer from lack of water. Strictly speaking, excessively drained soils are a result of excessive runoff due to steep slopes or low available water-holding capacity due to small amounts of silt and clay in the soil material. The following classes are used to express soil drainage:

- Well drained - Excess water drains away rapidly and no mottling occurs within 36 inches of the surface.
- Moderately well drained - Water is removed from the soil somewhat slowly, resulting in small but significant periods of wetness. Mottling occurs between 18 and 36 inches.

Drainage, Soil (continued)

- Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Mottling occurs between 8 and 18 inches.

- Poorly drained - Water is removed so slowly that the soil is wet for a large part of the time. Mottling occurs between 0 and 8 inches.
- Very poorly drained - Water is removed so slowly that the water table remains at or near the surface for the greater part of the time. There may also be periods of surface ponding. The soil has a black to gray surface layer with mottles up to the surface.

Drawdown — Lowering of the water surface (in open channel flow), water table or piezometric surface (in ground water flow) resulting from a withdrawal of water.

Drop-inlet spillway — Overall structure in which the water drops through a vertical riser connected to a discharge conduit.

Drop spillway — Overall structure in which the water drops over a vertical wall onto an apron at a lower elevation.

Drop structure — A structure for dropping water to a lower level and dissipating its surplus energy; a fall. A drop may be vertical or inclined.

Dry weather flow — The combination of sanitary sewage, and industrial and commercial wastes normally found in sanitary or storm sewers during the dry weather season of the year. Also that flow in streams during the dry season.

EIS — See Environmental Impact Statement.

ESC — Erosion and Sediment Control (Plan).

Earth material — any rock, natural soil or fill and/or any combination thereof.

Easement — The legal right to use a parcel of land for a particular purpose. It does not include fee ownership, but may restrict the owners use of the land.

Embankment — A structure of earth, gravel, or similar material raised to form a pond bank or foundation for a road.

Emergent plants — Aquatic plants that are rooted in the sediment but whose leaves are at or above the water surface. These wetland plants often have high habitat value for wildlife and waterfowl, and can aid in pollutant uptake.

Emergency spillway — A vegetated earth channel used to safely convey flood discharges in excess of the capacity of the principal spillway.

R0073345

Energy dissipator — Any means by which the total energy of flowing water is reduced. In stormwater design, they are usually mechanisms that reduce velocity prior to, or at, discharge from an outfall in order to prevent erosion. They include rock splash pads, drop manholes, concrete stilling basins or baffles, and check dams.

Energy gradient — The slope of the specific energy line (i.e., the sum of the potential and velocity heads.)

Engineering geologist — A geologist experienced and knowledgeable in engineering geology.

Engineering geology — The application of geologic knowledge and principles in the investigation and evaluation of naturally occurring rock and soil for use in the design of civil works.

Engineering plan — A plan prepared and stamped by a professional civil engineer. An engineering plan contains a Technical Information Report and Site Improvement Plans which are described in detail in Chapter I-3.

Enhancement — To raise value, desirability, or attractiveness of an environment associated with surface water.

Environmental Impact Statement (EIS) — A document that discusses the likely significant adverse impacts of a proposal, ways to lessen the impacts, and alternatives to the proposal. They are required by the national and state environmental policy acts when projects are determined to have significant environmental impact.

Erodible granular soils — Soil materials that are easily eroded and transported by running water, typically fine or medium grained sand with minor gravel, silt, or clay content. Such soils are commonly described as Everett or Indianola series soil types in the SCS classification. Also included are any soils showing examples of existing severe stream channel incision as indicated by unvegetated streambanks standing over two feet high above the base of the channel.

Erosion — The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

- Accelerated erosion - Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires).
- Geological erosion - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc. Synonymous with natural erosion.

Erosion (continued)

- Gully erosion - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.
- Natural erosion - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Synonymous with geological erosion.
- Normal erosion - The gradual erosion of land used by man which does not greatly exceed natural erosion. See Natural erosion.
- Rill erosion - An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See Rill.
- Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by runoff.
- Splash erosion - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.

Erosion classes (soil survey)

A grouping of erosion conditions based on the degree of erosion or on characteristic patterns. Applied to accelerated erosion, not to normal, natural, or geological erosion. Four erosion classes are recognized for water erosion and three for wind erosion.

Erosion/sedimentation control

Any temporary or permanent measures taken to reduce erosion; control siltation and sedimentation; and ensure that sediment-laden water does not leave the site.

Erosion and sediment control facility

A type of drainage facility designed to hold water for a period of time to allow sediment contained in the surface and stormwater runoff directed to the facility to settle out so as to improve the quality of the runoff.

Escarpment

A steep face or a ridge of high land.

Estuarine wetland

Generally, an eelgrass bed; salt marsh; or rocky, sandflat, or mudflat intertidal area where fresh and salt water mix. (Specifically, a tidal wetland with salinity greater than 0.5 parts per thousand, usually semi-enclosed by land but with partially obstructed or sporadic access to the open ocean).

Estuary

An area where fresh water meets salt water, or where the tide meets the river current (e.g., bays, mouths of rivers, salt marshes and lagoons). Estuaries serve as nurseries and spawning and feeding grounds for large groups of marine life and provide shelter and food for birds and wildlife.

R0073347

Eutrophication — Refers to the process where nutrient over-enrichment of water leads to excessive growth of aquatic plants, especially algae.

Evapotranspiration — The collective term for the processes of evaporation and plant transpiration by which water is returned to the atmosphere.

Excavation — The mechanical removal of earth material.

Exfiltration — The downward movement of runoff through the bottom of an infiltration BMP into the soil layer or the downward movement of water through soil.

Existing site conditions means

(a) For developed sites with stormwater facilities that have been constructed to meet the standards in the Minimum Requirements of this manual, existing site conditions shall mean the existing conditions on the site.

(b) For developed sites that do not have stormwater facilities that meet the Minimum Requirements, existing site conditions shall mean the conditions that existed prior to the development of the project site. If in question, the existing site conditions shall be documented by aerial photograph records, or other appropriate means.

(c) (c) For undeveloped sites existing site conditions shall mean the existing conditions on the site.

Experimental best management practice (BMP) — A BMP that has not been tested and evaluated by the Department of Ecology in collaboration with local governments and technical experts.

FIRM — See Flood Insurance Rate Map.

Fertilizer — Any material or mixture used to supply one or more of the essential plant nutrient elements.

Fill — A deposit of earth material placed by artificial means.

Filter fabric — A woven or nonwoven, water-permeable material generally made of synthetic products such as polypropylene and used in stormwater management and erosion and sediment control applications to trap sediment or prevent the clogging of aggregates by fine soil particles.

Filter fabric fence — A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts and entrenched. The filter fence is constructed of stakes and synthetic filter fabric with a rigid wire fence backing where necessary for support.

Filter strip — A strip of vegetation used to retard or collect sediment for the protection of diversions, drainage basins, or other structures. Often used in conjunction with a level spreader to keep flow from becoming channelized in the filter strip.

R0073348

Flocculation	The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules which eventually settle out of suspension. This process occurs naturally but can also be caused through the use of such chemicals as alum.
Flood	An overflow or inundation that comes from a river or any other source, including (but no limited to) streams, tides, wave action, storm drains or excess rainfall. Any relatively high stream flow overtopping the natural or artificial banks in any reach of a stream.
Flood control	Methods or facilities for reducing flood flows and the extent of flooding.
Flood control project	A structural system installed to protect land and improvements from floods by the construction of dikes, river embankments, channels, or dams.
Flood frequency	The frequency with which the flood of interest may be expected to occur at a site in any average interval of years. Frequency analysis defines the "n-year flood" as being the flood that will, over a long period of time, be equaled or exceeded on the average once every "n" years.
Flood fringe	That portion of the floodplain outside of the floodway which is covered by floodwaters during the base flood; it is generally associated with standing water rather than rapidly flowing water.
Flood Hazard Areas	Those areas subject to inundation by the base flood. Includes, but is not limited to streams, lakes, wetlands, and closed depressions.
Flood Insurance Rate Map (FIRM)	The official map on which the Federal Insurance Administration has delineated many areas of flood hazard, floodway, and the risk premium zones.
Flood Insurance Study	The official report provided by the Federal Insurance Administration that includes flood profiles and the FIRM.
Flood peak	The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge.
Floodplain	The total area subject to inundation by the base flood including the flood fringe and floodway.
Flood-proofing	Adaptations that ensure a structure is substantially impermeable to the passage of water below the flood protection elevation that resists hydrostatic and hydrodynamic loads and effects of buoyancy.
Flood protection elevation	The base flood elevation or higher as defined by the local government.

R0073349

Flood protection facility — Any levee, berm, wall, enclosure, raise bank, revetment, constructed bank stabilization or armoring, that is commonly recognized by the community as providing significant protection to a property from inundation by flood waters.

Flood routing — An analytical technique used to compute the effects of system storage dynamics on the shape and movement of flow represented by a hydrograph.

Flood stage — The stage at which overflow of the natural banks of a stream begins.

Floodway — The channel of the river or stream and those portions of the adjoining floodplains which are reasonably required to carry and discharge the base flood flow. The portions of the adjoining floodplains which are considered to be "reasonably required" is defined by flood hazard regulations.

Forebay — An easily maintained, extra storage area provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond or wetland BMP.

Forest practice — Any activity conducted on or directly pertaining to forest land and relating to growing, harvesting, or processing timber, including but not limited to:

a. Road and trail construction.
b. Harvesting, final and intermediate.
c. Precommercial thinning.
d. Reforestation.
e. Fertilization.
f. Prevention and suppression of diseases and insects.
g. Salvage of trees.
h. Brush control.

Forested communities (wetlands) — In general terms, communities (wetlands) characterized by woody vegetation that is greater than or equal to 6 meters in height; in this manual the term applies to such communities (wetlands) that represent a significant amount of tree cover consisting of species that offer wildlife habitat and other values and advance the performance of wetland functions overall.

Freeboard — The vertical distance between the design water surface elevation and the elevation of the barrier which contains the water.

Frequently flooded areas — the 100-year floodplain designations of the Federal Emergency Management Agency and the National Flood Insurance Program or as defined by the local government.

R0073350

Frost-heave — The upward movement of soil surface due to the expansion of water stored between particles in the first few feet of the soil profile as it freezes. May cause surface fracturing of asphalt or concrete.

Frequency of storm (design storm frequency) — The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur; thus a 10-year storm can be expected to occur on the average once every 10 years. Sewers designed to handle flows which occur under such storm conditions would be expected to be surcharged by any storms of greater amount or intensity.

Functions — The ecological (physical, chemical, and biological) processes or attributes of a wetland without regard for their importance to society (see also values). Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, floodflow alteration, ground water recharge and discharge, water quality improvement, and soil stabilization.

Gabion — A rectangular or cylindrical wire mesh cage (a chicken wire basket) filled with rock and used as a protecting agent, revetment, etc., against erosion. Soft gabions, often used in streambank stabilization, are made of geotextiles filled with dirt, in between which cuttings are placed.

Gage or gauge — Device for registering precipitation, water level, discharge, velocity, pressure, temperature, etc. Also, a measure of the thickness of metal; e.g., diameter of wire, wall thickness of steel pipe.

Gaging station — A selected section of a stream channel equipped with a gage, recorder, or other facilities for determining stream discharge.

Geologist — A person who has earned a degree in geology from an accredited college or university or who has equivalent educational training and has at least five years of experience as a practicing geologist or four years of experience and at least two years post-graduate study, research or teaching. The practical experience shall include at least three years work in applied geology and landslide evaluation, in close association with qualified practicing geologists or geotechnical professional/civil engineers.

Geologically hazardous areas — Areas that because of their susceptibility to erosion, sliding, earthquake or other geological events, are not suited to the siting of commercial, residential or industrial development consistent with public health or safety concerns.

Geometrics — The mathematical relationships between points, lines, angles and surfaces used to measure and identify areas of land.

Geotechnical professional civil engineer — A practicing, geotechnical/civil engineer licensed as a professional Civil Engineer with the State of Washington who has at least four years of professional employment as a geotechnical engineer in responsible charge, including experience with landslide evaluation.

Grade — The slope of a road, channel, or natural ground. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction such as paving or the laying of a conduit.

(To) Grade — To finish the surface of a canal bed, roadbed, top of embankment or bottom of excavation.

Gradient terrace — An earth embankment or a ridge-and-channel constructed with suitable spacing and an acceptable grade to reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a stable nonerosive velocity.

Grassed waterway — A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate. See also biofilter.

Ground water — Water in a saturated zone or stratum beneath the land surface or a surface water body.

Ground water recharge — Inflow to a ground water reservoir.

Ground water table — The free surface of the ground water, that surface subject to atmospheric pressure under the ground, generally rising and falling with the season, the rate of withdrawal, the rate of restoration, and other conditions. It is seldom static.

(the) Guidance Manual — "The Stormwater Program Guidance Manual for the Puget Sound Basin," a companion manual to this technical manual which contains program implementation guidance for local governments. Examples of the guidance contained are model ordinances, public education information, and guidance on setting up a stormwater utility.

Gully — A channel caused by the concentrated flow of surface and stormwater runoff over unprotected erodible land.

Habitat — The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be protected from harmful contaminants.

Hardpan — A cemented or compacted and often clay-like layer of soil that is impenetrable by roots.

R0073352

Harmful pollutant A substance that has adverse effects to an organism including immediate death, chronic poisoning, impaired reproduction, cancer or other effects.

Head (Hydraulics) The height of water above any plain of reference. The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. Used in various compound terms such as pressure head, velocity head, and head loss.

Head loss Energy loss due to friction, eddies, changes in velocity, or direction of flow.

Heavy metals Metals of high specific gravity, present in municipal and industrial wastes, that pose long-term environmental hazards. Such metals include cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.

Humus Organic matter in or on a soil, composed of partly or fully decomposed bits of plant tissue or from animal manure.

Hydraulic gradient Slope of the potential head relative to a fixed datum.

Hydrodynamics Means the dynamic energy, force, or motion of fluids as affected by the physical forces acting upon those fluids.

Hydrograph A graph of runoff rate, inflow rate or discharge rate, past a specific point over time.

Hydrologic cycle The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hydrologic Soil Groups A soil characteristic classification system defined by the U.S. Soil Conservation Service in which a soil may be categorized into one of four soil groups (A, B, C, or D) based upon infiltration rate and other properties.

Hydrology The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.

Hydroperiod A seasonal occurrence of flooding and/or soil saturation; it encompasses depth, frequency, duration, and seasonal pattern of inundation.

Hyetograph A graph of percentages of total precipitation for a series of time steps representing the total time in which precipitation occurs.

Illicit discharge All non-stormwater discharges to stormwater drainage systems that cause or contribute to a violation of state water quality, sediment quality or ground water quality standards, including but not limited to sanitary sewer connections, industrial process water, interior floor drains, car washing and greywater systems.

Impact basin A device used to dissipate the energy of flowing water. Generally constructed of concrete in the form of a partially depressed or partially submerged vessel, it may utilize baffles to dissipate velocities.

Impervious A surface which cannot be easily penetrated. For instance, rain does not readily penetrate paved surfaces.

Impervious surface A hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces.

Impoundment A natural or man-made containment for surface water.

Improvement Streets (with or without curbs or gutters), sidewalks, crosswalks, parking lots, water mains, sanitary and storm sewers, drainage facilities, street trees and other appropriate items.

Industrial activities Material handling, transportation, or storage; manufacturing; maintenance; treatment; or disposal. Areas with industrial activities include plant yards, access roads and rail lines used by carriers of raw materials, manufactured products, waste material, or by-products; material handling sites; refuse sites; sites used for the application or disposal of process waste waters; sites used for the storage and maintenance material handling equipment sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater.

Infiltration Means the downward movement of water from the surface to the subsoil.

R0073354

Infiltration facility (or system)	A drainage facility designed to use the hydrologic process of surface and stormwater runoff soaking into the ground, commonly referred to as a percolation, to dispose of surface and stormwater runoff.
Ingress/egress	The points of access to and from a property.
Inlet	A form of connection between surface of the ground and a drain or sewer for the admission of surface and stormwater runoff.
Insecticide	A substance, usually chemical, that is used to kill insects.
Interception (Hydraulics)	The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs, and other vegetation. Often used for "interception loss" or the amount of water evaporated from the precipitation intercepted.
Interflow	That portion of rainfall that infiltrates into the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface for example, in a wetland, spring or seep.
Intermittent stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources. It is dry for a large part of the year, ordinarily more than three months.
Invasive weedy plant species	Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to non-native species in this manual.
Invert	The lowest point on the inside of a sewer or other conduit.
Invert elevation	The vertical elevation of a pipe or orifice in a pond which defines the water level.
Isopluvial map	A map with lines representing constant depth of total precipitation for a given return frequency.
Lag time	The interval between the center of mass of the storm precipitation and the peak flow of the resultant runoff.
Lake	An area permanently inundated by water in excess of two meters deep and greater than 20 acres in size as measured at the ordinary high water marks.
Land disturbing activity	Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to demolition, construction, clearing, grading, filling and excavation.

R0073355

Landslide	Episodic downslope movement of a mass of soil or rock that includes but is not limited to rockfalls, slumps, mudflows, and earthflows. For the purpose of these rules, snow avalanches are considered to be a special case of landsliding.
Landslide Hazard Areas	Those areas subject to a severe risk of landslide.
Large Parcel Erosion and Sediment Control Plan" or "LPESC Plan"	A plan to implement BMPs to control pollution generated during land disturbing activity. Guidance for preparing a Large Parcel ESC Plan is contained in Chapter II-4. *[Note: Ecology will be adding a sample Large Parcel ESC Plan to the Guidance Manual.]*
Leachate	Liquid that has percolated through soil and contains substances in solution or suspension.
Leaching	Removal of the more soluble materials from the soil by percolating waters.
Legume	A member of the legume or pulse family, Leguminosae, one of the most important and widely distributed plant families. The fruit is a "legume" or pod. Includes many valuable food and forage species, such as peas, beans, clovers, alfalfas, sweet clovers, and vetches. Practically all legumes are nitrogen-fixing plants.
Level spreader	A temporary ESC device used to spread out stormwater runoff uniformly over the ground surface as sheet flow (i.e., not through channels). The purpose of level spreaders are to prevent concentrated, erosive flows from occurring, and to enhance infiltration.
Local government	Any county, city, or town having its own incorporated government for local affairs.
Low flow channel	An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and/or baseflow, directly to the outlet without detention.
Lowest floor	The lowest enclosed area (including basement) of a structure. An area used solely for parking of vehicles, building access, or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that the enclosed area meets all of the structural requirements of the flood hazard standards.
MDNS	A Mitigated Determination of Nonsignificance (See DNS and Mitigation).

R0073356

Manning's equation (Hydraulics)

An equation used to predict the velocity of water flow in an open channel or pipelines:

$$V = \frac{1.486R^{2/3}S^{1/2}}{n}$$

where:

V is the mean velocity of flow in feet per second

R is the hydraulic radius in feet

S is the slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and

n is Manning's roughness coefficient or retardance factor of the channel lining.

Mass wasting

The movement of large volumes of earth material downslope.

Master Drainage Plan

A comprehensive drainage control plan intended to prevent significant adverse impacts to the natural and manmade drainage system, both on and off-site.

Mean annual water level fluctuation

Derived as follows--

(1) Measure the maximum water level (e.g., with a crest stage gage, Reinelt and Horner 1990) and the existing water level at the time of the site visit (e.g., with a staff gage) on at least eight occasions spread through a year.

(2) Take the difference of the maximum and existing water level on each occasion and divide by the number of occasions.

Mean depth (Hydraulics)

Average depth; cross-sectional area of a stream or channel divided by its surface or top width.

Mean velocity

The average velocity of a stream flowing in a channel or conduit at a given cross-section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the reach.

Measuring weir

A shaped notch through which water flows are measured. Common shapes are rectangular, trapezoidal, and triangular.

Mechanical analysis

The analytical procedure by which soil particles are separated to determine the particle size distribution.

Mechanical practices

Soil and water conservation practices that primarily change the surface of the land or that store, convey, regulate, or dispose of runoff water without excessive erosion.

R0073357

Metals — Elements, such as mercury, lead, nickel, zinc and cadmium, that are of environmental concern because they do not degrade over time. Although many are necessary nutrients, they are sometimes magnified in the food chain, and they can be toxic to life in high enough concentrations. They are also referred to as heavy metals.

Mitigation — Means, in the following order of preference:

(a) Avoiding the impact altogether by not taking a certain action or part of an action;

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

(c) Rectifying the impact by repairing, rehabilitating or restoring the affected environment;

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(e) Compensation for the impact by replacing, enhancing, or providing substitute resources or environments.

Modification, Modified (wetland) — A wetland whose physical, hydrological, or water quality characteristics have been purposefully altered for a management purpose, such as by dredging, filling, forebay construction, and inlet or outlet control.

Monitor — To systematically and repeatedly measure something in order to track changes.

Monitoring — The collection of data by various methods for the purposes of understanding natural systems and features, evaluating the impacts of development proposals on such systems, and assessing the performance of mitigation measures imposed as conditions of development.

NGPE — See Native Growth Protection Easement.

NGVD — National Geodetic Vertical Datum (see Base flood elevation).

NPDES — The National Pollutant Discharge Elimination System as established by the Federal Clean Water Act.

National Pollutant Discharge Elimination System (NPDES) — The part of the federal Clean Water Act, which requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

Native Growth Protection Easement (NGPE)
An easement granted for the protection of native vegetation within a sensitive area or its associated buffer. The NGPE shall be recorded on the appropriate documents of title and filed with the County Records Division.

Natural location
Means the location of those channels, swales, and other non-manmade conveyance systems as defined by the first documented topographic contours existing for the subject property, either from maps or photographs, or such other means as appropriate.

New development
Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of impervious surfaces; subdivision, short subdivision and binding site plans, as defined and applied in Chapter58.17 RCW. All other forest practices and commercial agriculture are not considered new development.

Nitrate (NO_3)
A form of nitrogen which is an essential nutrient to plants. It can cause algal blooms in water if all other nutrients are present in sufficient quantities. It is a product of bacterial oxidation of other forms of nitrogen, from the atmosphere during electrical storms and from fertilizer manufacturing.

Nitrification
The biochemical oxidation process by which ammonia is changed first to nitrites and then to nitrates by bacterial action, consuming oxygen in the water.

Nitrogen, Available
Usually ammonium, nitrite, and nitrate ions, and certain simple amines available for plant growth. A small fraction of organic or total nitrogen in the soil is available at any time.

Nonpoint source pollution
Pollution that enters a water body from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.

Normal depth
The depth of uniform flow. This is a unique depth of flow for any combination of channel characteristics and flow conditions. Normal depth is calculated using Manning's Equation.

Nutrients
Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to degradation of water quality and algal blooms. Some nutrients can be toxic at high concentrations.

Off-site
Any area lying upstream of the site that drains onto the site and any area lying downstream of the site to which the site drains.

Off-system storage Facilities for holding or retaining excess flows over and above the carrying capacity of the stormwater conveyance system, in chambers, tanks, lagoons, ponds, or other basins that are not a part of the subsurface sewer system.

On-site The entire property that includes the proposed development.

OperationalBMPs Schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. Operational BMPs are a type of Source Control BMP.

Ordinary High Water Mark The term ordinary high water mark means the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil destruction on terrestrial vegetation, or the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding area.

The ordinary high water mark will be found by examining the bed and banks of a stream and ascertaining where the presence and action of waters are so common and usual, and so long maintained in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation. In any area where the ordinary high water mark cannot be found, the line of mean high water shall substitute. In any area where neither can be found, the channel bank shall be substituted. In braided channels and alluvial fans, the ordinary high water mark or substitute shall be measured so as to include the entire stream feature.

Orifice An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purpose of measurement or control of water.

Outlet Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

Outlet channel A waterway constructed or altered primarily to carry water from man-made structures, such as terraces, tile lines, and diversions.

Overflow A pipeline or conduit device, together with an outlet pipe, that provides for the discharge of portions of combined sewer flows into receiving waters or other points of disposal, after a regular device has allowed the portion of the flow which can be handled by interceptor sewer lines and pumping and treatment facilities to be carried by and to such water pollution control structures.

Overflow rate Detention basin release rate divided by the surface area of the basin. It can be thought of as an average flow rate through the basin.

Overtopping To flow over the limits of a containment or conveyance element.

Peak discharge — The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.

Peak-shaving — Controlling post-development peak discharge rates to pre-development levels by providing temporary detention in a BMP.

Percolation — The movement of water through soil.

Percolation rate — The rate, usually expressed as a velocity, at which water moves through saturated granular material.

Permanent Stormwater Quality Control (PSQC) Plan — A plan which includes permanent BMPs for the control of pollution from stormwater runoff after construction and/or land disturbing activity has been completed. For small sites, this requirement is met by implementing a Small Parcel Erosion and Sediment Control Plan. Guidance on preparing a PSQC Plan is contained in Chapter I-3 and Chapter I-4. *[Note: Ecology will add a sample Large Parcel ESC Plan to the Guidance Manual.]*

Permeability rate — The rate at which water will move through a saturated soil. Permeability rates are classified as follows:

a. Very slow - Less than 0.06 inches per hour.
b. Slow - 0.06 to 0.20 inches per hour.
c. Moderately slow - 0.20 to 0.63 inches per hour.
d. Moderate - 0.63 to 2.0 inches per hour.
e. Moderately rapid - 2.0 to 6.3 inches per hour.
f. Rapid - 6.3 to 20.0 inches per hour.
g. Very rapid - More than 20.0 inches per hour.

Permeable soils — Soil materials with a sufficiently rapid infiltration rate so as to greatly reduce or eliminate surface and stormwater runoff. These soils are generally classified as SCS hydrologic soil types A and B.

Person — Any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.

Perviousness — Related to the size and continuity of void spaces in soils; related to a soil's infiltration rate.

Pesticide — A general term used to describe any substance - usually chemical - used to destroy or control organisms; includes herbicides, insecticides, algicides, fungicides, and others. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins which are extracted from plants and animals.

pH A measure of the alkalinity or acidity of a substance which is conducted by measuring the concentration of hydrogen ions in the substance. A pH of 7.0 indicates neutral water. A 6.5 reading is slightly acid.

Physiographic Characteristics of the natural physical environment (including hills).

Planned unit development (PUD) A special classification authorized in some zoning ordinances, where a unit of land under control of a single developer may be used for a variety of uses and densities, subject to review and approval by the local governing body. The locations of the zones are usually decided on a case-by-case basis.

Plat A map or representation of a subdivision showing the division of a tract or parcel of land into lots, blocks, streets, or other divisions and dedications.

Plunge pool A device used to dissipate the energy of flowing water that may be constructed or made by the action of flowing. These facilities may be protected by various lining materials.

Point discharge The release of collected and/or concentrated surface and stormwater runoff from a pipe, culvert, or channel.

Pollution Contamination or other alteration of the physical, chemical, or biological properties, of waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Pollution-generating impervious surface(PGIS) Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities; or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall. Metal roofs are also considered to be PGIS unless they are treated to prevent leaching.

A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced firelanes, diesel equipment storage yards, and airport runways.

Pollution-generating impervious surface(PGIS) (continued)	The following are not considered regularly-used surfaces: road shoulders primarily used for emergency parking, paved bicycle pathways, bicycle lanes adjacent to unpaved or paved road shoulders primarily used for emergency parking, fenced firelanes, and infrequently used maintenance access roads.
Pollution-generating pervious surface	Any non-impervious surface subject to use of pesticides and fertilizers or loss of soil. Modified PGPS means any existing PGPS that is re-graded or re-contoured by the proposed project.
Prediction	For the purposes of this document an expected outcome based on the results of hydrologic modelling and/or the judgment of a trained professional civil engineer or geologist.
Pretreatment	The removal of material such as gross solids, grit, grease, and scum from flows prior to physical, biological, or physical treatment processes to improve treatability. Pretreatment may include screening, grit removal, stormwater, and oil separators.
Priority peat systems	Unique, irreplaceable fens that can exhibit water pH in a wide range from highly acidic to alkaline, including fens typified by Sphagnum species, <u>Ledum groenlandicum</u> (Labrador tea), <u>Drosera rotundifolia</u> (sundew), and <u>Vaccinium oxycoccos</u> (bog cranberry); marl fens; estuarine peat deposits; and other moss peat systems with relatively diverse, undisturbed flora and fauna. Bog is the common name for peat systems having the Sphagnum association described, but this term applies strictly only to systems that receive water income from precipitation exclusively.
Professional civil engineer	A person registered with the state of Washington as a professional engineer in civil engineering.
Project	The proposed action of a permit application or an approval which requires a drainage review.
Project site	That portion of a property or properties subject to proposed project improvements including those required by this manual.
Puget Sound basin	Puget Sound south of Admiralty Inlet (including Hood Canal and Saratoga Passage); the waters north to the Canadian border, including portions of the Strait of Georgia; the Strait of Juan de Fuca south of the Canadian border; and all the lands draining into these waters as mapped in Water Resources Inventory Areas numbers 1 through 19, set forth in WAC 173-500-040.
R/D	See Retention/detention facility.

Rare, threatened, or endangered species — Plant or animal species that are regional relatively uncommon, are nearing endangered status, or whose existence is in immediate jeopardy and is usually restricted to highly specific habitats. Threatened and endangered species are officially listed by federal and state authorities, whereas rare species are unofficial species of concern that fit the above definitions.

Rational method — A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the area. This method is no longer used in the technical manual.

Reach — A length of channel with uniform characteristics.

Receiving waters — Bodies of water or surface water systems receiving water from upstream manmade (or natural) streams.

Recharge — The flow to ground water from the infiltration of surface and stormwater runoff.

Redevelopment — On an already developed site, the creation or addition of impervious surfaces, structural development including construction, installation or expansion of a building or other structure, and/or replacement of impervious surface that is not part of a routine maintenance activity; and land disturbing activities associated with structural or impervious redevelopment.

Regional — An action (here, for stormwater management purposes) that involves more than one discrete property.

Regional detention facility — A stormwater quantity control structure designed to correct existing excess surface water runoff problems of a basin or subbasin. The area downstream has been previously identified as having existing or predicted significant and regional flooding and/or erosion problems.

This term is also used when a detention facility is used to detain stormwater runoff from a number of different businesses, developments or areas within a catchment. The use of regional detention facilities may be more efficient than on-site stormwater treatment although the preferred option is to include some on-site stormwater treatment through the use of grassy swales etc. even when regional detention facilities are used.

Release rate — The computed peak rate of surface and stormwater runoff for a particular design storm event and drainage area conditions.

Replaced impervious surface — For structures, the removal and replacement of any exterior surfaces or foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement, excluding impervious surfaces removed for the sole purpose of installing underground utilities.

Residential density	The number of persons per unit of residential land area. Net density includes only occupied land. Gross density includes unoccupied portions of residential areas, such as roads and open space.
Restoration	Actions performed to reestablish wetland functional characteristics and processes that have been lost by alterations, activities, or catastrophic events in an area that no longer meets the definition of a wetland.
Retention	The process of collecting and holding surface and stormwater runoff with no surface outflow.
Retention/detention facility (R/D)	A type of drainage facility designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground; or to hold surface and stormwater runoff for a short period of time and then release it to the surface and stormwater management system.
Retrofitting	The renovation of an existing structure or facility to meet changed conditions or to improve performance.
Return interval	A statistical term for the average time of expected interval that an event of some kind will equal or exceed given conditions (e.g., a stormwater flow that occurs every 2 years).
Rhizome	A modified plant stem that grows horizontally underground.
Riffles	Fast sections of a stream where shallow water races over stones and gravel. Riffles usually support a wider variety of bottom organisms than other stream sections.
Rill	A small intermittent watercourse with steep sides, usually only a few inches deep. Often rills are caused by an increase in surface water flow when soil is cleared of vegetation.
Riprap	A facing layer or protective mound of stones placed to prevent erosion or sloughing of a structure or embankment due to flow of surface and stormwater runoff.
Riparian	Pertaining to the banks of streams, wetlands, lakes or tidewater.
Riser	A vertical pipe extending from the bottom of a pond BMP that is used to control the discharge rate from a BMP for a specified design storm.
Rodenticide	A substance used to destroy rodents.
Runoff	Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes and wetlands as well as shallow ground water.
SCS	Soil Conservation Service, U.S. Department of Agriculture.

SCS Method — A hydrologic analysis based on the Curve Number method (National Engineering Handbook - Section 4: Hydrology, August 2971).

SEPA — See State Environmental Policy Act.

Salmonid — A member of the fish family Salmonidae. Chinook, coho, chum, sockeye and pink salmon; cutthroat, brook, brown, rainbow and steelhead trout; Dolly Varden, kokanee and char are examples of salmonid species.

Saturation point — In soils, the point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount.

Scour — Erosion of channel banks due to excessive velocity of the flow of surface and stormwater runoff.

Sediment — Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

Sedimentation — The depositing or formation of sediment.

Sensitive emergent vegetation communities — Assemblages of erect, rooted, herbaceous vegetation, excluding mosses and lichens, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as sundew and, as well as a number of species of Carex (sedges).

Sensitive life stages — Stages during which organisms have limited mobility or alternatives in securing the necessities of life, especially including reproduction, rearing, and migration periods.

Sensitive scrub-shrub vegetation communities — Assemblages of woody vegetation less than 6 meters in height, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as Labrador tea, bog laurel, and cranberry.

Settleable solids — Those suspended solids in stormwater that separate by settling when the stormwater is held in a quiescent condition for a specified time.

Sheet erosion — The relatively uniform removal of soil from an area without the development of conspicuous water channels.

Sheetflow — Runoff which flows over the ground surface as a thin, even layer, not concentrated in a channel.

Shoreline development — The proposed project as regulated by the Shoreline Management Act. Usually the construction over water or within a shoreline zone (generally 200 feet landward of the water) of structures such as buildings, piers, bulkheads, and breakwaters, including environmental alterations such as dredging and filling, or any project which interferes with public navigational rights on the surface waters.

Short circuiting — The passage of runoff through a BMP in less than the design treatment time.

Siltation — The process by which a river, lake, or other water body becomes clogged with sediment. Silt can clog gravel beds and prevent successful salmon spawning.

Site — A property which is subject to development.

Slope — Degree of deviation of a surface from the horizontal; measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90° slope being vertical (maximum) and 45° being a 1:1 or 100 percent slope.

Sloughing — The sliding of overlying material. It is the same effect as caving, but it usually occurs when the bank or an underlying stratum is saturated or scoured.

Small Parcel — Single family residential and small subdivision projects that add less than 10,000 ft2 of impervious surface and disturb less than 1 acre. Other types of development projects that add less than 5,000 ft2 of impervious surface and disturb less than 1 acre.

Soil — The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

Soil group, hydrologic — A classification of soils by the Soil Conservation Service into four runoff potential groups. The groups range from A soils, which are very permeable and produce little or no runoff, to D soils, which are not very permeable and produce much more runoff.

Soil horizon — A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming factors.

Soil profile — A vertical section of the soil from the surface through all horizons, including C horizons.

Soil structure — The relation of particles or groups of particles which impart to the whole soil a characteristic manner of breaking; some types are crumb structure, block structure, platy structure, and columnar structure.

Soil permeability — The ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil.

Soil stabilization — The use of measures such as rock lining, vegetation or other engineering structures to prevent the movement of soil when loads are applied to the soil.

Sorption — The physical or chemical binding of pollutants to sediment or organic particles.

Source control BMP — A BMP that is intended to prevent pollutants from entering stormwater. A few examples of source control BMPs are erosion control practices, maintenance of stormwater facilities, constructing roofs over storage and working areas, and directing wash water and similar discharges to the sanitary sewer or a dead end sump.

Specific energy — The total energy within any system with respect to the channel bottom, equal to the potential head plus velocity and pressure heads.

Spillway — A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.

State Environmental Policy Act (SEPA) — The Washington State law intended to minimize environmental damage. SEPA requires that state agencies and local governments consider environmental factors when making decisions on activities, such as development proposals over a certain size and comprehensive plans. As part of this process, environmental documents are prepared and opportunities for public comment are provided.

Steep slope — Slopes of 40 percent gradient or steeper.

Storm drains — The enclosed conduits that transport surface and stormwater runoff toward points of discharge (sometimes called storm sewers).

Storm drain system — Refers to the system of gutters, pipes, streams, or ditches used to carry surface and stormwater from surrounding lands to streams, lakes, or Puget Sound.

Storm frequency — The time interval between major storms of predetermined intensity and volumes of runoff for which storm sewers and other structures are designed and constructed to handle hydraulically without surcharging and backflooding, e.g., a 2-year, 10-year or 100-year storm.

Storm sewer — A sewer that carries stormwater and surface water, street wash and other wash waters or drainage, but excludes sewage and industrial wastes. Also called a storm drain.

Stormwater — That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels or pipes into a defined surface water channel, or a constructed infiltration facility.

Stormwater drainage system — constructed and natural features which function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate, divert, treat or filter stormwater.

Stormwater facility — A constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention basins, retention basins, constructed wetlands, infiltration devices, catchbasins, oil/water separators, sediment basins and modular pavement.

Stormwater Management Manual for the Puget Sound Basin or "Manual" — this manual as prepared by Ecology that contains BMPs to prevent, control or treat pollution in stormwater [or a technically equivalent Manual approved by Ecology].

Stormwater Program — Either the Basic Stormwater Program or the Comprehensive Stormwater Program as appropriate to the context of the reference. See the "Stormwater Program Guidance Manual for the Puget Sound Basin" for a complete description of the requirements of each program.

Stormwater Site Plan — a plan which includes an Erosion and Sediment Control (ESC) Plan and/or a Permanent Stormwater Quality Control Plan (PSQC). For small sites, this plan is the equivalent of a Small Parcel Erosion and Sediment Control Plan. Guidance on preparing a Stormwater Site Plan is contained in Chapter I-3.

Stream gaging — The quantitative determination of stream flow using gages, current meters, weirs, or other measuring instruments at selected locations. See Gaging station.

Streambanks — The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.

Stream classification The following stream classification which applies to all streams.

1. Type 1 streams are all streams inventoried as Shorelines of the State under Chapter 90.58 RCW.
2. Type 2 streams are all streams smaller than Type 1 streams that flow year around during years of normal rainfall, or are used by salmonids.
3. Type 3 streams are streams that are intermittent or ephemeral during years of normal rainfall and are not used by salmonids.

Streams Those areas where surface waters flow sufficiently to produce a defined channel or bed. A defined channel or bed is indicated by hydraulically sorted sediments or the removal of vegetative litter or loosely rooted vegetation by the action of moving water. The channel or bed need not contain water year-round. This definition is not meant to include irrigation ditches, canals, stormwater runoff devices or other entirely artificial watercourses unless they are used to convey Type 1 and 2 streams naturally occurring prior to construction. Those topographic features that resemble streams but have no defined channels (i.e. swales) shall be considered streams when hydrologic and hydraulic analyses done pursuant to a development proposal predict formation of a defined channel after development.

Structure A catchbasin or manhole in reference to a storm drainage system.

Structural Source Control BMPs Physical, structural, or mechanical devices that are intended to prevent pollutants from entering stormwater.

Stub-out A short length of pipe provided for future connection to a storm drainage system.

Subbasin A drainage area which drains to a water course or waterbody named and noted on common maps and which is contained within a basin.

Subcatchment A subdivision of a drainage basin (generally determined by topography and pipe network configuration).

Subcritical flow Flow at depths greater than the critical depth.

Sub-division retention/detention facility A retention/detention facility which is both (1) located within or associated with a short or formal plat sub-division containing only single family or duplex residential structures located on individual lots; and 2) which is required to handle excess runoff generated by development of an area of which two-thirds or more is designated for single family or duplex residential structures located on individual lots.

Subdrain A pervious backfilled trench containing stone or a pipe for intercepting ground water or seepage.

Subgrade — A layer of stone or soil used as the underlying base for a BMP.

Subsoil — The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."

Substrate — The natural soil base underlying a BMP.

Supercritical flow — Flow at depths less than the critical depth.

Surcharge — The flow condition occurring in closed conduits when the hydraulic grade line is above the crown of the sewer.

Surface and stormwater — Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands as well as shallow ground water.

Surface and stormwater management system — Drainage facilities and any other natural features which collect, store, control, treat and/or convey surface and stormwater.

Suspended solids — Organic or inorganic particles that are suspended in and carried by the water. The term includes sand, mud, and clay particles (and associated pollutants) as well as solids in stormwater.

Swale — A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than one foot.

Terrace — An embankment or combination of an embankment and channel across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

Threshold Discharge Area — An onsite area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flowpath). The examples below illustrate this definition. The purpose of this definition is to clarify how the thresholds of this manual are applied to project sites with multiple discharge points.

Drawings of three different situations depicting the relationship of project sites, natural discharge locations, and threshold discharge areas.

Tile, Drain — Pipe made of burned clay, concrete, or similar material, in short lengths, usually laid with open joints to collect and carry excess water from the soil.

Tile drainage — Land drainage by means of a series of tile lines laid at a specified depth and grade.

Time of concentration — The time period necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point in the tributary drainage area.

Toe of slope — A point or line of slope in an excavation or cut where the lower surface changes to horizontal or meets the exiting ground slope.

Top of slope — A point or line on the upper surface of a slope where it changes to horizontal or meets the original surface.

Topography — General term to include characteristics of the ground surface such as plains, hills, mountains; degree of relief, steepness of slopes, and other physiographic features.

Total dissolved solids — The dissolved salt loading in surface and subsurface waters.

Total solids — The solids in water, sewage, or other liquids, including the dissolved, filterable, and nonfilterable solids. The residue left when the moisture is evaporated and the remainder is dried at a specified temperature, usually 130°C.

Toxic — Poisonous, carcinogenic, or otherwise directly harmful to life.

Tract — A legally created parcel of property designated for special nonresidential and noncommercial uses.

Trash rack — A structural device used to prevent debris from entering a spillway or other hydraulic structure.

Travel time — The estimated time for surface water to flow between two points of interest.

Treatment BMP — A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration swales and constructed wetlands.

Turbidity — Dispersion or scattering of light in a liquid, caused by suspended solids and other factors; commonly used as a measure of suspended solids in a liquid.

Underdrain — Plastic pipes with holes drilled through the top, installed on the bottom of an infiltration BMP which are used to collect and remove excess runoff.

Undisturbed buffer	A zone where development activity shall not occur, including logging, and/or the construction of utility trenches, roads, and/or surface and stormwater facilities.
Undisturbed low gradient uplands	Forested land, sufficiently large and flat to infiltrate surface and storm runoff without allowing the concentration of water on the surface of the ground.
Unstable slopes	Those sloping areas of land which have in the past exhibited, are currently exhibiting, or will likely in the future exhibit, mass movement of earth.
Unusual biological community types	Assemblages of interacting organisms that are relatively uncommon regionally.
Urbanized area	Areas designated and identified by the U.S. Bureau of Census according to the following criteria: an incorporated place and densely settled surrounding area that together have a maximum population of 50,000.
USEPA	The United States Environmental Protection Agency.
Values	Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.
Vegetation	All organic plant life growing on the surface of the earth.
Water body	Surface waters including rivers, streams, lakes, marine waters, estuaries, and wetlands.
Water quality	A term used to describe the chemical, physical, and biological characteristics off water, usually in respect to its suitability for a particular purpose.
Water quality BMP	A BMP specifically designed for pollutant removal.
Water quality design storm	The 6-month 24-hour design storm.
Water quality standards	Minimum requirements of purity of water for various uses; for example, water for agricultural use in irrigation systems should not exceed specific levels of sodium bicarbonate, pH, total dissolved salts, etc. In Washington, the Department of Ecology sets water quality standards.
Water quality swale	An open vegetated drainage channel intended to optimize water quality treatment of surface and stormwater runoff by following the specific design criteria described in the manual.

Watershed — A geographic region within which water drains into a particular river, stream, or body of water as identified and numbered by the State of Washington Water Resource Inventory Areas (WRIAs) as defined in Chapter 173-500 WAC.

Water table — The upper surface or top of the saturated portion of the soil or bedrock layer, indicates the uppermost extent of ground water.

Weir — Device for measuring or regulating the flow of water.

Weir notch — The opening in a weir for the passage of water.

Wetlands — Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. This includes wetlands created, restored or enhanced as part of a mitigation procedure. This does not include constructed wetlands or the following surface waters of the state intentionally constructed from sites that are not wetlands: Irrigation and drainage ditches, grass-lined swales, canals, agricultural detention facilities, farm ponds, and landscape amenities.

Wetland edge — Delineation of the wetland edge shall be based on the U.S. Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Miss. (1987)

Wetponds and wetvaults — Drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb, and to allow biologic activity to occur that metabolizes nutrients and organic pollutants.

Zoning ordinance — An ordinance based on the police power of government to protect the public health, safety, and general welfare. It may regulate the type of use and intensity of development of land and structures to the extent necessary for a public purpose. Requirements may vary among various geographically defined areas called zones. Regulations generally cover such items as height and bulk of buildings, density of dwelling units, off-street parking, control of signs, and use of land for residential, commercial, industrial, or agricultural purposes. A zoning ordinance is one of the major methods for implementation of a comprehensive plan.

Notations

This list of notations is provided only as a guide to some of the notations used in this report. The exact definition and units are listed when the symbol is used. Since the same symbol can be used for different design methods, the exact definition should be obtained directly from the appropriate section of the report.

A	=	drainage area (mi^2), also full cross-sectional area of culvert barrel (ft^2)
A_b	=	top surface area of basin (ft^2), also area of pond bottom (ft^2)
A_d	=	drainage area
A_p	=	surface area of porous asphalt pavement (ft^2)
A_s	=	surface area of swale (ft^2), also average surface area for detention BMP
A_t	=	total area (acres)
C	=	estimated runoff coefficient
CN	=	SCS runoff curve number
ΔCN	=	change in curve number
D	=	interior height of culvert barrel (ft)
D_{50}	=	median stone diameter (riprap)
d	=	average permanent pool depth of a detention BMP
d_b	=	basin depth (ft)
d_c	=	critical depth (ft)
d_p	=	depth of porous asphalt paving stone subbase (ft)
d_s	=	depth of swale check dam (ft)
dt	=	time interval in minutes
d_x	=	a mixture of riprap sizes where the percent of stone by weight is $<x$ (the specified diameter)
E	=	designated fraction of particulates to be removed by a BMP
f	=	final infiltration rate of soil (in/hr)

f_d = infiltration rate including a safety factor of two

g = acceleration due to gravity, 32.2 ft/sec^2

H = stage height (ft) or water depth above pond bottom, also $H = H_f + H_e + H_{ex}$; head on orifice

H_c = specific head at critical depth ($d_c + V_c^2/2g$) (ft)

H_d = design depth of pond

H_e = entrance head loss (ft) = $K_e(V^2/2g)$

H_{ex} = exit head loss (ft) = $V^2/2g$

H_f = Friction loss (ft) = $V^2n^2L/2.22R^{1.35}$ Note: if (H_f + TW - LS) <D, adjust H_f such that (H_f + TW - LS) = D. This will keep the analysis simple and still yield reasonable results (erring on the conservative side)

HW = headwater depth above inlet invert (ft)

h_b = distance from the hydraulic grade line at the 2-year flow on the outflow pipe to the overflow elevation

I = inflow at time 1 and time 2

I(t) = instantaneous hydrograph, in cfs (SBUH hydrograph method)

i = hydraulic gradient (ft/ft)

K_e = entrance loss coefficient

k = time of concentration velocity factor (feet/second)

k_c = time of concentration velocity factor; channel flow

k_s = time of concentration velocity factor; shallow flow

L = distance of flow across a given segment, also length of culvert (ft), also width of emergency overflow weir

MB_{el} = mean tributary basin elevation above sea level (ft)

M_s = potential average snowmelt during storms (in)

m = number of flow segments

N_s = number of check dams along total length of swale

n	=	Manning's "n"
n_s	=	sheet flow; Manning's effective roughness coefficient
O	=	outflow at time 1 and time 2
P	=	rainfall depth (inches)
P_R	=	the total precipitation at a site for the 24-hour design storm event for the given return frequency (R)
Q	=	flow or discharge (cfs), also runoff depth from overlying area of dry well (ft), also orifice area
Q_a	=	after development depth of runoff (inches)
Q_b	=	before development depth of runoff (inches)
Q_c	=	depth of runoff from contributing area (ft)
Q_d	=	runoff depth in inches over a given area
Q_o	=	average release rate from detention BMP
Q_s	=	depth of runoff controlled by vegetated swale (inches)
Q_t	=	release rate for orifice
Q_{total}	=	total flow at maximum head
$Q(t)$	=	the routed flow of the runoff hydrograph (SBUH method)
$Q_{10\%}$	=	the flow that is not exceeded more than 10% of the time during the months of adult (salmonid) migration
ΔQ	=	change in runoff depth (inches)
Δq	=	change in peak discharge (cfs)
R	=	hydraulic radius (ft) in Manning's equation
$R(t)$	=	the total runoff depth at time increment dt, in inches; also known as precipitation excess
S	=	storage at time 1 and time 2, also culvert barrel slope (ft/ft)
$S(H)$	=	storage (ft^3) at stage height (H)
S_d	=	the largest volume from an initial pond sizing

s_f	=	friction slope = $n^2V^2/2.21R^{4/3}$
s_o	=	slope of flow path (ft/ft), also bottom slope
T	=	width of swale or vegetated filter strip
T_c	=	time of concentration (hrs)
T_t	=	travel time of overland flow across separate flow path segments
$T_{1,2,n}$	=	the consecutive flow paths of different land cover categories having significant differences in flow path slope
TW	=	tailwater depth above invert of culvert outlet (ft) Note: if TW < $(D + d_c)/2$, set TW = $(D + d_c)/2$.
t_d	=	design detention time of a BMP
Δt	=	time interval; time 2 - time 1
V	=	average velocity across the land cover (ft/sec), also barrel velocity (fps), also mean velocity
V_c	=	flow velocity at critical depth (fps)
V_{max}	=	maximum allowed velocity of runoff in a biofilter
V_{pp}	=	permanent pool volume
V_r	=	void ratio
V_{sed}	=	settling velocity of the deign soil particle
W_{50}	=	the median stone size (riprap)
w	=	settling velocity of target particle
y	=	depth of flow
y_n	=	normal flow depth
Z	=	basin side slope ratio (h:v)
Z^1,Z^2	=	side slope ratio of swale cross section (h:v)
α	=	energy coefficient which corrects for the non-uniform distribution of velocity over the channel cross-section

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

DATE: 5/31 PAGES (including cover sheet): 6

TO: Name: XAVIER, Swamikannu

Organization: L.A. Regional Board

Office/Mail Code:

Fax Number: 213-576-6640

Verification Number:

FROM: Name: Eugene Bromley

Mailcode: WTR-5

Phone Number: 415-744-1906

Fax Number:

NOTE:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

MAY 31 2000

In Reply
Refer to: WTR-5

Elizabeth Miller Jennings
Office of Chief Counsel
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Re: Petition for Review Concerning the Los Angeles County SUSMP
(SWRCB Files A-1280, A-1280(a) and A-1280(b))

Dear Ms. Jennings:

The purpose of this letter is to provide comments on the Petition for Review which was submitted to the State Board challenging the SUSMP which was adopted on January 26, 2000 by the Los Angeles Regional Board for new developments in Los Angeles County. We supported the adoption of the SUSMP in a letter to the Regional Board dated January 13, 2000, and we also provided testimony in the support of the SUSMP at the January 26, 2000 adoption hearing. We have reviewed the arguments in the Petition for Review and we continue to believe that the Regional Board acted properly in adopting the SUSMP. Our comments on the specific issues raised in the Petition for Review are enclosed.

Should you have any questions regarding this matter, please call me at (415) 744-1860, or Eugene Bromley of the CWA Standards and Permits Office at (415) 744-1906.

Sincerely,

Alexis Strauss
Director, Water Division

cc: Xavier Swamikannu, Los Angeles Regional Board

ENCLOSURE - Region 9 Comments on the Petition for Review Concerning the Los Angeles County SUSMP

1) Compliance with California Water Code Section 13360

The Petitioners have argued that the SUSMP violates Section 13360 of the California Water Code which prohibits the Regional Board from specifying the "design, location, type of construction, or particular manner" in which compliance with a permit is to be achieved. The Petitioners note that the SUSMP specifies a "design" storm for which treatment or mitigation must be provided and contend that this violates Section 13360. EPA disagrees with this argument. Although the SUSMP specifies a particular storm for which treatment or mitigation must be provided, the exact nature of the mitigation is not specified in the SUSMP.

The SUSMP is a technology-based effluent limitation which is the same category of effluent limitation as secondary treatment effluent limitations for POTWs, or similar numeric effluent limitations for industrial sources. Technology-based effluent limitations most commonly specify a pollutant concentration which must be achieved. To ensure compliance with Section 13360, these effluent limitations do not specify the manner in which compliance is to be achieved. Although the SUSMP specifies a numeric "design" storm, the SUSMP also provides flexibility in selecting and implementing different control technologies similar to that which is provided to a POTW or industrial facility in designing for compliance with their effluent limitations.

The effect of having the "design" storm in the SUSMP is simply to select for treatment or mitigation that fraction of the total storm water discharges which are generated by the first 0.75" of rainfall. For a POTW, mitigation (sufficient to comply with numeric effluent limitations) must be provided for 100% of the wastewater which is discharged rather than just a portion as in the case of the SUSMP. In neither case is the exact nature of the treatment or mitigation specified. Therefore, we believe that the SUSMP is consistent with Section 13360.

The SUSMP might seem more familiar to the Petitioners if numeric effluent limitations were specified for the runoff generated by the design storm. Even this would be consistent with Section 13360 since only the effluent limitation would be specified and not the manner of compliance.

2) Appropriateness of the Numeric Standards in Meeting MEP

Despite the arguments raised by the Petitioners, we believe that the numeric standards for post-construction controls in the SUSMP are fully consistent with the requirement in the Clean Water Act to reduce pollutants to the maximum extent practicable (MEP). Region 9's January 13, 2000 letter to the Regional Board noted that NPDES regulations at 40 CFR 122.26(d)(2)(iv)(A)(2) require that MS4 permittees include requirements for post-construction storm water controls in their storm water management programs. EPA's guidance manual for Part 2 MS4 permit applications (EPA 833-B-92-002) specifically encourages "design criteria and performance standards" for post-construction control measures for storm water discharges.

Design criteria are appropriate to ensure an adequate and enforceable level of control over the pollutants in the discharges.

Region 9 also pointed out in its letter of January 13, 2000 that requirements similar to the Regional Board's SUSMP already exist in other areas such as the State of Florida, the Puget Sound area in Washington, Prince George's County in Maryland and selected cities such as Phoenix, AZ. The experiences in these other areas show that the SUSMP requirements can be achieved without an excessive burden on developers. We believe these experiences show that the SUSMP is consistent with the requirement to reduce pollutants in storm water runoff to the MEP level.

A Petitioner also argued that a recent decision by the Ninth Circuit (Defenders of Wildlife v. Browner 191 F.3d 1159, 1166-67 (9th Cir. 1999)) indicates that numeric standards are not required by the Clean Water Act for MS4 permits. However, this case involved numeric water quality-based effluent limitations rather than technology-based effluent limitations. The SUSMP is a technology-based effluent limitation based on the MEP requirements of the Clean Water Act. As such, the Ninth Circuit case does not support the Petitioner on this matter. Moreover, the Court found that the Regional Board could include numeric water quality-based effluent limitations at its discretion.

3) Compliance with the California Administrative Procedure Act, CEQA, and the Unfunded Mandate Provisions of the California Constitution

The Petitioners have argued that since the SUSMP is allegedly not a Federal requirement, it violates the California Administrative Procedure Act, CEQA, and also the unfunded mandate provisions of the California Constitution. We disagree that the SUSMP is not a Federal requirement. The SUSMP is simply the Regional Board's best judgment as to what it is required to do in order to comply with Federal NPDES regulations at 40 CFR 122.26(d)(2)(iv)(A)(2). As noted above under item #2, EPA's guidance manual for Part 2 MS4 permit applications specifically encourages design criteria in complying with the regulations.

4) Cost-Effectiveness of the SUSMP

The Petitioners have objected that the Regional Board has not adequately addressed the issue of whether the SUSMP is cost-effective. They note that the Los Angeles County MS4 permit includes cost-effectiveness as one of the factors to be considered in developing SUSMP requirements. However, the Regional Board has conducted certain cost analyses which are discussed in the Regional Board's Response to the Petition and which support the SUSMP. Further, EPA's final Phase II storm water regulations included a cost/benefit analysis for the regulations, including the six minimum measures which would be required to be implemented by the MS4s covered by the regulations. Post-construction storm water controls similar to those which would be required by the Regional Board's SUSMP are one of the six minimum measures required by the Phase II regulations. EPA's analysis shows that the six minimum measures are cost-effective. In addition, this analysis concludes that the inclusion of post-construction controls in new developments (such as required by the SUSMP) is the most cost-effective of all approaches to storm water quality management. EPA believes that the Regional Board's analyses, buttressed by EPA's analysis for the Phase II regulations, adequately addresses the Petitioners' concerns regarding the cost-effectiveness of the SUSMP.

We would also point out that a number of TMDLs, such as the trash TMDL which was distributed for comment on March 17, 2000, are currently under development in the Los Angeles area. By itself, the SUSMP may not ensure that the pollutant loading reductions called for by the TMDLs are attained, but we would expect that the SUSMP would be an important contributor to the needed reductions. By implementing the SUSMP (and doing so as expeditiously as possible), the SUSMP should ultimately ease the costs and burdens of complying with the TMDLs.

As another indicator of EPA's belief in the value of including appropriate controls in the design of new developments, EPA's Office of Science and Technology is in the process of developing effluent limitations guidelines for construction site discharges. These regulations are expected to address runoff during the construction phase as well as post-construction discharges. However, the guidelines are still being developed and the specific requirements remain to be seen. The guidelines will not even be proposed until 2002, and we believe the Regional Board acted appropriately to adopt its SUSMP now to expedite the water quality benefits from the controls.

Petitioners have also expressed concern regarding whether meaningful pollutant reductions could be expected from the SUSMP. Performance data for the types of controls contemplated by the SUSMP can be found in any of a number of BMP manuals, including the California Storm Water Best Management Practices Handbooks. EPA and ASCE have also just recently established a national database of BMP effectiveness information. The data indicate that BMP effectiveness will vary substantially depending on the particular BMP and the pollutant involved. However, the data indicate that overall, the SUSMP should result in meaningful pollutant loading reductions in the discharges.

5) Regional Board Procedures in Reviewing and Approving the SUSMP

The Petitioners argued that the Regional Board failed to follow the procedures in Part 2.I.G of the Los Angeles County MS4 permit in reviewing the SUSMP. However, we would point out that SUSMP which was originally submitted in July, 1999 was the subject of workshops on August 10, 1999 and September 9, 1999, and numerous meetings with interested parties prior to the final adoption hearing on January 26, 2000.

Although the Regional Board may not have followed exactly the procedures in the MS4 permit, EPA believes the Regional Board's procedures have afforded commenters ample time and opportunity to express their views on issues surrounding the SUSMP. Therefore, EPA believes that the Regional Board has acted reasonably and in accord with the intent of the permit.

We would also point out that the permit requires that individual permittees submit their own programs consistent with the SUSMP no later than July 31, 1999, a deadline which has past. As we have noted previously, we believe it is important to expedite the SUSMP to realize its benefits as soon as possible in order to address existing water quality impairments.

6) Ground Water Concerns

The Petitioners have argued that compliance with the SUSMP may adversely affect ground water resources. However, in response to this issue, we would point out that the SUSMP includes waiver provisions in section 11 which address this concern.

Department of
Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

May 31, 2000

Ms. Elizabeth M. Jennings, Esquire
Office of the Chief Counsel
State Water Resources Board
P.O. Box 100
Sacramento, California 95812-0100

Mr. Xavier Swamikannu
Stormwater Program
Water Quality Control Board
320 W. 4th Street, Suite 200
Los Angeles, California 90013

Dear Ms. Jennings and Mr. Swamikannu:

This letter is sent in response to the email that I received from Mr. Swamikannu on May 19 requesting information about the State of Florida's stormwater treatment requirements. Where appropriate I also have included information that may be helpful about stormwater treatment programs in other states. This information was collected and published in the books *Institutional Aspects of Urban Runoff Programs: A Guide for Program Development* and *Implementation and Operation, Maintenance, and Management of Stormwater Management Systems*. I also have enclosed a paper that I use in teaching stormwater classes that I think will be helpful.

You specifically requested a response to the following questions:

1. **Why did your state elect to have requirements on new development and redevelopment?**

Studies conducted in the mid to late 1970s as part of the Section 208 Areawide Water Quality Management Program demonstrated that stormwater was a significant source of water pollution, especially from urban development. These studies also demonstrated that it was much easier and cheaper to prevent stormwater pollution using BMPs than to restore degrade water bodies and retrofit already developed areas. Accordingly, given the rapid urban growth Florida was experiencing in the late 1970s and the project growth in the 1980s, the Department of Environmental Protection determined that stormwater was a pollution source that needed treating. Consequently, the Environmental Regulation Commission adopted an interim stormwater rule requiring treatment in 1979 until further studies could be done on BMP effectiveness. On February 1, 1982, the final state stormwater rule was adopted requiring all new development and redevelopment activities to treat their runoff.

Today, six states in the country (Florida, Maryland, Delaware, Virginia, South Carolina, and Massachusetts) have adopted laws or rules that require the treatment of runoff from new developments. In addition, there are numerous regional (i.e., Puget Sound) and local governments that have implemented requirements for stormwater treatment.

2. **Does your state have design standards and performance standards for treatment control BMPs for new development/ redevelopment?**

Under the Federal Clean Water Act, water pollution control programs can be either water quality effluent based or technology based. Every stormwater treatment program in the United States is a technology based program. The key components of a technology based program are a performance standard (desired level of stormwater treatment) and design criteria for BMPs that assure they will provide that level of treatment. To develop design criteria, a number of analyses must be conducted including rainfall characteristics (annual volume, number of storms, interevent time, etc), runoff characteristics (i.e., stormwater volume, pollutant loadings, drainage area), whether BMPs are on-line or off-line, and BMP effectiveness.

Like all stormwater treatment programs in the United States, Florida's performance standard for stormwater treatment is to reduce the average annual loading of TSS by 80% (note that this is postdevelopment loading, so even with treatment, pollutant loads almost always increase). We adopted design criteria for various stormwater treatment BMPs (ie, retention, wet detention, detention with filtration) in our first rule. These criteria have been revised periodically as we gained additional information to assure that they meet the desired level of treatment. I have included a copy of Rule 40C-42 from the St. Johns River Water Management District which is the most current of our state stormwater rules with respect to design criteria. Also please remember that, during construction, erosion and sediment control BMPs must be used to retain sediment on site.

3. **Do you have thresholds for new development and or redevelopment (impervious area; size etc) for requirements to apply.**

The threshold varies depending on the stormwater/environmental resource permitting rule. Florida's stormwater program is cooperatively implemented by DEP and our regional water management districts. Therefore, we have five sets of rules in the state. The typical threshold is the creation of 4000 square feet of impervious area.

4. **What development categories do the requirements apply to [i.e. commercial; parking lots; residential etc]?**

Our rule applies to all urban development (and many agricultural activities as well).

5. **How long have such requirements been in place. Are they statewide or region specific?**

As previously stated, the statewide stormwater rule was first adopted in 1979 with a revised comprehensive rule in place on February 1, 1982. Florida's stormwater program is cooperatively implemented by DEP and our regional water management districts. Therefore, we have five sets of rules in the state. The WMD rules combine stormwater quantity, stormwater quality, and wetlands protection into a single permit called an environmental resource permit.

6. **Have the design standards and performance standards unduly burdened cities and builders with unsupportable costs? Has compliance been difficult? Has change been for the better or have you seen none. Any noticeable improvements in water quality?**

Complying with Florida's stormwater rule is a way of life that does not impose unduly burdens on local governments or the private sector. It also has provided many jobs for the engineering profession. The only part of compliance that is difficult is assuring long term operation and maintenance of the stormwater BMPs. They need to be inspected at least annually. Unfortunately, the public sector will never have enough inspectors which is why Delaware and Florida have implemented training and certification programs for inspectors. We have no doubts that the implementation of Florida's stormwater treatment program has greatly reduced the effects of growth in Florida on water quality and is a major reason why the state has so few truly impaired waters. We also have seen improvements in water quality as a result of retrofitting older stormwater drainage systems.

7. **Typically, what is your estimate of the range in additional cost (in percent of project cost) that the requirements have imposed on builders.**

This question is very site specific since the major cost is the land cost and that varies with every site. We estimate that complying with our stormwater rules requires about 5-10 percent of the land area of a development, although much of this is related to flood protection.

8. **How have municipalities ensured that the post construction BMPs O & M has been provided and/or BMPs are properly maintained.**

As part of our permitting process, the developer must identify the responsible maintenance entity. Typically, this is a homeowner or property owners association for residential development or the property owner for commercial development. The DEP and WMDs require recertification that the stormwater system is functioning on a regular basis (every 1 to 2 years). Additionally, since stormwater systems are part of the local infrastructure, many local governments conduct inspections annually and several have implemented stormwater operating permit systems that require annual inspections. Some of the 100+ local stormwater utilities in the state provide credits for functioning onsite stormwater systems providing an economic incentive to land owners to maintain their stormwater systems.

9. What are the policy goals that the standards are intended to achieve [reverse impairment; hold the line etc.]

Florida statutes and rules establishes the goals for the state's stormwater management program. These include:

- Effective stormwater management for existing and new systems to protect, preserve and restore the functions of natural systems and the beneficial uses of waters;
- Preventing stormwater problems from new land use changes and restoring degraded water bodies by reducing the pollution contributions from older stormwater systems;
- Preserving freshwater resources by encouraging stormwater infiltration and reuse;
- Trying to assure that the stormwater peak discharge rate, volume and pollutant loading are no greater after a site is developed than before; and
- Eliminating the discharge of inadequately managed stormwater into waters and to minimize other adverse impacts on natural systems, property and the health, safety and welfare caused by improperly managed stormwater.

9. Also discuss standards and requirements in other states that you are familiar with because of you special role and expertise.

As previously stated, nearly all of the stormwater treatment programs in the United States are similar. All of the above information for 32 stormwater programs around the country are summarized in books *Institutional Aspects of Urban Runoff Programs: A Guide for Program Development.*

I hope that this information is helpful. It is truly unfortunate that the development industry is still denying that urban runoff is a major source of degradation of our aquatic ecosystems. However, don't be discouraged. When we first adopted our rule, we went through 29 official rule drafts and over 100 TAC meetings before the final rule was adopted. Given the knowledge about stormwater pollution and the effects of urbanization on aquatic ecosystems, it should be much easier to fight any challenges that arise. Please let me know if I can be of further assistance.

Sincerely,

Eric H. Livingston

Eric H. Livingston
Chief
Bureau of Watershed Management

Best Management Practices for Urban Stormwater Management

Eric H. Livingston
Bureau of Watershed Management
FDEP
Tallahassee, Florida

Introduction

Before discussing stormwater practices, stormwater management program considerations will be briefly reviewed. ***Successful stormwater management requires more than simply the use of runoff control techniques. It also requires a strong institutional foundation.*** A key component of this foundation is establishing effective mechanisms to assure that stormwater systems not only are designed and constructed correctly, but that they also are inspected, maintained and operated properly.

2.1 Stormwater Program Components

This section briefly discusses the many components of a successful stormwater management program. No single framework for a stormwater management program can be recommended. Flexibility is needed to establish or refine programs, based on an area's existing legal authorities and institutional framework.

Experience has shown that no single entity can do everything. ***Program implementation typically will be shared by a partnership involving all appropriate levels of government, together with the public sector and all citizens. Cooperation and coordination among all of the partners involved in program implementation are cornerstones of successful programs.*** It is especially important that the roles of each partner involved in program implementation be clearly stated. This will help to avoid duplication and distribute program activities to the entity most suited for the role. This is especially true for assuring the long term performance of stormwater management practices.

Experience also has shown that successful stormwater management programs share several common building blocks (WMI, 1997). These involve the program's institutional framework, its technical foundations, and the many activities that are undertaken by the stormwater program.

2.2. Stormwater Program Evolution to Address Existing Development

Stormwater quality management programs typically must be phased in. They usually must be integrated with existing "drainage" programs to provide coordinated management of stormwater quantity and quality. ***Initial program efforts are aimed at***

preventing and mitigating stormwater problems from new development, both during and after construction. Generally, these programs rely upon on-site planning and BMP implementation. Once all aspects, including inspections and operation/maintenance, of this new development program are running smoothly, the program can be expanded to correct stormwater problems caused by existing development and land uses (retrofitting). Section 2.3 discusses important components of programs aimed at stormwater from new development.

Establishing a program to retrofit existing stormwater systems, however, presents many technical, institutional, and financial dilemmas. In many instances, the unavailability or high cost of land in urban areas makes the use of conventional BMPs infeasible. State laws and institutional arrangements promote piecemeal, crisis-solving approaches aimed at managing stormwater within political boundaries — yet stormwater follows watershed boundaries. Finally, retrofitting usually is prohibitively expensive. With many local governments already short of funds, the need for innovative, dedicated stormwater funding sources, such as stormwater utility fees, cannot be overemphasized.

Solving existing stormwater problems will require comprehensive, coordinated, creative approaches and technology. Essential elements of a comprehensive, long-term effort to reduce pollutant loadings from existing land uses and older stormwater systems include:

A. Watershed Management

A watershed approach which integrates land use planning with the development of stormwater infrastructure is essential. After all, ***it is the intensification of land use and the increase in impervious surfaces within a watershed that creates the stormwater and water resources management problems***. Consequently, a "watershed management team" effort is necessary which involves state, regional and local governments, together with the private sector and all citizens within a watershed. Section 403.0891, Florida Statutes, and Section 62-40.432, F.A.C. (State Water Policy) create the legal institutional framework for Florida's Stormwater Management Program. This framework includes a watershed approach which relies upon the SWIM Program and the Local Government Growth Management Program. Implementation involves FDEP, the WMDs, local governments, and the private sector. To further promote watershed management in Florida, the DEP recently created a Bureau of Watershed Management that will be responsible for implementing the new rotating basin approach to water management. The bureau consists of five sections that are responsible for nearly all aspects of watershed management. The sections and their administrators include: Watershed Monitoring and Data Management (Ellen McCarron), Watershed Assessment (Jan Mandrup-Poulsen), Watershed Planning & Coordination (Fred Calder), Nonpoint Source Management and Water Quality Standards (Greg Knecht), and Ground Water Protection (Jim McNeal). Implementation of the watershed approach will be especially important given the new focus on Total Maximum Daily Loads and the implementation of the Florida Watershed Restoration Act of 1999.

B. Treatment Requirements for Older Systems (Retrofitting)

Numerous problems inherent to a highly urbanized area make it nearly impossible to apply the same stormwater design and performance standards that are applied to new developments. Instead, a "watershed loading" concept should be considered. This "big picture" approach considers the beneficial uses of the receiving waters, assesses the loadings from all pollution sources, and establishes the maximum loadings of pollutants that can be assimilated by those waters. A key element is setting a "stormwater pollutant load reduction goal" for existing untreated stormwater discharges. An ecologically based goal should be established, such as increasing the area of sea grasses or restoring habitat for desired aquatic species. It is important that the ecologically-based goal is understood by the public and determined with broad community participation. Stormwater PLRGs are required by State Water Policy and they are being established as part of the SWIM plans for the SWIM priority water bodies. Additionally, TMDLs will be established for the state's impaired waters over the next 13 years.

Success in meeting the load reduction goal will depend not only on the treatment benefits from retrofitting projects, but also by assuring that the on-site systems serving new development are constructed, operated, and maintained properly. Even with BMPs, post-development stormwater pollution loadings are still greater than pre-development levels. Minimizing stormwater pollutant loadings from new developments is essential in assuring the success of stormwater retrofitting programs. Otherwise, the desired watershed pollutant loadings will be exceeded and the community's desired ecological goals will not be achieved.

C. Selective Targeting

The extremely high cost of retrofitting older urban stormwater systems makes it essential to carefully evaluate pollutant reduction goals, allocation strategies, and BMP implementation. ***States should establish a priority watershed program which leads to development and implementation of watershed management plans***. Implementation of these long term (15-30 years) plans will be designed to protect or restore the beneficial uses of priority, targeted water bodies. In Florida, our priority watersheds are those established by the SWIM Program.

Within priority watersheds, sub-basins can be targeted based on pollution sources, flooding, and water quality problems. Regional and local stormwater master plans are an essential component of the watershed plan. In these local plans, existing stormwater systems can be targeted for modification to assure that citizens receive the greatest benefit (pollutant load reduction, flood protection) for the dollar. The upgrading of older systems also needs to be coordinated with other planned infrastructure improvements, such as road widenings, and with park, recreation, and urban redevelopment projects .

D. Alternative Controls

Nonstructural BMPs and source controls need to be used extensively to reduce stormwater pollution from already developed areas. For example, street sweepers remove lots of litter, debris, and sediments from paved surfaces even if they can't collect the smaller particles (<60 microns) which contain high concentrations of metals and other pollutants. Prohibiting and eliminating the discharge of wastewaters other than stormwater into storm sewers and other conveyances can also greatly reduce pollutant loadings. These types of controls are especially appropriate in downtown business districts, where other BMPs usually are infeasible, and in certain industrial situations.

Education programs for the public and for stormwater management professionals also are vital. Citizens, businesses, and practitioners need to understand how their everyday activities contribute to stormwater pollution. For example, citizens should not discard leaves, grass clippings, used motor oil or other material into swales or storm sewers. Yet ***many people believe that storm "sewers" go to the wastewater treatment plant and not to the nearest water body.*** Getting youth and citizen groups involved in storm sewer stenciling projects (Dump No Wastes, Drains to Lake) is an excellent way of reducing dumping of potential pollutants into these conveyances. Equally important are comprehensive training and certification programs for those in the private and public sectors who design, review, construct, inspect, operate, or maintain stormwater management systems.

E. Funding

Even just to solve existing flooding problems, the national cost of improving stormwater infrastructure is gigantic. Yet, local governments already are struggling financially. ***Traditional revenue sources such as property taxes cannot be relied upon to pay for stormwater management.*** Alternative funding sources are needed.

An excellent example is the stormwater utility - a dedicated source of revenue with fees based on a site's contribution to the stormwater problem. Section 403.0893, F.S., authorizes Florida's local governments to implement stormwater utilities and over 100 have been established in the state. Additionally, the State Revolving Fund provides loan interest loans for stormwater treatment projects.

F. Innovative BMPs

The infeasibility of using traditional BMPs to reduce stormwater pollutant loads in urban areas requires creative and innovative BMPs. ***Regional stormwater systems, which manage stormwater from several developments or an entire drainage basin, offer many advantages over the piecemeal approach that relies upon small, individual on-site systems.*** Regional systems can use natural processes, such as extended detention and constructed wetlands, or mechanical processes, such as alum injection, to reduce stormwater pollutants. They provide economies of scale in construction, operation and maintenance. Regional systems are especially useful in managing stormwater from existing land uses. They need to be a central part of any retrofitting program. They can also be used to provide stormwater management for new development, but this requires excellent planning and an expenditure of funds by the local government or a developer to build the regional system and then get repaid by those who use it. Regional systems are most successful when a watershed approach is used that fully integrates land use, stormwater management, wetlands protection, parks, and recreation/open space.

Innovative practices which are not land intensive are urgently needed. Injecting chemical coagulating agents into storm sewers to enhance flocculation and sedimentation of stormwater pollutants is an example. This often may be a better BMP where land for traditional detention basins is unavailable or expensive. Several alum injection systems have been installed in urban areas in Florida to help restore receiving lakes. Concerns over potential aluminum toxicity, however, must still be addressed before this innovative BMP can be fully endorsed.

2.3. Stormwater BMPs and New Development

This section will briefly discuss some key issues of using BMPs to reduce the stormwater impacts associated with new development. These issues include the stormwater program's goals, the setting of performance standards, and the establishment of design criteria for specific BMPs.

2.3.1. Program Goals

The goals of a stormwater management program must be clearly established up front. Until recently, this was a relatively easy task since programs typically were established only to control stormwater peak discharge rates. This is why stormwater management frequently is referred to as "drainage" -- the traditional focus is on draining runoff away from developed property as quickly as possible.

<u>A. Stormwater Quantity Goals</u>

Today, even the goals of stormwater quantity management are changing and broadening. Control of stormwater volume, not just peak discharge rate, is being required in closed basins and for discharges to estuaries. Peak discharge rate control also is evolving - from control of a single frequency storm to multiple frequency storms. ***It is becoming common to control the peak discharge from a 1 or 2-year storm to minimize the erosion of stream channels, in addition to controlling the peak discharges for 10-, 25- and/or 100-year storms for flood control.*** Some stormwater management entities such as the Suwannee River Water Management District and the Florida Department of Transportation are requiring control of the "critical storm". This storm creates the biggest difference between pre-development and post-development peak discharge rate and/or volume.

B. Stormwater Quality Goals

The increasing awareness of stormwater quality problems by citizens and elected officials, along with Federal Clean Water Act requirements, is stimulating state and local governments to broaden the objectives of their stormwater programs. ***Today, stormwater management program goals include consideration of stormwater quantity, stormwater quality, erosion prevention and sediment control, aesthetic values, stormwater reuse, and even open space and recreational benefits.***

Stormwater quality programs need to be implemented within the framework of the federal Clean Water Act. It establishes two types of regulatory approaches to control pollutant discharges. ***Technology-based effluent limitations*** reflect the best controls available, considering their technical and economic achievability. ***Water quality-based effluent limitations*** reflect the water quality standards and allowable pollutant loadings set up by permit (U.S. EPA, 1994).

With respect to stormwater discharges, the latter approach possibly can be developed and implemented through a comprehensive monitoring approach. This not only involves traditional water chemistry monitoring, but also needs to includes sediment chemistry, and an assessment of physical habitat, stream bank erosion, biological community structure, and possibly even whole-effluent toxicity. These techniques are more appropriate than water column chemistry in assessing cumulative, intermittent stormwater impacts.

However, implementing a water quality-based effluent limit permit program for stormwater discharges is nearly impossible because of staffing and technical limitations. The many land use changes occurring in this country create tens of thousands of new stormwater discharges each year. Site-specific analyses to establish water quality-based effluent limitations for so many new discharges simply can't be done. Additionally, there is a sparsity of data on stormwater toxicity and ecological impacts. Therefore, **nearly all stormwater quality permitting programs are technology-based.**

In 1987, the EPA issued guidance on the development of technology-based stormwater programs and the role of water quality criteria. The guidance recognizes that **Best Management Practices (BMPs)** are the primary mechanism for achieving water quality standards. **BMPs are control techniques used for a given set of site conditions to achieve stormwater quality and quantity enhancement at a minimum cost** (Wanielista and Yousef, 1986). The guidance also recommends that state programs should include the following iterative process:

1. Design of BMPs based on site-specific conditions, technical, institutional and economic feasibility, and the water quality standards of the receiving waters.
2. Monitoring to ensure that practices are correctly designed and applied.
3. Monitoring to determine the effectiveness of BMPs in meeting water quality standards and the appropriateness of water quality criteria in reasonably assuring

protection of beneficial uses.

4. Adjustment of BMPs when water quality standards are not being protected to a designed level, or evaluation and possible adjustment of water quality standards.

The ultimate water quality goal of stormwater management programs is to protect or restore the beneficial uses of the receiving waters through the proper installation and operation of program-approved BMPs. If beneficial uses are not maintained or restored, additional BMPs need to be implemented and/or the design criteria for current BMPs should be modified to improve their performance.

2.3.2. Program Performance Standards

Whether for BMPs serving new development or for retrofitting, a performance standard must be established so that specific BMP design criteria can be developed. ***The performance standard establishes a technology-based effluent limitation for stormwater treatment systems.***

<u>A. Stormwater Management Goals</u>

Ideally, the basic goal for stormwater systems serving new development is to assure that the post-development peak discharge rate, volume, timing and pollutant load does not exceed pre-development levels. However, this goal usually is unattainable because our current BMPs, either alone or in combination, can not achieve this level of treatment and/or volume control, and because of the limitations imposed by variations in site conditions. This necessitates the establishment of performance standards that can be achieved through the implementation of BMPs.

<u>B. Stormwater Treatment Performance Standards</u>

The stormwater treatment programs in Florida, Delaware, and Maryland have established similar performance standards for stormwater systems serving new development. ***They require stormwater systems to achieve at least an 80% reduction in the annual average post-development pollutant loading of Total Suspended Solids (TSS) discharged to fishable/swimmable waters.*** This performance standard corresponds to secondary treatment levels, thereby helping to create greater equity between intermittent stormwater discharges and the treatment requirements for traditional point sources such as domestic and industrial wastewater discharges. Florida's program also sets a 95% removal level for stormwater discharges to sensitive waters such as potable supply waters, shellfish harvesting waters, and Outstanding Florida Waters. Florida's minimum stormwater treatment performance standards are set forth in State Water Policy, Section 62-40.431(4),F.A.C.

2.3.3. BMP Design Criteria Factors

Once the performance standard is established, design criteria then need to be set for each of the various BMPs that are going to be used for stormwater management.

This section will briefly review some of the factors that must be considered when setting BMP design criteria. The primary factors influencing BMP removal efficiency include rainfall characteristics; the volume of stormwater that is detained, infiltrated, or reused ("treatment volume"); the time needed to recover the treatment volume; the processes used to capture, filter, or assimilate stormwater pollutants; whether the system is on-line or off-line; and site conditions. By analyzing the factors below, an average annual pollutant removal efficiency can be calculated based on the annual mass of pollutants introduced and the annual mass removed.

A. Rainfall Characteristics

An analysis of long-term rainfall records needs to be undertaken to determine the statistical distribution of various rainfall characteristics such as storm intensity and duration, precipitation volume, number of storms, time between storms, etc. ***Unlike flood control, which focuses on large, infrequent storms, effective stormwater treatment generally relies on capturing and treating runoff from small, frequent events that carry the majority of pollutants***. For example, in Florida, nearly 90% of a year's storm events produce one inch of rainfall or less, and 75% of the total annual volume of rain falls in storms of one inch or less (Wanielista, 1977). Also, the average time between storms is an important consideration in designing stormwater management practices (Wanielista et. al., 1991).

B. "First Flush" Phenomenon

"First flush" describes the washing action that runoff may have on accumulated pollutants in the watershed. In the early stages of runoff, the land surfaces, especially impervious surfaces like streets and parking areas, are flushed clean by the stormwater. This can result in higher concentrations of some stormwater pollutants, especially particulates, during the early part of the storm (Miller, 1985). However, ***the occurrence of "first flush" depends on many factors, including the pollutant, conveyance system, drainage area, percent imperviousness, rainfall patterns, and location***. For example, in the Pacific northwest, which has frequent, long duration, low volume storms, first flush is much less pronounced. Where a target pollutant is associated with the first flush phenomenon, only this early fraction of the total storm runoff volume must be captured and treated to reach the desired treatment level.

C. Land Use Pollutant Loadings

Stormwater pollutant sources, concentration peaks, and decay functions vary from site to site. Accordingly, ***the typical stormwater pollutant loading from any particular type of land use can vary greatly***. Runoff from residential lands have lower concentrations and loadings of most pollutants when compared to stormwater from commercial land uses or highways. Runoff from streets and parking lots will have higher concentrations of heavy metals and other petroleum associated pollutants. Consequently, setting design criteria for stormwater BMPs must include evaluation of factors such as land use, the pollutants on site, and the characteristics of the drainage basin, such as the soil type, amount of imperviousness, type of stormwater conveyance system, and the length and time of travel.

D. On-line vs. off-line BMPs

On-line BMPs capture all of the runoff from a design storm, temporarily storing it before discharge. They primarily provide flood control benefits, with water quality benefits secondary. However, some on-line BMPs, such as wet detention systems, can do an excellent job of achieving both objectives.

Off-line BMPs divert the runoff "treatment volume" for treatment and isolate it from the remaining fraction of runoff, which must still be managed for flood control. This helps to improve treatment efficiency, reduce BMP maintenance, and make maintenance easier.

E. BMP Efficiency and Cost Data

During the past 15 years, many investigations of BMP effectiveness have been performed. Typical information generated often includes the pollutant removal effectiveness of various BMPs, and the costs of BMP construction and operation. A review of Florida BMP investigations (Wanielista and Shannon, 1977) revealed that ***the cost of treatment increases exponentially beyond "secondary treatment" (i.e., removal of 80% of the annual load)***. Therefore, higher levels of treatment are required in Florida only for stormwater discharges to the state's most sensitive water bodies.

F. Site evaluation

The soil types, slopes, geology, water table and other features of a site will greatly influence which BMPs will be most effective. Sandy soils imply using infiltration practices while natural low areas and high water tables offer opportunities for wet detention ponds or constructed wetlands.

3. STORMWATER POLLUTANTS AND REDUCTION MECHANISMS

The key to properly specifying, designing, and operating treatment practices is an awareness of the pollutants in stormwater and an understanding of the biological, chemical, and physical mechanisms that can be used to prevent them from proceeding into receiving waters. Table 2-1 lists the principal mechanisms that have potential to capture, hold, and transform the various classes of pollutants in urban runoff. The most common stormwater pollutants and amelioration mechanisms are summarized below:

1. **Sediment** is solid material that originates mostly from disintegrated rocks, eroded soil, or accumulated organic materials deposited on the land surface. The quantity, characteristics, and causes of the sediment are influenced by many factors including slope, slope length, soil characteristics, and land use, and traffic volume. Sediment

particles vary greatly in size and density. ***The settleability of a particular sediment particle depends directly on it's size and density.*** Sediment size and density must be determined to know which BMPs are most appropriate to remove the particles and to build into the stormwater management system appropriate mechanisms to promote the settling of these particles. Some soils, because of their silty, colloidal nature, can almost never be settled once they get into suspension. These soils may require the use of coagulating agents, such as alum or ferric compounds, to remove them from the water. ***Of course, the most effective control method for sedimentation is erosion control--prevent the production of sediment as much as possible.***

2. **Oxygen-demanding substances** include numerous organic materials that are decomposed by microorganisms thereby creating a need for oxygen. Consequently, a stormwater system such as a detention pond must include mechanisms to maintain high oxygen levels and prevent the formation of anaerobic conditions. Oxygenation mechanisms can be natural (such as shallow depths, sufficient length and width to induce wind mixing, and orientation to maximize the opportunities for wind mixing) or mechanical (such as aerators).

3. **Heavy metals** in highway runoff originate from the operation of motor vehicles, atmospheric deposition, and the degradation of highway materials. The most abundant heavy metals in stormwater are lead, zinc and copper, which together account for about 90 percent of the dissolved heavy metals and 90-98 percent of the total metal concentrations (Harper, 1985). ***Except for copper, zinc, and cadmium, the majority of metals are present in particulate form.*** Consequently, very good removal efficiencies (60-95%) can be obtained in properly designed stormwater management practices.

To maximize heavy metal removal in detention designs, designers should provide physical configurations which encourage a gradual reduction in flow velocity to promote particle sedimentation; maximize the flow length from inlets to the discharge point; prevent short circuiting of flows and hydraulically dead zones; and include suitable aquatic plants to promote uptake and removal of dissolved metal species. ***To keep metals bound to sediment, it is important that the sediment pH be kept near 7 and that the sediments be aerobic***. A decrease in pH and, to lesser extent, a reduction in redox potential, will cause metals to become soluble and release from the sediment (Harper, 1985). For this reason, it is important to monitor the accumulation of sediment and decaying organic matter within detention ponds since this can result in lowered pH and possible anaerobic conditions. Failure to properly remove sediments could cause release of accumulated metals into the underlying ground water or into surface waters.

4. **Nutrients**, such as nitrogen and phosphorus, are common constituents of stormwater. They stimulate the growth of algae and other aquatic plants, and contribute to oxygen depletion as these plants decompose. Excessive nutrients accelerate the natural process of eutrophication in lakes and streams. ***Nutrients in stormwater may be either dissolved or particulate, with particulate forms slightly dominating (about 60%)***. Consequently, a stormwater management system,

especially a wet detention system, must incorporate provisions for settling to remove particulate forms of nutrients and include nutrient assimilation for dissolved forms. A littoral zone planted with suitable aquatic plants should be concentrated near the discharge point to provide nutrient assimilation. Biofiltration, swale conveyance, sediment sumps, or a perimeter swale and berm system can be used to reduce particulate nutrients.

5. **Increased temperature of stormwater** occurs because urban lands, especially impervious surfaces, are heated on warm days. Runoff stored in BMPs, especially shallow ponds, is also heated by the sun between storms. Proper selection of BMPs is the best way to minimize adverse thermal impacts from stormwater BMP discharges. Galli (1991) ranks the potential of BMPs to raise receiving water temperatures, from least to most serious, as: infiltration basins < extended detention wetlands < extended dry detention ponds < wet detention ponds. Other methods to lessen thermal impacts include using trees to help shade BMPs, especially pilot channels and outfall channels for extended dry detention ponds. The use of exposed riprap or concrete surfaces for these channels also can be mnimized. BMPs also can be oriented to take advantage of prevailing winds, promoting water circulation and cooling.

6. **Increased stormwater volume** associated with the increased imperviousness which accompanies urbanization is now being recognized as a major cause of water body degradation. The increased volume of runoff causes channels and streams to flow at bank full levels more frequently resulting in streambank and bed erosion, and loss of habitat. Additionally, the discharge of greater volumes of runoff to estuaries has led to decreases in their salinity and shifts in biological communities. Reducing stormwater volume is not easy. Nonstructural BMPs to minimize imperviousness and reduce directly connected impervious area are the most effective. Structural BMPs which help to reduce stormwater volume include infiltration systems, many biofiltration systems, and wet detention stormwater reuse systems.

Although not specifically listed in Table 2-1, **treatment time is an important factor in the functioning of all mechanisms**. The effectiveness of settling a solid particle is directly related to the time provided to complete sedimentation at the characteristic settling velocity of the particle. Time is also a crucial variable in determining the degree to which chemical and biological mechanisms operate. Chemical reactions and biologically mediated processes all proceed at characteristic rates, which must be implicitly recognized to obtain their benefits in treatment. For all of these reasons, water residence time is the most basic variable for applying treatment practice technology effectively.

An alternative way of looking at the information presented in Table 2-1 is to group features that promote certain specific pollutant control objectives. The following list extracts those features for the most common objectives:

Features That Help Achieve All Objectives

- Increasing hydraulic residence time
- Low turbulence
- Fine, dense herbaceous plants
- Medium-fine texture soil

Features That Help Achieve Specific Objectives

- Phosphorus control:
    - High soil exchangeable aluminum and/or iron content
    - Addition of precipitating agents

- Nitrogen control:
    - Alternating aerobic and anaerobic conditions
    - Low levels of toxicants
    - Circumneutral pH (around 7)

- Metals control:
    - High soil organic content
    - High soil cation exchange capacity
    - Circumneutral pH
    - Organics control:
    - Aerobic conditions
    - High light
    - High soil organic content
    - Low levels of toxicants
    - Circumneutral pH

The degree of control that the treatment system designer and operator can exert to influence the operation of these various features differs. Fortunately, at least three of the four features that promote all favorable mechanisms (possibly excluding the soil) are under a high degree of control. The additional features that promote the more specific objectives require more intervention (e.g., developing some desired soil condition).

4. STORMWATER MANAGEMENT PRACTICES (BMPs)

The stormwater management tool box contains many tools that can help prevent or correct stormwater problems. The broadening objectives of stormwater management is leading to the development of new tools and the refinement of some of our existing tools. The goals of a stormwater program usually will play a major role in deciding which tools will be selected and used.

Generally, the ***stormwater tool box can be separated into two main drawers: nonstructural controls and structural controls.*** Generally, nonstructural controls are those that can help to prevent stormwater problems, while structural controls are used to mitigate stormwater problems. Until recently, most stormwater programs, because of their focus on flood control, have relied upon structural controls.

Nonstructural controls often are somewhat difficult to implement. Several of them require consideration and control of changes in property (i.e., growth management, land use planning, zoning) - often very controversial topics. ***Nonstructural controls also include "source controls", which are used to limit the types and amounts of potential pollutants that get into runoff.*** Many source controls involve modifying or controlling certain aspects of human behavior such as the use of fertilizers, pesticides or household cleaners. Doing so may be very difficult or highly controversial. However, source controls can be very effective, especially in highly urbanized areas, and less costly than structural controls. ***The dilemma for stormwater managers is the effectiveness of nonstructural controls is not well understood yet***.

With respect to structural controls, broadening of stormwater management goals often requires reconsideration of the usual BMP design, less emphasis and use of certain practices, changes in preferred alternatives, and greater emphasis on regular maintenance. For example:

- To improve pollutant removal, detention pond design typically must be changed to increase residence time, maximize length of flow through the pond, and include shallow littoral zones planted with appropriate native wetland plants to help remove dissolved nutrients and metals.

- Less emphasis is placed on use of dry detention, which is used widely for flood control. However, dry detention systems provide very low pollutant removal benefits because of very short detention times, bottom discharge controls, and paved channels.

- In many locations, local codes require the use of street curbs and gutters with storm sewers to eliminate ponding of runoff, even for short periods of time. To promote infiltration, thereby decreasing runoff volume and improving pollutant removal, many localities are eliminating this requirement and promoting the use of roadside vegetated swales, especially in low or medium density residential areas.

- ***There is increasing emphasis on the "BMP treatment train" concept, wherein several types of stormwater controls are used together and integrated into a comprehensive stormwater management system***. This is especially true where wet detention ponds are the primary control but are being promoted as a visual and recreational amenity on a project. To help prevent the wet pond from turning into an algae-covered eyesore, swales can be used for conveyance instead of storm sewers, and vegetated littoral zones are added to assimilate nutrients. Increasingly, the use of small, off-line depressional storage areas is being integrated into site plans, usually as part of the site's required open space and landscaping. These can not only reduce pollutants but decrease the overall size and cost of downstream stormwater system components.

In Florida, the primary BMPs used for treating stormwater from new developments include:

Retention (infiltration)
- Basins
- Trenches
- Swales

Detention with filtration
Wet detention
Wetlands treatment

For each of the above BMPs, specific design criteria have been established which are presumed to assure that the BMP acheives the minimum level of treatment specified in State Water Policy. FDEP and the WMDs periodically review the latest scientific data on BMP performance and revise the design criteria as needed to assure that BMPs are performing optimally.

4.1. BMP Selection

Effective operation and minimum maintenance of a stormwater system begins with selection of the most appropriate BMP(s) for the site. Factors which need to be evaluated include:

A. Watershed Area

Infiltration, biofiltration, and filter BMPs generally are more suitable for smaller areas. Pond BMPs typically require a larger drainage area to assure proper operation.

B. Area Required

Adequate area must be available at the site. Many BMPs are land intensive but some can be installed underground, although this increases maintenance difficulties and costs.

C. Stormwater pollutants

Most BMPs are more effective at removing particulate related pollutants. Some BMPs, primarily those with vegetative components, can also reduce dissolved constituents.

D. High Sediment Loading

Many BMPs are highly susceptible to clogging. Pretreatment (BMP Treatment Train) helps to increase effectiveness, reduce maintenance, and extend the life of BMPs.

E. Soil type

Soil permeability has a profound influence on BMP effectiveness, especially for infiltration practices. Also, silty and clayey soils that get into stormwater are much harder to settle than sandy ones.

F. Slope

Steep slopes can restrict the use of several BMPs, especially when water ponding or flow velocity may cause instability or erosion.

G. Water Table Elevation

A crucial factor in the design of all BMPs is water table elevation. Incorrectly estimating the seasonal high water table so it is too close to the bottom can cause BMP failure, decrease effectiveness, and increase maintenance. This is especially true for infiltration or dry detention systems. Wet ponds need high water tables to maintain their permanent pools.

H. Bedrock or Hardpan

Restrictive soil layers or rock can impede downward infiltration of runoff or make excavation for ponds impossible or expensive.

I. Karst Geology

Fractured limerock geology provides channels for stormwater pollutants to migrate into the ground water. Excavation or the hydraulic head of stored runoff may create sinkholes in the bottom of BMPs creating a direct discharge to ground water.

J. Proximity to Foundations, Septic Tanks, and Wells

BMPs should not be located close to building foundations, septic tanks, or drinking wells. Seepage problems or ground water pollution can result, especially from infiltration practices.

K. Receiving Water

If the stormwater discharge will be to an estuary or other saline habitat, BMPs which reduce stormwater volume need to be considerd first. If the discharge is to a water body which supports a cold water fishery or biological community, the potential thermal impacts must be considered in the selectionof the most appropriate stormwater BMPs.

L. Water Availability

Water may be needed during the dry season to keep grass or other vegetation alive and continuing to function as a filtering media.

M. Side Effects and Ancillary Benefits

Potential for mosquito breeding or ground water contamination need to be considered, as do opportunities for wildlife use and passive recreation.

N. Public Acceptance

No stormwater system will be maintained if the property owner does not like or approve of its design or the types of BMP used.

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

CHAPTER 40C-42, F.A.C.

ENVIRONMENTAL RESOURCE PERMITS: REGULATION OF STORMWATER MANAGEMENT SYSTEMS

Revised
October 3, 1995

R0073405

CHAPTER 40C-42

ENVIRONMENTAL RESOURCE PERMITS: REGULATION OF STORMWATER MANAGEMENT SYSTEMS

40C-42.011 Scope.

(1) This chapter governs stormwater management systems which are designed and constructed or implemented to control discharges necessitated by rainfall events. These systems may incorporate methods to collect, convey, store, absorb, inhibit, treat, use or reuse water to prevent or reduce flooding, overdrainage, environmental degradation and pollution, or otherwise affect the quality and quantity of discharges. Standard general and individual environmental resource stormwater permits are required under this chapter for construction, operation, maintenance, alteration, removal, or abandonment of systems that are not permitted under provisions of chapters 40C-4, 40C-40, or 40C-400, F.A.C. Permits issued under this chapter must be consistent with the objectives of the District and not cause harm to the water resource.

R0073406

(2) A permit under this chapter will be required only for certain stormwater management systems as defined herein. This provision shall not affect the District's authority to require appropriate corrective action whenever any system causes or contributes to violations of state water quality standards.

(3) Stormwater discharges to groundwaters shall be regulated under the provisions of section 62-28.700, F.A.C., and other applicable rules of the Department of Environmental Protection .

Specific Authority 373.044, 373.113, 373.171, 373.418 FS. Law Implemented 373.416, 403.812, 403.814 FS. History--New 4-1-86. Amended 9-25-91, 10-3-95.

40C-42.021 Definitions.

(1) "Appropriate Registered Professional" or "Registered Professional" means, for purposes of this rule, a professional registered in Florida with the necessary expertise in the fields of hydrology, drainage, flood control, erosion and sediment control, and stormwater pollution control to design and certify stormwater management systems. Examples of registered professionals may include professional engineers licensed under chapter 471, F.S., professional landscape architects licensed under chapter 481, F.S., and professional geologists licensed under chapter 492, F.S., who have the referenced skills.

(2) "As-Built Drawings" means plans certified by an appropriate registered professional or registered surveyor which accurately represents the constructed condition of a system.

(3) "Completion of Construction" means the time at which the stormwater management system is first placed into operation, when the project passes final building inspection or when the project receives a certificate of occupancy, whichever occurs first.

(4) "Construction" means any activity including land clearing, earth moving, or the erection of structures which will result in the creation of a stormwater management system.

(5) "Control Device" or "Bleed-down Device" means that element of a discharge structure which allows the gradual release of water under controlled conditions.

(6) "Control Elevation" means the lowest elevation at which water can be released through the control device.

(7) "Detention with Filtration" or "Filtration" means the selective removal of pollutants from stormwater by the collection and temporary storage of stormwater and the subsequent gradual release of the stormwater into surface waters in the state through at least 2 feet of suitable fine textured granular media such as porous soil, uniformly graded sand, or other natural or artificial fine aggregate, which may be used in conjunction with filter fabric and/or perforated pipe.

(8) "Detention" or "To Detain" means the collection and temporary storage of stormwater with subsequent gradual release of the stormwater.

(9) "Direct Discharge" means, for purposes of this chapter, a point or nonpoint discharge which enters Class I, Class II, or Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting without an adequate opportunity for mixing and dilution to prevent significant degradation. Examples of direct discharge include the following:

(a) discharge without entering any other water body or conveyance prior to release to the Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting;

(b) discharge into an intermittent watercourse which is a tributary of a Class I, Class II, Outstanding Florida Water, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting; and

(c) discharge into a perennial watercourse which is a tributary of a Class I, Class II, Outstanding Florida Water, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting when there is not an adequate opportunity for mixing and dilution to prevent significant degradation.

(10) "Dry detention" means a system designed to collect and temporarily store stormwater in a normally dry basin with subsequent gradual release of the stormwater.

(11) "Effective Grain Size" means the diameter of filter sand or other aggregate that corresponds to the 10 percentile finer by dry weight on the grain size distribution curve.

(12) "Intermittent Watercourse" means a stream or waterway that flows only at certain times of the year, flows in direct response to rainfall, and is normally an influent stream except when the ground water table rises above the normal wet season level.

(13) "Littoral zone" means, in reference to stormwater management systems, that portion of a wet detention pond which is designed to contain rooted aquatic plants.

(14) "Off-line" means the storage of a specified portion of the stormwater in such a manner so that subsequent runoff in excess of the specified volume of stormwater does not flow into the area storing the initial stormwater.

(15) "Operational Maintenance" means any activity or repair required to keep a stormwater management system functioning as permitted and designed.

(16) "Operate" or "Operation" means to cause or to allow a stormwater management system to function.

(17) "Perennial Watercourse" means a stream or waterway which is not an intermittent watercourse.

(18) "Permanent Pool" means that portion of a wet detention pond, which normally holds water (e.g., between the normal water level and the pond bottom) excluding any water volume claimed as wet detention treatment volume pursuant to paragraph 40C-42.026(4)(a), F.A.C.

(19) "Pollution" means the presence in waters of the state of any substances, contaminants, or manmade or man-induced impairment of waters or alteration of the chemical, physical, biological, or radiological integrity of water in quantities or at levels which are or may be potentially harmful or injurious to human health or welfare, animal or plant life, or property or which unreasonably interfere with the enjoyment of life or property, including outdoor recreation unless authorized by applicable law.

(20) "Registered Surveyor" means a registered professional land surveyor licensed in the state of Florida under chapter 472, F.S.

(21) "Reconstruction" means rebuilding or construction in an area upon which construction has previously occurred.

(22) "Retention" means a system designed to prevent the discharge of a given volume of stormwater runoff into surface waters in the state by complete on-site storage. Examples may

include excavated or natural depression storage areas, pervious pavement with subgrade, or above ground storage areas.

(23) "Seasonal high ground water table elevation" means the highest level of the saturated zone in the soil in a year with normal rainfall.

(24) "Semi-impervious" means land surfaces which partially restrict the penetration of water; included as examples are porous concrete and asphalt pavements, limerock, and certain compacted soils.

(25) "Sensitive Karst Areas" means those areas of the District delineated in chapters 40C-4 and 40C-41, F.A.C., in which the Floridan aquifer is near the land surface.

(26) "Stormwater" means the flow of water which results from, and which occurs immediately following, a rainfall event.

(27) "Stormwater Discharge Facility" means a stormwater management system which discharges stormwater into surface waters of the State.

(28) "Stormwater Management System" means a system which is designed and constructed or implemented to control discharges which are necessitated by rainfall events, incorporating methods to collect, convey, store, absorb, inhibit, treat, use or reuse water to prevent or reduce flooding, overdrainage, environmental degradation, and water pollution or otherwise affect the quality and quantity of the discharges.

(29) "Swale" means a manmade trench which:

(a) Has a top width to depth ratio of the cross-section equal to or greater than 6:1, or side slopes equal to or greater than 3 feet horizontal to 1 foot vertical; and,

(b) Contains contiguous areas of standing or flowing water only following a rainfall event; and,

(c) Is planted with or has stabilized vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake; and,

(d) Is designed to take into account the soil erodibility, soil percolation, slope, slope length, and drainage area so as to prevent erosion and reduce pollutant concentration of any discharge.

(30) "Underdrain" means a drainage system installed beneath a stormwater holding area to improve the infiltration and percolation characteristics of the natural soil when permeability is restricted due to periodic high water table conditions or the presence of layers of fine textured soil below the bottom of the holding area. These systems usually consist of a system of interconnected below-ground conduits such as perforated pipe, which simultaneously limit the water table elevation and intercept, collect, and convey stormwater which has percolated through the soil.

(31) "Underground Exfiltration Trench" or "Exfiltration Trench" means a below-ground system consisting of a conduit such as perforated pipe surrounded by natural or artificial aggregate which is utilized to percolate stormwater into the ground.

(32) "Uniformity Coefficient" means the number representing the degree of homogeneity in the distribution of particle sizes of filter sand or other granular material. The coefficient is calculated by determining the D^{60}/D^{10} ratio where D^{10} and D^{60} refer to the particle diameter corresponding to the 10 and 60 percentile of the material which is finer by dry weight.

(33) "Waters" are as defined in subsection 373.019(8), F.S.

(34) "Wet Detention" means the collection and temporary storage of stormwater in a permanently wet impoundment in such a manner as to provide for treatment through physical, chemical, and biological processes with subsequent gradual release of the stormwater.

(35) "Wetlands Stormwater Management System" means a stormwater management system which incorporates those wetland described in subsection 40C-42.0265(2), F.A.C., into the stormwater management system to provide stormwater treatment.

Specific Authority 373.044, 373.113, 373.171, 373.418 FS. Law Implemented 373.413, 373.416 FS. History--New 4-1-86. Amended 9-25-91, 3-21-93, 4-11-94, 10-3-95

40C-42.022 Permits Required.

(1) A permit is required under this chapter for construction (including operation and maintenance) of a stormwater management system which serves a project that exceeds any of the following thresholds:

(a) Construction of 4,000 square feet or more of impervious or semi-impervious surface area subject to vehicular traffic. This area includes roads, parking lots, driveways, and loading zones;

(b) Construction of 5000 square feet or more of building area or other impervious area not subject to vehicular traffic; or

(c) Construction of 5 acres or more of recreational area. Recreation areas include but are not limited to golf courses, tennis courts, putting greens, driving ranges, or ball fields.

(2) A permit is required under this chapter for alteration, removal, reconstruction, or abandonment of existing stormwater management systems which serve a project which may be expected to result in any of the following:

(a) Increase pollutant loadings (including sediment) in stormwater runoff from the project,

(b) Increase in peak discharge rate,

(c) Decrease in onsite or instream detention storage,

(d) Replacement of roadside swales with curb and gutter,

(e) Construction of 4,000 square feet or more of impervious or semi-impervious surface area subject to vehicular traffic. This area includes roads, parking lots, driveways, and loading zones;

(f) Construction of 5,000 square feet or more of building area or other impervious area not subject to vehicular traffic; or

(g) Construction of 5 acres or more of recreational area. Recreation areas include but not limited to golf courses, tennis courts, putting greens, driving ranges, or ball fields.

(3) These thresholds include all cumulative activity which occurs on or after September 25, 1991.

(4) For purposes of this section, the calculation of the amount of impervious surface shall not include water bodies.

(5) Applications received by the District for which a permit has not been issued prior to the rule revisions effective April 11, 1994, and which do not require a permit pursuant to sections (1) or (2), above, may be withdrawn by the applicant.

(6) Permits issued by the District for systems which no longer require a permit pursuant to sections (1) or (2), above, may either be abandoned or relinquished by the permittee subject to the following:

(a) Local governments may have concurrent jurisdiction with the District over a stormwater system. The permittee is not relieved by this rule of the responsibility to comply with any other applicable rules or ordinances which may govern such system.

(b) The permittee provides reasonable assurance that there will not be a violation of state water quality standards as set forth in chapter 62-302 and 62-550, F.A.C.;

(c) The permittee provides reasonable assurance that adjacent or nearby properties not owned or controlled by the applicant will not be adversely affected by drainage or flooding; and

(d) The permittee must apply to the District for and receive written authorization from the District prior to abandonment of the system.

Specific Authority 373.044, 373.113, 373.171, FS. Law Implemented 373.413, 373.416 FS. History--New 9-15-91. Amended 4-11-94, 11-22-94.

40C-42.0225 Exemptions From Permitting for Stormwater Management Systems. The following types of stormwater management systems are exempt from the notice and permit requirements of this chapter:

(1) Systems designed to accommodate only one single family dwelling unit, duplex, triplex, or quadruplex, provided the single unit, duplex, triplex or quadruplex is not part of a larger common plan of development or sale.

(2) Systems which are designed to serve single family residential projects, including duplexes, triplexes and quadruplexes, of less than 10 acres total land area and which have less than 2 acres impervious surface and if the systems:

(a) Comply with all regulations or ordinances applicable to stormwater management adopted by a city or county;

(b) Are not part of a larger common plan of development or sale; and

(c) Discharge into a stormwater management system exempted or permitted by the District under this chapter which has sufficient capacity and treatment capability as specified in this chapter and is owned, maintained, or operated by a city, county, special district with drainage responsibility, or water management district; however, this exemption does not authorize discharge to a system without the system owner's prior written consent.

(3) Systems that qualify for a noticed general permit pursuant to chapter 40C-400, F.A.C. and which comply with the requirements of such noticed general permit.

Specific Authority 373.044, 373.113, 373.171, 373.413 FS. Law Implemented 373.413, 373.416, 403.812 FS. History--New 9-25-91. Amended 3-21-93, 10-3-95.

40C-42.023 Requirements for Issuance.

(1) To receive a general or individual permit under this chapter the applicant must provide reasonable assurance based on plans, test results and other information, that the stormwater management system:

(a) will not result in discharges from the system to surface and ground water of the state that cause or contribute to violations of state water quality standards as set forth in chapters 62-3, 62-4, 62-302 and 62-550, F.A.C., including any antidegradation provisions of sections 62-4.242(1)(a) and (b), 62-4.242(2) and (3), and 62-302.300, F.A.C., and any special standards for Outstanding Florida Waters and Outstanding National Resource Waters set forth in sections 62-4.242(2) and (3), F.A.C.;

(b) will not adversely affect drainage and flood protection on adjacent or nearby properties not owned or controlled by the applicant;

(c) will be capable of being effectively operated and maintained pursuant to the requirements of this chapter; and

(d) meets any applicable basin criteria contained in chapter 40C-41, F.A.C.

(2)(a) A showing by the applicant that the stormwater management system complies with the applicable criteria in sections 40C-42.024, 40C-42.025, 40C-42.026, and 40C-42.0265, F.A.C., shall create a presumption that the applicant has provided reasonable assurance that the proposed activity meets the requirements in paragraphs (a), above.

(b) A showing by the applicant that the stormwater management system complies with the criteria of subsections 40C-42.025(8) and (9), F.A.C., shall create a presumption that the applicant has provided reasonable assurance that the proposed activity meets the requirements in paragraph (b), above.

(c) A showing by the applicant that the stormwater management system complies with the applicable criteria of sections 40C-42.027, 40C-42.028, and 40C-42.029, F.A.C., shall create a presumption that the applicant has provided reasonable assurance that the proposed activity meets the requirements in paragraph (c), above.

Specific Authority 373.044, 373.113, 373.171, 373.418 FS. Law Implemented 373.413, 373.416 FS. History--New 9-25-91. Amended 3-21-93, 10-3-95.

40C-42.024 Standard General and Individual Permits.

(1) Any person proposing to construct, alter, operate, maintain, remove, or abandon a stormwater management system, which requires a permit pursuant to sections 40C-42.022, F.A.C., except those exempted pursuant to section 40C-42.0225, F.A.C., or noted in section 40C-42.061, F.A.C, shall apply to the District for a standard general or individual environmental resource stormwater permit, prior to the commencement of construction, alteration, removal, operation, maintenance, or abandonment of the stormwater management system. No construction, alteration, removal, operation, maintenance, or abandonment of a stormwater management system shall be undertaken without a valid standard general or individual environmental resource stormwater permit as required pursuant to this section.

(2) The following types of stormwater management systems qualify for a standard general environmental resource stormwater permit and shall be processed according to the administrative procedures set forth in chapter 40C-40, F.A.C.:

(a) Systems which discharge into a stormwater management system which is permitted pursuant to paragraph 40C-42.024(2)(b), (c), or (d), F.A.C., or subsection 40C-42.024(3), F.A.C., or which was previously approved pursuant to a noticed exemption under section 17-25.030 where the appropriate treatment criteria specified in this chapter and applied to the permitted or exempt system are not exceeded by the discharge; however, this does not authorize discharge to the permitted or exempt system without the system owner's prior written consent.

(b) Systems which meet the applicable design and performance standards of section 40C-42.025, F.A.C., and which comply with any one or more of the following:

1. Retention systems which meet the criteria of subsection 40C-42.026(1), F.A.C.;
2. Underdrain systems which meet the criteria of subsection 40C-42.026(2), F.A.C.;
3. Underground exfiltration trench systems which meet the criteria of subsection 40C-42.026(3), F.A.C.;
4. Wet detention systems which meet the criteria of subsection 40C-42.026(4), F.A.C.; or
5. Swale systems which meet the criteria in subsections 40C- 42.021(30) and 40C-42.026(5), F.A.C.
6. Dry detention systems within project areas less than 5 acres in size, and which serve draiage area less than 5 acres in size, and which meet the criteria of subsection 40C-42.026(6), F.A.C.

(c) Modification or reconstruction by a city, county, state agency, federal agency, or special district with drainage responsibility, of an existing stormwater management system which is not intended to increase the original design capacity, and which will not increase pollution loading, or change points of discharge in a manner that would adversely affect the designated uses of waters in the state.

(d) Paving of existing public dirt roads by a public entity if all of the following conditions are met:

1. The road will not serve new development.
2. Additional traffic lanes are not added to the road;
3. The traffic load is not expected to significantly increase;
4. The drainage system serving the road is not significantly altered;
5. Erosion and sediment controls are utilized to prevent turbidity during construction;
6. The project does not involve dredging or filling in wetlands or other surface waters, other than in ditches that were excavated through uplands ;
7. Permanent vegetative cover is established on both sides of the pavement within the road right of way; and
8. Swale blocks, or other means, are utilized to retain runoff and promote infiltration in areas with soil having good infiltration (i.e., SCS hydrologic soil groups "A" and "B").

(3) The following types of stormwater management systems will be processed as an individual permit according to the administrative procedures set forth in chapter 40C-4, F.A.C.:

(a) Wetlands stormwater management systems which are designed pursuant to the criteria in sections 40C-42.025 and 40C-42.0265, F.A.C.;

(b) Systems which propose to satisfy the standards of subsection 40C-42.023(1), F.A.C., by employing an alternative treatment methodology or device other than those described in subsection (2) or paragraph (3)(a), above. An affirmative showing by the applicant that the system design will provide treatment equivalent to retention systems described in paragraph (2)(b)1., above, will create a presumption in favor of satisfying the standards in paragraphs 40C-42.023(1)(a), F.A.C. In addition, systems which have a direct discharge to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting shall provide an additional level of treatment (i.e., additional treatment volume and off-line treatment) pursuant to section 40C-42.026, F.A.C., or an alternative demonstrated by the applicant to be equivalent.

(c) Systems which do not meet the applicable criteria of sections 40C-42.025, 40C-42.026, or 40C-42.0265, F.A.C. An affirmative showing by the applicant based on plans, test results, calculations, or other information that an alternative design is appropriate for the specific site conditions will create a presumption in favor of satisfying the applicable standards in subsection 40C-42.023(1), F.A.C.

(4) In otherwise determining whether reasonable assurance has been provided for paragraphs (3)(b) and (c), above, the District shall, where appropriate, consider:

(a) Whether best management practices are proposed, such as those described in "Stormwater Management Manual (October, 1981)," "The Florida Development Manual: A Guide to Sound Land and Water Management (June, 1988)," or best management practices described in manuals adopted by the Environmental Regulation Commission pursuant to section 62-25.050, F.A.C., or other appropriate best management practices (the manuals listed above by name are adopted and made a part of this rule by reference. Copies of these documents may be inspected at all District offices);

(b) The public interest served by the system;

(c) The probable efficacy and costs of alternative controls; and

(d) Whether reasonable provisions have been made for the operation and maintenance of the proposed system.

(5) The standard general or individual environmental resource stormwater permit which is granted will include a specified period for which the permit will be valid. Such period, unless the permit is modified or revoked, is generally:

(a) five years for permits to construct, alter, or remove a system; and

(b) permanent for permits to operate, maintain, or abandon a system.

(6) Procedures governing transfers, permit revocation, permit modifications, and extensions are found in chapters 40C-1 and 40C-4, F.A.C., and apply to permits obtained pursuant to this chapter. Procedures governing converting construction to operation permits and transferring the system to the operation and maintenance entity are found in section 40C-42.027, F.A.C., below.
Specific Authority 373.044, 373.113, 373.118, 373.171, 373.418 FS. Law Implemented 373.413, 373.416, 403.813 FS. History--New 9-25-91. Amended 3-21-93, 4-11-94, 10-3-95.

40C-42.025 Design and Performance Criteria for Stormwater Management Systems. The following criteria shall apply to stormwater management systems unless otherwise noted:

(1) Erosion and sediment control best management practices shall be used as necessary during construction to retain sediment on-site. These management practices shall be designed and certified by an appropriate registered professional experienced in the fields of soil conservation or sediment control according to specific site conditions and shall be shown or noted on the plans of the stormwater management system. The registered professional shall furnish the contractor with information pertaining to the construction, operation and maintenance of the erosion and sediment control practice. Sediment accumulations in the system from construction activities shall be removed to prevent loss of storage volume.

(2) Stormwater management systems which either receive stormwater from areas with greater than 50 percent impervious surface or are a potential source of oil and grease contamination in concentrations that exceed applicable water quality standards shall include a baffle, skimmer, grease trap or other mechanism suitable for preventing oil and grease from leaving the stormwater management system in concentrations that would cause or contribute to violations of applicable water quality standards in the receiving waters. For purposes of this subsection, the calculation of the amount of impervious surface shall not include water bodies.

(3) Unless applicable local regulations are more restrictive, for purposes of public safety the following requirements apply:

(a) Normally dry basins designed to impound more than two feet of water or permanently wet basins shall be fenced or otherwise restricted from public access, or shall contain side slopes that are no steeper than 4:1 (horizontal:vertical) out to depth of two feet below the control elevation; and,

(b) Control devices that are designed to contain more than a two foot depth of water within the structure under the design storm and have openings greater than one foot minimum dimension shall be restricted from public access.

(4) All stormwater basin side slopes shall be stabilized by either vegetation or other materials to minimize erosion and sedimentation of the basins.

(5) Stormwater management systems must be designed to accommodate maintenance equipment access and to facilitate regular operational maintenance (such as underdrain replacement, unclogging filters, sediment removal, mowing and vegetation control). Operational maintenance and operation easements shall be provided when necessary to facilitate equipment access.

(6) The applicant must obtain sufficient legal authorization as appropriate prior to permit issuance for stormwater management systems which propose to utilize offsite areas to satisfy the requirements in subsection 40C-42.023(1), F.A.C.

(7) Stormwater management systems (except retention and exfiltration trench systems) shall provide gravity or pumped discharge that effectively operates under one of the following tailwater conditions:

(a) Maximum stage in the receiving water resulting from the mean annual 24-hour storm. This storm depth is described in "Rainfall Analysis for Northeast Florida;" St. Johns River Water Management District Technical Publication No. SJ 88-3 (May, 1988). Lower stages may be utilized if the applicant demonstrates that flow from the project will reach the receiving water prior to the time of maximum stage in the receiving water;

(b) Mean annual high tide for tidal areas;

(c) Mean annual seasonal high water elevation. This elevation may be determined by water lines on vegetation or structures, historical data, adventitious roots or other hydrological or biological indicators, design of man-made systems, or estimated by a registered professional using standard hydrological methods based on the site and receiving water characteristics; or

(d) As an alternative, the applicant may propose any applicable criterion established by a local government, state agency, or stormwater utility with jurisdiction over the project.

(8) Stormwater management systems which require a permit pursuant to subsection 40C-42.022(1), F.A.C., and which serve new construction area with greater than 50 percent

impervious surface (excluding water bodies) must demonstrate that the post-development peak rate of discharge does not exceed the pre-development peak rate of discharge for one of the following:

(a) The mean annual 24-hour storm event. This storm depth is described in "Rainfall Analysis for Northeast Florida;" St. Johns River Water Management District Technical Publication No. SJ 88-3 (May, 1988). The criteria contained in sections 10.3.5 - 10.3.8 of the Management and Storage of Surface Waters Applicant's Handbook, (A.H.), are herein incorporated by reference;

(b) The mean annual 24-hour storm event utilizing the modified rational hydrograph method. This storm depth is described in the publication referenced in paragraph (a), above. This methodology should only be used for systems meeting the following criteria:

1. The drainage area is less than 40 acres;

2. The pre-development time of concentration for the system is less than 60 minutes; and,

3. The post-development time of concentration for the system is less than 30 minutes; or

(c) As an alternative to paragraphs (a) or (b), above, the applicant may propose a storm event, duration, and criteria specified by a local government, state agency, or stormwater utility with jurisdiction over the project.

(9) Stormwater management systems which alter existing conveyance systems must not adversely affect existing surface water conveyance capabilities. It is presumed that a system meets this criteria if one of the following are met:

(a) The existing hydraulic conveyance is maintained;

(b) The applicant demonstrates that changes in flood elevations or velocities will not adversely impact upstream or downstream off-site property;

(c) The applicant demonstrates that the criteria in 10.5.2(b), Applicant's Handbook, are met; or

(d) As an alternative, the applicant may propose to comply with applicable criteria established by a local government, state agency, or stormwater utility with jurisdiction over the project.

(10) The construction plans and supporting calculations must be signed, sealed, and dated by an appropriate registered professional as required by the relevant statutory provisions when the design of the stormwater management system requires the services of an appropriate registered professional.

(11) Stormwater management systems located within Sensitive Karst Areas must meet the requirements of subsection 40C-41.063(6), F.A.C.

Specific Authority 373.044, 373.113, 373.171, 373.418 FS. Law Implemented 373.117, 373.413, 373.416, 403.0877 FS. History--New 4-1-86. Amended 9-25-91, 3-21-93.

40C-42.026 Specific Design and Performance Criteria.

(1) Retention systems shall:

(a) Provide for one of the following:

1. Off-line retention of the first one half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater;

2. On-line retention of an additional one half inch of runoff from the drainage area over that volume specified in subparagraph 1., above;

3. On-line retention that provides for percolation of the runoff from the three year, one-hour storm; or

4. On-line retention of the runoff from one inch of rainfall or 1.25 inches of runoff from the impervious area, whichever is greater, for systems which serve an area with less than 40 percent impervious surface and that contain only U.S. Department of Agriculture Soil Conservation Service (SCS) hydrologic group "A" soils.

(b) Provide retention in accordance with one of the following for those systems which have direct discharge to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting:

1. At least an additional fifty percent of the applicable treatment volume specified in subparagraph 1., above. Off-line retention must be provided for at least the first one half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated;

2. On-line retention of an additional fifty percent of the treatment volume specified in subparagraph 2., above;

3. On-line retention that provides percolation of the runoff from the three-year, one-hour storm; or

4. On-line retention that provides at least an additional 50 percent of the runoff volume specified in subparagraph 40C-42.026(1)(a)4., above, for systems which serve an area with less that 40 percent impervious surface and that contain only U.S. Department of Agriculture Soil Conservation Service (SCS) hydrologic group "A" soils.

(c) Provide the capacity for the appropriate treatment volume of stormwater specified in paragraphs (a) or (b) above, within 72 hours following the storm event assuming average antecedent moisture conditions. The storage volume must be provided by a decrease of stored water caused only by percolation through soil, evaporation or evapotranspiration.

(d) Be stabilized with pervious material or permanent vegetative cover. Permanent vegetative cover must be utilized, except for pervious pavement systems, when U.S. Department of Agriculture Soil Conservation Service (SCS) hydrologic group "A" soils underlie the retention basin.

(2) Underdrain stormwater management systems shall:

(a) Provide for either of the following:

1. Off-line storage of the first one half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater; or

2. On-line storage of an additional one half inch of runoff from the drainage area over that volume specified in subparagraph 1., above.

(b) Provide either of the following for those underdrain systems which have direct discharge to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, restricted, or conditionally restricted for shellfish harvesting:

1. At least an additional fifty percent of the applicable treatment volume specified in subparagraph 1., above. Off-line storage must be provided for at least the first one half inch of

runoff or 1.25 inches of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated; or

2. On-line storage of the runoff from a three-year, one-hour storm or an additional fifty percent of the treatment volume specified in subparagraph 2., above, whichever is greater.

(c) Provide the capacity for the appropriate treatment volume of stormwater specified in paragraphs (a) or (b), above, within 72 hours following a storm event. The storage volume must be provided by a decrease of stored water caused only by percolation through soil with subsequent transport through the underdrain pipes, evaporation or evapotranspiration.

(d) Provide at least two feet of indigenous soil between the bottom of the stormwater holding area and the underdrain pipe(s).

(e) Be designed with a safety factor of at least two unless the applicant affirmatively demonstrates based on plans, test results, calculations or other information that a lower safety factor is appropriate for the specific site conditions. Examples of how to apply this factor include but are not limited to reducing the design percolation rate by half or designing for the required drawdown within 36 hours instead of 72 hours.

(f) Contain areas of standing water only following a rainfall event.

(g) Be stabilized with permanent vegetative cover.

(h) Include, at a minimum, a capped and sealed inspection and cleanout ports which extend to the surface of the ground at the following locations of each drainage pipe:

1. The terminus; and

2. Every 400 feet or every bend of 45 or more degrees, whichever is less.

(i) Utilize filter fabric or other means used to prevent the soil from moving and being washed out through the underdrain pipe.

(3) Underground exfiltration trench systems shall:

(a) Provide for either of the following:

1. Off-line storage of the first one half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater; or

2. On-line storage of an additional one half inch of runoff from the drainage area over that volume specified in subparagraph 1., above.

(b) Provide either of the following for those exfiltration trench systems which have direct discharge to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, conditionally restricted for shellfish harvesting:

1. At least an additional fifty percent of the applicable treatment volume specified in subparagraph 1., above. Off-line storage must be provided for at least the first one half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated; or

2. On-line storage of the runoff from the three-year, one-hour storm or an additional fifty percent of the treatment volume specified in subparagraph 2., above, whichever is greater.

(c) Provide the capacity for the appropriate treatment volume of stormwater specified in paragraphs (a) or (b), above, within 72 hours following a storm event assuming average antecedent moisture conditions. The storage volume must be provided by a decrease of stored water caused only by percolation into the soil.

(d) Be designed with a safety factor of at least two unless the applicant affirmatively demonstrates based on plans, test results, calculations or other information that a lower safety factor is appropriate for the specific site conditions. Examples of how to apply this factor include but are not limited to reducing the design percolation rate by half or designing for the required drawdown within 36 hours instead of 72 hours.

(e) Be designed with a twelve (12) inch minimum pipe diameter.

(f) Be designed with a three (3) foot minimum trench width.

(g) Be designed so that aggregate in the trench is enclosed in filter fabric.

(h) Provide cleanout and inspection structures which extend to the surface of the ground at the inlet and terminus of each pipe. Inlet structures should include sediment sumps.

(i) Be designed so that the invert elevation of the trench must be at least two feet above the seasonal high ground water table elevation unless the applicant demonstrates based on plans, test results, calculations or other information that a alternative design is appropriate for the specific site conditions.

(j) Be designed so that the system must have the capacity to retain the required treatment volume without considering discharges to ground or surface waters.

(4) Wet detention stormwater management systems shall:

(a) Provide a treatment volume of the greater of the following:

1. First one inch of runoff; or

2. 2.5 inches of runoff from the impervious area.

(b) Be designed so that the outfall structures shall bleed down one-half the volume of stormwater specified in paragraph (a), above, within 48 to 60 hours following a storm event, but no more than one-half of this volume will be discharged within the first 48 hours.

(c) Contain a permanent pool of water sized to provide an average residence time of at least 14 days during the wet season (June - October).

(d)1. Provide a littoral zone to be designed as follows:

a. The littoral zone shall be gently sloped (6:1 or flatter). At least 30 percent of the wet detention system surface area shall consist of a littoral zone. The percentage of littoral zone is based on the ratio of vegetated littoral zone to surface area of the pond at the control elevation.

b. The treatment volume should not cause the pond level to rise more than 18 inches above the control elevation unless the applicant affirmatively demonstrates that the littoral zone vegetation can survive at greater depths.

c. Eighty percent coverage of the littoral zone by suitable aquatic plants is required within the first twenty-four months of completion of the system or as specified by permit conditions.

d. To meet the 80% coverage requirement, planting of the littoral zone is recommended. As an alternative, portions of the littoral zone may be established by placement of wetland top soils (at least a four inch depth) containing a seed source of desirable native plants. When utilizing this alternative, the littoral zone must be stabilized by mulching or other means and at least the portion of the littoral zone within 25 feet of the inlet and outlet structures must be planted.

2. In lieu of the requirements of subparagraph 1., above, the applicant may provide either of the following:

a. At least fifty percent additional permanent pool volume over that specified in paragraph (c), above; or

b. Treatment of the stormwater pursuant to subparagraphs 40C- 42.024(2)(b)2., 3., 4., or 6., F.A.C., prior to the stormwater entering the wet detention pond.

(e) Be designed so that the mean depth of the permanent pool is between 2 and 8 feet and the maximum depth does not exceed 12 feet below the invert of the bleed down device, unless the applicant affirmatively demonstrates that alternative depths will not inhibit the physical, chemical, and biological treatment processes or cause the resuspension of pollutants into the water column due to anaerobic conditions in the water column.

(f) Be designed so the flow path through the pond has an average length to width ratio of at least 2:1. The alignment and location of inlets and outlets should be designed to maximize flow paths in the pond. If short flow paths are unavoidable, the effective flow path should be increased by adding diversion barriers such as islands, peninsulas, or baffles to the pond. Inlet structures shall be designed to dissipate the energy of water entering the pond.

(g) Be designed so that bleed down devices incorporating dimensions smaller than three inches minimum width or less than 20 degrees for "v" notches shall include a device to eliminate clogging. Examples include baffles, grates, and pipe elbows.

(h) Be designed so that bleed down structure invert elevations are at or above the estimated post-development normal ground water table elevation. If the structure is proposed to be set below this elevation, ground water inflow must be considered in the drawdown calculations, calculation of average residence time, estimated normal water level in the pond, and pollution removal efficiency of the system.

(i) Provide for permanent maintenance easements or other acceptable legal instruments to allow for access to and maintenance of the system, including the pond, littoral zone, inlets, and outlets. The easement or other acceptable instrument must cover the entire littoral zone.

(j) Be designed so that the average pond side slope measured between the control elevation and two feet below the control elevation is no steeper than 3:1 (horizontal:vertical).

(k) Wet detention systems which have direct discharge to Class I, Class II Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting shall provide either of the following in addition to the requirements in paragraphs (b), (d), and (e) - (j), above:

1. An additional fifty percent of the applicable treatment volume specified in paragraph (a), above, and an additional fifty percent of the applicable permanent pool volumes specified in paragraphs (c) or subparagraph (d)2., above; or

2. Treatment pursuant to subsections (1), (2), (3) above, or (5) below, prior to discharging into a wet detention pond designed pursuant to paragraphs (a) - (j), above.

(5) Swale systems shall:

(a) Percolate 80% of the runoff from the three year, one-hour storm.

(b) Percolate the runoff from the three-year, one-hour storm for those swale systems which have direct discharge to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting.

(c) Provide the capacity for the given volume of stormwater pursuant to paragraphs (a) or (b), above, and contain no contiguous areas of standing or flowing water within 72 hours following the storm event referenced in paragraphs (a) and (b), above, assuming average antecedent moisture conditions. The storage volume must be provided by a decrease of stored water caused only by percolation through soil, evaporation or evapotranspiration.

(d) Meet the criteria in subsection 40C-42.021(29), F.A.C.

(6) Dry detention systems shall:

(a) Provide off-line detention of the first one inch of runoff or 2.5 inches of runoff from the impervious area, whichever is greater.

(b) Provide at least an additional fifty percent of the applicable treatment volume specified in subparagraph 1., above, for those systems which have direct discharge to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting.

(c) Be designed so that the outfall structures shall discharge one-half the appropriate treatment volume of stormwater specified in paragraphs (a) or (b), above, between 24 to 30 hours following a storm event.

(d) Be designed so that discharge structures shall include a device to prevent the discharge of accumulated sediment, minimize exit velocities, and prevent clogging. Examples include perforated riser enclosed in a gravel jacket and perforated pipes enclosed in sand or gravel.

(e) Contain areas of standing water for no longer than 3 days following a rainfall event.

(f) Be stabilized with permanent vegetative cover.

(g) Be designed so the average flow path through the basin has a length to width ratio of at least 2:1. The alignment and location of inlets and outlets should be designed to maximize flow paths in the basin. If short flow paths are unavoidable, the effective flow path should be increased by adding diversion barriers such as baffles to the basin.

(h) Be designed so inlet structures dissipate the energy of water entering the basin.

(i) Be designed to include a maintenance schedule for removal of sediment and debris on at least a bi-monthly basis from the basin and mowing and removal of grass clippings.

(j) Be designed so the basin floor is level or uniformly sloped toward the outfall structure.

(k) Be designed so that the basin floor and control elevation is at least one foot above the seasonal high ground water table elevation. Sumps may be placed up to one foot below the control elevation.

Specific Authority 373.044, 373.113, 373.118, 373.177, 373.418 FS. Law Implemented 373.413, 373.416, 403.813 FS. History--New 9-25-91. Amended 3-21-93, 6-15-93, 4-11-94, 7-20-95.

40C-42.0265 Design and Performance Criteria for Wetlands Stormwater Management Systems.

(1) The wetlands stormwater management system design and performance criteria and other provisions relating to such systems are an initial but necessary step by the District in a field in which there exists limited knowledge. In an effort to further refine the District's wetlands stormwater management system policies, monitoring data and other pertinent information relating to the performance criteria will be collected and analyzed and periodic reports of the results of this

monitoring shall be made available to the public. The District must attempt to ensure that the wetlands stormwater management system is compatible with the ecological characteristics of the wetlands utilized for stormwater treatment and to ensure that water quality standards will not be violated by discharges from wetlands stormwater management system. To achieve these goals, specific performance criteria are set forth in this section for systems which incorporate wetlands for stormwater treatment.

(2) The only wetlands to be used for stormwater treatment are those:

(a) Which are isolated wetlands; and

(b) Which would be isolated wetlands, but for a hydrologic connection to other wetlands or surface waters via another watercourse that was excavated through uplands.

(3) Applications for wetland stormwater management systems shall be processed by the District as an individual permit application according to the administrative procedures set forth in chapter 40C-4, F.A.C.

(4) In the review of wetlands stormwater management system permit applications, the District shall consider the following:

(a) Compliance of the wetlands stormwater management system permit with the performance criteria specified in subsection 40C-42.0265(5).

(b) If the applicant is unable to show compliance with the performance criteria in subsection 40C-42.0265(5), the applicant shall qualify for a wetlands stormwater management system permit using alternative design and performance criteria if the applicant affirmatively demonstrates that the use of the wetlands is compatible with the ecological characteristics of the wetland and the applicant complies with the standards in section 40C-42.023, F.A.C.

(c) If the applicant proposes to dredge or fill in the wetlands used for stormwater treatment, the District in its review of the permit application shall evaluate the adverse effects of the dredging or filling on the treatment capability of the wetland.

(5) A showing by the applicant that the wetlands stormwater management system design complies with the performance criteria listed below shall create a presumption in favor of the issuance of the permit:

(a) The system complies with the requirements of section 40C-42.025 and subsection 40C-42.0265(2), F.A.C.

(b) The system is part of a comprehensive stormwater management system that utilizes wetlands in combination with other best management practices to provide treatment of the runoff from the greater of the following:

1. First one inch of runoff; or
2. 2.5 inches times the impervious area.

(c) Those systems which direct discharge to Class I, Class II, or Outstanding Florida Waters shall provide an additional fifty percent of the applicable treatment volume specified in paragraph (b), above.

(d) The wetlands stormwater management system must provide treatment for the runoff as specified in paragraph 40C-42.0265(5)(b) or (c), F.A.C., within the wetlands. The design features of the system shall maximize residence time of the stormwater within the wetland. The outfall structure shall be designed to bleed down one-half the volume specified in paragraph 40C-42.0265(5)(b) or (c) within the first 60 to 72 hours.

(e) Stormwater shall be discharged into the wetlands utilized so as to minimize the channelized flow of stormwater by employing methods including, but not limited to, sprinklers, overland flow or spreader swales.

(f) The use of wetlands for stormwater must meet the criteria in section 12.0, Environmental Considerations, of the Applicant's Handbook: Management and Storage of Surface Waters, adopted by reference in section 40C-4.091, F.A.C.

(6) In order to establish a reliable, scientifically valid data base upon which to evaluate the performance criteria and the performance of the wetlands stormwater management system, a monitoring program may be required. Monitoring programs shall provide the District with comparable data for different types of wetlands and drainage designs. Data to be collected shall include (unless irrelevant to the permitted system): sedimentation rate, sediment trace metal concentrations, sediment nitrogen and phosphorus concentrations, changes in the frequency, abundance and distribution of vegetation, and inflow and outflow water quality for nutrients, metals, turbidity, oils and greases, bacteria and other parameters related to the specific site conditions. Inflow and outflow water quality parameters will be monitored on such storm event occurrences as established by the District based on a site specific basis. The District shall eliminate the requirement to continue the monitoring program upon its determination that no further data is necessary to evaluate the performance criteria or ensure compliance with the performance criteria and applicable water quality standards.

Specific Authority 373.044, 373.113, 373.177, 373.418 FS. Law Implemented 373.413, 373.416 FS. History--New 9-25-91, 3-21-93, 10-3-95.

40C-42.027 Legal Operation and Maintenance Entity Requirements.

(1) The District considers the following entities to be acceptable for meeting the requirements necessary to ensure that a stormwater management system will be operated and maintained in compliance with the requirements of this Chapter and other District regulations in chapters 40C-4 or 40C-40, F.A.C.:

(a) Local governmental units including counties or municipalities, or Municipal Service Taxing Units established pursuant to section 125.01, F.S.;

(b) Active water control districts created pursuant to chapter 298, F.S., or drainage districts created by special act, or Community Development Districts created pursuant to chapter 190, F.S., or Special Assessment Districts created pursuant to chapter 170, F.S.;

(c) State or federal agencies; or

(d) Duly constituted stormwater, communication, water, sewer, electrical or other public utilities.

(2) The property owner or developer is normally not acceptable as a responsible entity when the property is intended to be subdivided. The property owner or developer shall be acceptable in any of the following circumstances:

(a) Written proof is furnished either by letter or resolution, that a governmental entity or such other acceptable entity as set forth in paragraphs (a)-(d) above, will accept the operation and maintenance of the stormwater management system at a time certain in the future;

(b) Proof of bonding or assurance of a similar nature is furnished in an amount sufficient to cover the cost of the operation and maintenance of the stormwater management system;

(c) The property is wholly owned by the permittee and ownership is intended to be retained. This would apply to a farm, corporate office or single industrial facility, for example; or

(d) The ownership of the property is retained by the permittee and is either leased or rented to third parties such as in shopping centers or mobile home parks.

(3) Profit or non-profit corporations including homeowners associations, property owners associations, condominium owners associations or master associations shall be acceptable only under certain conditions that ensure that the corporation has the financial, legal and administrative capability to provide for the long term operation and maintenance of the stormwater management system.

(4) Entity Requirements.

(a) If a multimember association such as a Homeowner, Property Owner, Condominium or Master Association is proposed, the owner or developer must submit Articles of Incorporation for the Association, and Declaration of Covenants and Restrictions, or such other organizational and operational documents which affirmatively assign authority and responsibility for the operation or maintenance of the stormwater management system.

(b) The Association shall have sufficient powers reflected in its organizational or operational documents to:

1. Operate and maintain the stormwater management system as permitted or exempted by the District;

2. Establish rules and regulations;

3. Assess members a fee for the cost of operation and maintenance of the system, and enforce collection of such assessments;

4. Contract for services (if the Association contemplates employing a maintenance company) to provide the services for operation and maintenance;

5. Exist in perpetuity. The Articles of Incorporation must provide that if the association is dissolved the stormwater management system shall be transferred to and maintained by an entity acceptable to the District as defined in this section. Transfer of maintenance responsibility shall be effectuated prior to dissolution of the association;

6. Enforce the restrictions relating to the operation and maintenance of the stormwater management system;

7. Provide that the portions of the Declarations which relate to the operation and maintenance may be enforced by the District in a proceeding at law or in equity; and

8. Require that amendments to the documents which alter the stormwater management system beyond maintenance in its original condition must receive District approval prior to taking effect.

(5) Phased Projects.

(a) If an Operation and Maintenance entity is proposed for a project which will be constructed in phases, and subsequent phases will utilize the same stormwater management systems as the initial phase or phases, the entity shall have the ability to accept responsibility for the operation and maintenance of stormwater management system for future phases of the project.

(b) If the development scheme contemplates independent operation and maintenance entities for different phases, and the stormwater management system is integrated throughout the project, the entities either separately or collectively shall have the authority and responsibility to operate and maintain the stormwater management system for the entire project. That authority shall include cross easements for stormwater management and the ability to enter and maintain the various systems, should any sub-entity fail to maintain a portion of the stormwater management system within the project.

(6) The applicant shall be an acceptable entity from the time construction begins until the stormwater management system is dedicated to and accepted by a legal entity established pursuant to this section. The applicant shall provide proof of the existence of an entity pursuant to this section or of the future acceptance of the system by an entity described in this section prior to initiating construction.

Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 403.812, 403.814 FS. History--New 4-1-86. Amended 9-25-91, 3-21-93.

40C-42.028 Operation Phase Permits.

(1) The operation phase of a stormwater management system permit which was designed by an appropriate registered professional does not become effective until all of the following criteria in this subsection and subsection (3) have occurred:

(a) Within 30 days after completion of construction of the stormwater management system, permittee shall submit a signed and sealed certification by an appropriate registered professional indicating that the system has been constructed and that the system is ready for inspection by the District.

(b) The certification prepared by a registered professional (not necessarily the project design registered professional but one who has been retained by the permittee to provide professional services during the construction phase of project completion) shall be made on form number 40C-1.181(13), As Built Certification by a Registered Professional.

(c) The registered professional shall certify that:

1. The system has been constructed substantially in accordance with approved plans and specifications, or;

2. Any deviations from the approved plans and specifications will not prevent the system from functioning in compliance with the requirements of this chapter. The registered professional shall note and explain substantial deviations from the approved plans and specifications and provide two copies of as-built drawings to the District.

(d) The certification shall be based upon on-site observation of construction (scheduled and conducted by the professional or by a project representative under his or her direct supervision) or review of as-built drawings for the purpose of determining if the work was completed in compliance with approved plans and specifications.

(e) As-built drawings shall be the permitted drawings revised to reflect any changes made during construction. Both the original and revised specifications must be clearly shown. The plans must be clearly labeled as "as-built" or "record" drawings. All surveyed dimensions and elevations required shall be certified by a registered surveyor. The following information, at a minimum, shall be verified on the as-built drawings:

1. Dimensions and elevations of all discharge structures including all weirs, slots, gates pumps, pipes, and oil and grease skimmers;

2. Locations, dimensions, and elevations of all filter, exfiltration, or underdrain systems including cleanouts, pipes, connections to control structures, and points of discharge to the receiving waters;

3. Dimensions, elevations, contours, or cross-sections of all treatment storage areas sufficient to determine stage-storage relationships of the storage area and the permanent pool depth and volume below the control elevation for normally wet systems, when appropriate;

4. Dimensions, elevations, contours, final grades, or cross-sections of the system to determine flow directions and conveyance of runoff to the treatment system;

5. Dimensions, elevations, contours, final grades, or cross-sections of all conveyance systems utilized to convey off-site runoff around the system;

6. Existing water elevation(s) and the date determined; and

7. Elevation and location of benchmark(s) for the survey.

(2) The operation phase of a stormwater management system permit which was not designed by an appropriate registered professional does not become effective until all of the criteria in this subsection, and subsection (3) below, have occurred. Within 30 days after completion of construction of the stormwater management system, permittee shall submit a certification, on form number 40C-1.181(14), As Built Certification, that the system has been constructed in accordance with the design approved by the District and shall notify the District that the system is ready for inspection.

(3) The permittee shall submit documentation to the District showing that adequate provisions have been made for the operation and maintenance of the system and for meeting any special permit conditions. Entities which qualify to operate and maintain systems for purposes of this rule are listed at section 40C-42.027, supra. Documentation must include an affirmative indication that the entity intends to or agrees to take over maintenance responsibility for the system, unless the transfer is associated with the conversion of the construction permit to its operation phase and the maintenenac entity exists as approved under the permit.

(4) The permit will be converted from a construction permit to an operation permit once the project is determined to be in compliance with the permitted plans and an appropriate entity exists for maintenance of the system. The District will transfer the permit to the maintenance entity upon request, pursuant to section 40C-4.351, F.A.C., once all conditions for converting the construction permit to an operation permit have been met.

Specific Authority 373.044, 373.113, 373.171, 373.418 FS. Law Implemented 373.413, 373.416 FS. History--New 9-25-91, 3-21-93. Amended 7-20-95.

40C-42.029 Monitoring and Operational Maintenance Requirements.

(1) The operation and maintenance entity is required to provide for periodic inspections of the stormwater management system to insure that the system is functioning as designed and permitted. The entity shall submit inspection reports to the District, certifying that the stormwater management system is operating as designed. In addition, the entity will state in the report what operational maintenance has been performed on the system. The reports shall only be required for those systems which are subject to operation phase permits pursuant to subsection 40C-42.028(1),

F.A.C., after the effective date of this rule adoption, unless indicated otherwise in a permit. The reports shall be submitted to the District as follows unless otherwise required by a permit condition:

(a) Inspection reports for retention, underdrain, wet detention, swales, and wetland stormwater management systems shall be submitted two years after the completion of construction and every two years thereafter on form number 40C-1.181(15), Registered Professional's Inspection Report, for systems designed by a registered professional. For systems not designed by a registered professional, the inspection reports shall be submitted on form number 40C-1.181(16), Statement of Inspection Report. However, reports for those systems in sensitive karst areas must be submitted pursuant to paragraph (c) below.

(b) Inspection reports for dry detention, exfiltration, and pumped systems shall be submitted one year after the completion of construction and every two years thereafter on form number 40C-1.181(15), Registered Professional's Inspection Report. A registered professional must sign and seal the report certifying the dry detention, filtration, exfiltration, or pumped system is operating as designed. However, reports for those systems in sensitive karst areas must be submitted pursuant to paragraph (c) below.

(c) Systems in sensitive karst areas must be inspected monthly for the occurrence of sinkholes and solution pipes. The inspection reports for these systems must be submitted to the District annually on form number 40C-1.181(15), Registered Professional's Inspection Report, for systems designed by a registered professional. For systems not designed by a registered professional, the inspection reports shall be submitted on form number 40C-1.181(16), Statement of Inspection Report.

(2) Permittees which operate stormwater management systems that are designed and constructed to accept stormwater from multiple parcels within the drainage area served by the system shall notify the District annually of the stormwater discharge volumes of all new parcels which have been allowed to discharge into the system in the previous year and shall certify that the maximum allowable treatment volume of stormwater has not been exceeded.

(3) The following operational maintenance activities shall be performed on all permitted systems on a regular basis or as needed:

(a) Removal of trash and debris,

(b) Inspection of inlets and outlets,

(c) Removal of sediments when the storage volume or conveyance capacity of the stormwater management system is below design levels, and

(d) Stabilization and restoration of eroded areas.

(4) Specific operational maintenance activities are required, depending on the type of permitted system, in addition to the practices listed in subsection (3), above.

(a) Retention, swale and underdrain systems shall include provisions for:

1. Mowing and removal of grass clippings, and

2. Aeration, tilling, or replacement of topsoil as needed to restore the percolation capability of the system. If tilling or replacement of the topsoil is utilized, vegetation must be established on the disturbed surfaces.

(b) Exfiltration systems shall include provisions for removal of sediment and debris from sediment sumps.

(c) Wet detention systems shall include provisions for operational maintenance of the littoral zone. Replanting shall be required if the percentage of vegetative cover falls below the permitted level. It is recommended that native vegetation be maintained in the littoral zone as part of the system's operation and maintenance plan. Undesirable species such as cattail and exotic plants should be controlled if they become a nuisance.

(d) Dry detention systems shall include provisions for mowing and removal of grass clippings

(e) Systems in sensitive karst areas shall include provisions for the repair of any sinkhole or solution pipe that develops in the system.

(5) If the system is not functioning as designed and permitted, operational maintenance must be performed immediately to restore the system. If operational maintenance measures are insufficient to enable the system to meet the design and performance standards of this chapter, the permittee must either replace the system or construct an alternative design. A permit modification must be obtained from the District prior to constructing such alternative design pursuant to section 40C-4.331, F.A.C.

Specific Authority 373.044, 373.113, 373.171, 373.418 FS. Law Implemented 373.413, 373.416 FS. History--New 9-25-91. Amended 3-21-93, 4-11-94.

40C-42.031 Exemptions for Stormwater Management Systems.

Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 403.812, 403.814 FS, History--New 4-1-86. Amended 8-11-91. Repealed 9-25-91.

40C-42.032 Limiting Conditions.

(1) The Governing Board shall impose upon any permit granted pursuant to this Chapter such reasonable conditions as are necessary to assure that construction and operation of the permitted system will not be inconsistent with the District's permitting standards set forth in section 40C-42.023, F.A.C., and will not be harmful to the water resources of the District.

(2)(a) In addition to project-specific special conditions, the following standard limiting conditions shall be attached to all permits issued pursuant to this Chapter unless waived by the Board upon a determination that the conditions are inapplicable for the work authorized by a given permit:

1. This permit for construction will expire five years from the date of issuance unless otherwise specified by a special condition of the permit.

2. Permittee must obtain a permit from the District prior to beginning construction of subsequent phases or any other work associated with this project not specifically authorized by this permit.

3. Before any offsite discharge from the stormwater management system occurs, the retention and detention storage must be excavated to rough grade prior to building construction or placement of impervious surface within the area served by those systems. Adequate measures must be taken to prevent siltation of these treatment systems and control structures during construction or siltation must be removed prior to final grading and stabilization.

4. The permittee must maintain a copy of this permit complete with all conditions, attachments, exhibits, and permit modifications, in good condition at the construction site. The

complete permit must be available for review upon request by District representatives. The permittee shall require the contractor to review the complete permit prior to commencement of the activity authorized by this permit.

5. All activities shall be implemented as set forth in the plans, specifications and performance criteria as approved by this permit. Any deviation from the permitted activity and the conditions for undertaking that activity shall be considered a violation of this permit.

6. District authorized staff, upon proper identification, must be granted permission to enter, inspect and observe the system to insure conformity with the plans and specifications approved by the permit.

7. Prior to and during construction, the permittee shall implement and maintain all erosion and sediment control measures (best management practices) required to retain sediment on-site and to prevent violations of state water quality standards. All practices must be in accordance with the guidelines and specifications in chapter 6 of the Florida Land Development Manual: A Guide to Sound Land and Water Management (Florida Department of Environmental Regulation 1988), which are hereby incroporated by reference, unless a project specific erosion and sediment control plan is approved as part of the permit, in which case the practices must be in accordance with the plan. If site specific conditions require additional measures during any phase of construction or operation to prevent erosion or control sediment, beyond those specified in the erosion and sediment control plan, the permittee shall implement additional best management practices as necessary, in accordance with the specifications in chapter 6 of the Florida Land Development Manual: A Guide to Sound Land and Water Management (Florida Department of Environmental Regulation 1988). The permittee shall correct any erosion or shoaling that causes adverse impacts to the water resources.

8. If the permitted system was designed by a registered professional, within 30 days after completion of the stormwater system, the permittee must submit to the District the following: District Form No. 40C-1.181(13) (As Built Certification By a Registered Professional), signed and sealed by an appropriate professional registered in the State of Florida, and two (2) sets of "As Built" drawings when a) required by a special condition of this permit, b) the professional uses "As Built" drawings to support the As Built Certification, or c) when the completed system substantially differs from permitted plans. This submittal will serve to notify the District staff that the system is ready for inspection and approval.

9. If the permitted system was not designed by a registered professional, within 30 days after completion of the stormwater system, the permittee must submit to the District the following: District Form No. 40C-1.181(14) (As Built Certification), signed by the permittee and two (2) sets of "As Built" drawings when required by a special condition of this permit, or when the completed system substantially differs from permitted plans. This submittal will serve to notify the District staff that the system is ready for inspection and approval.

10. Stabilization measures shall be initiated for erosion and sediment control on disturbed areas as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than seven (7) days after the construction activity in that portion of the site has temporarily or permanently ceased.

11. Should any other regulatory agency require changes to the permitted system, the permittee shall provide written notification to the District of the changes prior to implementation so that a determination can be made whether a permit modification is required.

12. Within thirty (30) days after sale or conveyance of the permitted stormwater management system or the real property on which the system is located, the owner in whose name the permit was granted shall notify the District of such change of ownership. Transfer of this permit shall be in accordance with the provisions of section 40C-1.612, Florida Administrative Code. All terms and conditions of this permit shall be binding upon the transferee. The permittee transferring the permit shall remain liable for any corrective actions that may be required as a result of any permit violations prior to such sale, conveyance or other transfer.

13. The stormwater management system must be completed in accordance with the permitted plans and permit conditions prior to the initiation of the permitted use of site infrastructure. The system must be completed in accordance with the permitted plans and permit conditions prior to transfer of responsibility for operation and maintenance of the stormwater management system to a local government or other responsible entity.

14. The operation phase of the permit shall not become effective until the requirements of condition No. 8 or 9 have been met, the District determines that the system complies with the permitted plans, and the entity approved by the District in accordance with section 40C-42.027, F.A.C., accepts responsibility for operation and maintenance of the system. The permit cannot be transferred to such an approved responsible operation and maintenance entity until the requirements of section 40C-42.028, F.A.C., are met, and the operation phase of the permit becomes effective. Following inspection and approval of the permitted system by the District in accordance with section 40C-42.028, F.A.C., the permittee shall request transfer of the permit to the responsible approved operation and maintenance entity, if different from the permittee. Until the permit is transferred pursuant to subsection 40C-42.028(4), F.A.C., the permittee shall be liable for compliance with the terms of the permit.

15. Prior to lot or unit sales, or upon completion of construction of the system, whichever occurs first, the District must receive the final operation and maintenance document(s) approved by the District and recorded, if the latter is appropriate. For those systems which are proposed to be maintained by county or municipal entities, final operation and maintenance documents must be received by the District when maintenance and operation of the system is accepted by the local government entity. Failure to submit the appropriate final document will result in the permittee remaining personally liable for carrying out maintenance and operation of the permitted system.

16. This permit does not eliminate the necessity to obtain any required federal, state, local and special district authorizations prior to the start of any activity approved by this permit. This permit does not convey to the permittee or create in the permittee any property right, or any interest in real property, nor does it authorize any entrance upon or activities on property which is not owned or controlled by the permittee, or convey any rights or privileges other than those specified in the permit and Chapter 40C-42, F.A.C.

17. The permittee shall hold and save the District harmless from any and all damages, claims, or liabilities which may arise by reason of the activities authorized by the permit or any use of the permitted system.

18. The permittee shall immediately notify the District in writing of any previously submitted information that is later discovered to be inaccurate.

19. Activities approved by this permit shall be conducted in a manner which do not cause violations of state water quality standards.

(b) This section shall not be construed as a limitation on the authority of the Board to impose such other limiting conditions as may be necessary in order to assure that the permitted system is consistent with the requirements for issuance listed in section 40C-42.023, F.A.C.
Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 373.409, 373.413, 373.416, 373.419, 373.423, 373.426 FS. History--New 3-21-93, 10-3-95.

40C-42.033 Implementation.

(1) This chapter shall become effective on September 25, 1991.

(2)(a) Each construction permit issued under chapter 40C-42, F.A.C., prior to the effective date of this rule shall remain valid according to its terms.

(b) Each construction permit application which is filed with the District prior to the effective date of this rule will be processed and evaluated under the rules implemented on April 1, 1986.

(c) Each construction permit application which is not filed with the District prior to September 25, 1991, will be processed and evaluated according to the rule provisions implemented on September 25, 1991.

(3) If the validity of any provisions of chapter 40C-42, F.A.C., or the application thereof to any person or circumstance is challenged pursuant to Chapter 120 or 373, F.S., or pursuant to any other basis in law, it is the intent of the Governing Board of the St. Johns River Water Management District that neither a challenge to the validity of a provision or application thereof nor the invalidation of a provision or application thereof shall affect the validity or application of other provisions of the rule which can be given effect without the challenged or invalidated provision or application and to this end the provisions of chapter 40C-42, F.A.C., are declared severable.
Specific Authority 373.044, 373.113, 373.171, 373.429 FS. Law Implemented 373.416 FS. History--New 9-25-91.

40C-42.035 Stormwater General Permits.
Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 403.812, 403.814 FS. History--New 4-1-86. Repealed 9-25-91.

40C-42.041 Individual Permit Requirements for New Stormwater Discharge Facilities.
Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 403.812, 403.814 FS. History--New 4-1-86. Repealed 9-25-91.

40C-42.061 Relationship to Other Permitting Requirements.

(1) Whenever the construction, alteration, removal, operation, maintenance, or abandonment of a stormwater management system requires that an environmental resource permit be secured pursuant to Chapters 40C-4 or 40C-40 , F.A.C., the requirements in this chapter shall be reviewed as part of those permit applications. A separate permit application under this chapter shall not be required. However, the applicant must provide the required technical information as part of those applications to demonstrate compliance with this chapter. If the applicant requests a separate environmental resource stormwater permit, the applicant must notify the District of any other District permits, exemptions, or certifications which have or will be requested for the project.

(2) When a permit is required pursuant to this chapter and an individual environmental resource permit is required pursuant to chapter 40C-4 for the same system, the time frames of chapter 40C-4 shall apply to issuance of a permit under section 40C-42.024(2), F.A.C.

(3) This rule does not apply to any stormwater discharge facility listed in (a) and (b) below, unless such facility is modified pursuant to section 40C-42.024, F.A.C.:

(a) Which was in existence on February 1, 1982; or

(b) Which was permitted, modified, or found to be exempt, under Chapter 62-25, F.A.C., by the Department of Environmental Regulation (DER) after February 1, 1982, but prior to April 1, 1986, provided the facility was constructed in accordance with the DER permit or exemption, and is functioning in accordance with the requirements of chapter 62-25, F.A.C.

(4) The operation phase permit requirements set forth in subsection 40C-42.028(1), F.A.C., shall not apply to systems permitted and found to be in compliance with all rule requirements prior to the effective date of this rule.

(5) Applications for conceptual agency review of stormwater management systems, as required by section 380.06, F.S., will be reviewed in accordance with the procedure used by the District to review conceptual approval permit applications pursuant to subsection 40C-4.041(2), F.A.C.

(6) Systems for agricultural lands will be regulated under chapter 40C-44, F.A.C.

Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 373.413, 373.416, 380.06(9) FS. History--New 4-1-86. Amended 9-25-91, 3-21-93, 4-11-94, 7-20-95, 8-3-95.

40C-42.071 Permit Processing Fee. There shall be a non-refundable permit processing fee as specified by section 40C-1.603, F.A.C., payable to the District at the time that an application for a permit is submitted.

Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 373.109, 373.113 FS. History--New 4-1-86. Amended 9-25-91.

40C-42.081 General Provisions. Nothing under this chapter shall preclude:

(1) Stormwater effects from being considered in the evaluation of other types of permits where such consideration is relevant to a determination of compliance with applicable District requirements.

(2) The legal joinder in a permitting proceeding under this chapter of any person who owns or controls an unpermitted stormwater management system or systems which comprise a significant portion of the stormwater management system.

(3) The District from taking appropriate legal action including but not limited to the requiring of a permit to prevent the impairment of a use for which a water of the state has been designated under chapter 62-3, F.A.C.

(4) The District from entering interagency or interlocal agreements to accomplish the provisions of this chapter.

Specific Authority 373.044, 373.113, 373.171 FS. Law Implemented 403.812, 403.814 FS. History--New 4-1-86. Amended 9-25-91.

40C-42.091 Publications Incorporated by Reference.

(1) The Governing Board adopts by reference Part I "Policy and Procedures", Part II, "Criteria for Evaluation", and Part III "Operation and Maintenance", of the document entitled "Applicant's Handbook: Regulation of Stormwater Management Systems, Chapter 40C-42, F.A.C.", effective 10-3-95.

(2) This document provides information regarding the stormwater management system permitting program

(3) A copy of this document may be obtained by contacting:
Director, Division of Permitting Data Services,
St. Johns River Water Management District,
P.O. Box 1429,
Palatka, Florida 32178-1429

St. Johns River Water Management District,
7775 Baymeadows Way, Suite 102
Jacksonville, Florida 32256

St. Johns River Water Management District,
618 East South Street, Suite 200,
Orlando, Florida 32801

St. Johns River Water Management District,
305 East Drive,
Melbourne, Florida 32904

Specific Authority 120.54(8), 373.044, 373.113, 373.171, 373.418 F.S. Law Implemented 373.413, 373.416, 373.426. History--New 4-11-94. Amended 7-20-95, 10-3-95.

40C-42.900 Forms and Instructions. The following forms and instructions incorporated by reference have been approved the Governing Board and are available upon request from:

Department of Resource Management
St. Johns River Water Management District
P.O.Box 1429
Palatka, Florida 32178-1429.

(1) Joint Application For Environmental Resource Permit/Authorization to Use State Lands/Federal Dredge and Fill Permit , form number 40C-4.900(1) adopted 10-3-95 .

(2) As Built Certification by a Registered Professional, form number 40C-1.181(13), adopted March 21, 1993.

(3) As Built Certification, form number 40C-1.181(14), adopted 3-21-93.

(4) Registered Professional's Inspection Report, form number 40C-1.181(15), adopted 3-21-93.

(5) Statement of Inspection Report, form number 40C-1.181(16), adopted 3-21-93.

Specific Authority 120.53(1), 373.044, 373.113, 373.118 FS. Law Implemented 120.52(16), 120.53(1), 373.085, 373.116, 373.118, 373.103, 373.106, 373.229, 373.413 FS. History--New 5-30-90. Amended 9-25-91, 3-21-93, 2-27-94, 10-3-95.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

LOS ANGELES REGION

SERVING COASTAL LOS ANGELES & VENTURA COUNTIES

TRANSCRIPT OF PROCEEDINGS

Wednesday, June 30, 1999

9:05 A.M.

RICHARD H. CHAMBERS U.S. COURT OF APPEALS BUILDING
125 South Grand Avenue, Main Courtroom #3
Pasadena, California

REPORTED BY:
Lori D. Casillas,
CSR No. 9869, RPR
Our File No. 1-57224

APPEARANCES:

BOARD MEMBERS:

H. David Nahai, Chairman
Fran B. Diamond
Jack J. Coe, Ph.D., P.E.
Michael Keston
Marilyn Lyon

STAFF:

Dennis Dickerson
Deborah Smith
James KuyKendall
Robyn Goodman
Ronji Harris
Pat Guokas
J.T. Liu
Jorge Leon

P R O C E E D I N G S

* * *

MS. GOODMAN: This is a public meeting to consider Board action for the following proposed requirements; Item 9.1, City of Redondo Beach (Seaside Lagoon); Item 9.5, EXXON Company, U.S.A.; and Item 10.2, County Sanitation Districts of Los Angeles County (Puente Hills Landfill Corrective Action Program for Main Canyon).

Copies of these requirements were sent to the State Water Resources Control Board and other interested agencies, persons, and organizations. The order of presentation of testimony will be the discharger, public agencies, other interested agencies and groups. Anyone so desiring will be heard.

If you haven't filled out one of the blue cards located on the table at the back of the room, please raise your hand and we will get a card for you to fill out.

It will be appreciated if all persons appearing before the Board today will leave written copies of their testimony, if available. The Board will consider all testimony, however, in the interest of time it is requested that all repetitive and redundant statements be avoided.

The setting of time limits for the presentation of evidence is at the discretion of the Board.

Mr. Chairman, we now open the meeting.

MR. NAHAI: Could I ask everyone who is going to give testimony with respect to Items 9.1, 9.5 and 10.2 to rise, please, and repeat after me.

(Oath was given.)

MR. NAHAI: Thank you.

So the first matter is 9.1. And could we have the staff presentation?

MR. DASKER: Good morning, Mr. Chairman. My name is Dennis Dasker. I'm chief of the Watershed Regulatory Section. My business address is 320 West Fourth Street, Suite 200, Los Angeles, 90013. Also present today are Wendy Dusane and Mazhar Ali who worked on the presentation.

The City of Redondo Beach has a seaside lagoon, which is located at 200 Portifino Way in Redondo Beach. This is a man-made swimming lagoon which was constructed over 30 years ago. It is open from Memorial Day until Labor Day for public use. And it has a surface area of about 1.2 acres and contains about 1.4 million gallons of water.

The water supplied to it is from an adjacent power plant, it's the old Southern California Edison power plant, which is now the ADS LLC power plant. They tap off their cooling water discharge line and they supply about 2.3 million gallons per day of water to the Seaside Lagoon. The water is -- they add a disinfection to it, sodium hydrochloride, and a disinfectant prior to being discharged to King Harbor.

The intent requirements that we prepared limit coliforms, BOD, and reduce residual chlorine. We received telephone comments from Heal the Bay, which they commented that since the discharge from the power plant also at times includes low-volume waste, they felt that they should be excluded from being picked off and placed into the swimming lagoon. And actually we do agree with that.

They also suggested that intracaucus be used as an indicator organism in the monitoring program and that we place limitations on intracaucus.

We have prepared a change sheet which has been presented to you, which has a limitation for intracaucus; it also puts a specification in the permit that they not obtain water from the lagoon when AES is discharging, not including low-volume waste. And we also modified the monitoring program to conform to this.

So our recommendation is that the Board adopt the permit as modified by the change sheet.

MR. NAHAI: I don't have any cards from anybody else wishing to speak on this.

Do we have any questions from the Board?

MS. LYON: Were there any comments to the changes?

MR. DASKER: No, we have not, ma'am. They are agreeable to the changes.

MR. NAHAI: May we have a motion to approve?

MS. DIAMOND: I move to approve.

MS. LYON: Second.

MR. NAHAI: All in favor?

BOARD MEMBERS: Aye.

MR. NAHAI: Let's move on to Item No. 9.5.

MR. DASKER: Mr. Chairman, Board members, Dennis Dasker again. Business address is 320 West Fourth Street, Suite 200, Los Angeles, 90013. I'm the chief of the Watershed Regulatory Section. We also have Wayne Chiou and Dan Radulescu, the engineers that worked on this case.

This is EXXON Company, the Rancho Dominguez plant. This is a lubricant oil and grease manufacturing facility that indirectly discharges up to about 32,000 gallons per day of rainfall runoff which goes to Compton Creek.

The tentative order contains limitations to detect phenols, along with some other parameters. And the discharger has provided information to the Boards in comment letter that they do not have a reasonable potential to have detects in phenols in their effluent; and they also requested that those parameters be eliminated from the requirements; and also they requested that detoxicity be deleted from the effluent limitations.

We have looked into it. And we do agree that they do not have a reasonable potential for detect phenols; and we've provided you previously with a change sheet to remove those from the permit. Though we did feel that detoxicity should remain in the permit. And even though those parameters will be removed, they will still be monitored for those parameters.

The discharger also pointed out that they intermittently have approximately one gallon per day of (inaudible) and washdown water, which are also going to the discharge. So we are recommending in the change sheet that the findings be modified to identify the intermittent non-storm flow of one gallon per day of (inaudible) washdown water.

With that, the recommended tentative order be adopted as modified by the change sheet.

MR. NAHAI: Any questions?

I don't have any cards from any member of the public wishing to speak on this item.

So do we have a motion for approval?

MR. COE: I move for approval.

MR. NAHAI: Second?

MS. LYON: I second.

MR. NAHAI: All in favor?

BOARD MEMBERS: Aye.

MR. NAHAI: Motion carried.

Moving now to No. 10.2.

May we have the staff presentation?

MS. PONEK-BACHAROWSKI: Good morning, Mr. Chairman and Board members. My name is Blythe Ponek-Bacharowski and I'm an associate engineer geologist in the landfills unit on Board staff.

You'll notice that this item originally was supposed to be going consent as no written comments were received during the 30-day public comment period, with the exception of the current standards with the discharger submitted a letter to us. There was a very extensive mailing list. I just wanted you to be aware of that.

Item 10.2 is to modify the existing waste discharge requirements for the landfill to implement the discharger's proposed Corrective Action Program.

I'm going to give you a brief overview of the landfill and the state and federal regulations that govern the Corrective Action Program. And then the discharger will follow with a presentation for a Corrective Action Program.

The Puente Hills Landfill is a 1,365 acre nonhazardous solid waste landfill. It's the largest operating landfill in the western United States and at this time maybe in the world. And from 1957 to 1970 it was operated by the Pellisier Ranch as a small ranch and local dump site.

From 1970 to the present it was operated by the County Sanitation Districts of Los Angeles County. The landfill is bordered by the communities of Avocado Heights, Hacienda Heights, City of Industry and Whittier.

Here is an aerial map photo of the landfill showing the Main Canyon area, which is the subject of this Corrective Action Program. Canyon 9 and Eastern Canyons, which you see in green, are composite-lined areas of the landfill -- modern landfill and the Main Canyon is unlined.

You'll see kind of an orangy line to the north of Main Canyon; that orange line to the left is the subsurface barrier No. 3. And the larger orange line due north is subsurface barrier No. 1. These are both the subject of a Corrective Action Program.

Regional Board has had oversight on this site since 1957 through waste discharge requirements. The most current waste discharge requirements were adopted in 1990 for the Main Canyon area; 1993 were the waste discharge requirements for the Eastern Canyon expansion.

The waste discharge requirements had also been modified in 1993 by this federal Subtitle D requirements, which brought all landfills in line with the federal regulations.

The Regional Board staff approves all monitoring systems and all the programs, all the investigation work plans. They approve all containment structures, composite liners, and gas and groundwater extraction systems. Regional Board staff also approves all surface drainage systems and the closer/postclosure plans.

The Corrective Action Program is for the release of volatile organic compounds that have been detected in groundwater monitoring wells located downgradient of that older Main Canyon area, which is unlined, downgradient of the Barriers 1 and 3.

This is not unusual. We see this type of release of VOCs either from gas or leachate. Most commonly in unlined landfills. And that's, of course, the reason now that we require composite land systems.

The volatile organic concentrations range from below MCLs to about eight times MCLs. MCLs, of course, are drinking water standards.

To put this into prospective, the problems of VOC contamination from other industrial sources in the main San Gabriel basin, which of course, is the Superfund area, our whole investigation program works on that.

Those VOCs are anywhere from 100 to a 1,000 times drinking water standards. The plume extends approximately 200 feet to 350 feet from the subsurface barriers. And we feel that we have stabilized the plume at this point.

The tentative Waste Discharge Requirements before you will implement the dischargers proposed cleanup plan for these VOCs.

I would like to talk a little bit about the federal and state requirements for monitoring phases.

The first phase is Detection Monitoring Program; second is Evaluation Monitoring Program; and third is what our subject is today, the Corrective Action Program.

State and federal landfill regulations require that there be a monitoring system for groundwater, surface water and vadose zone; and that it be capable of detecting the earliest release from the landfill.

It also establishes site-specific water quality protection standards based on background water quality. The Waste Discharge Requirements for the landfill. We do have some of these water quality protection standards for EDS and sulfate, which the Board adopted in 1990.

We will present to you what we think the water quality protection standard should be for this volatile organic compound pollution that is coming from the landfill.

And Detection Monitoring Program also establishes minimum routine monitoring. These have been in place since the approval of both state and federal regulations and the Waste Discharge Requirements.

Once there has been a detection, the discharger is put into evaluation monitoring phase or program to determine the nature and extent of the release. It also has the discharger implement interim corrective action measures, including coordinated landfill gas control.

And the information derived from this Evaluation Monitoring Program helps to design a Corrective Action Program by conducting engineering feasibility studies to see what is the most appropriate remedy.

The discharger has explored some 20 plus of these technologies and have completed all these stages of the Evaluation Monitoring Program.

As part of this evaluation monitoring, I mentioned that there is Interim Corrective Action, or should be, in place. There has been Interim Corrective Action for sometime at the landfill by way of continuous groundwater extraction at the barrier system. This is why the barrier system is in place, it acts as an impedance. And once you extract the source water, you should not have any further source.

There were four additional extraction wells installed in the fall of 1996 at subsurface Barrier No. 1, which significantly improved the groundwater quality. And also, coordinated landfill gas extraction has been implemented.

The Corrective Action Program must be protective of human health and the environment; and must be capable of achieving compliance with the water quality protection standards that the Board adopts.

It also requires public participation. Of course, we have this public meeting today. But the discharger also conducted a public workshop that was held December of last year. It's interesting to know that there were no oral comments at all during that two-hour workshop, except from the discharger.

And the Corrective Action Program continues until the water quality correction standard is achieved. Once the Corrective Action Program has been in place and it has been successful, then once again you return to the detection monitoring to see if there is any further release.

The Board adopts the water quality protection standards or the cleanup goals in this matter. Current state and federal landfill regulation specify that the water quality protection standard should not exceed background concentrations, unless it's shown to be economically infeasible.

The background concentrations at this site are non-detect or essentially zero. And so our goal is to have the discharger clean up these volatile organics to background or non-detect.

As far as regulatory compliance, the discharger conducted an appropriate and relevant detection monitoring, which was capable of detecting the release of volatile organic compounds; and through that Evaluation Monitoring Program, the discharger has adequately determined the full lateral and vertical extent of the release of volatile organics.

The discharger is proposing a Corrective Action Program that uses regulatory criteria, both state and federal regulations. It is technically feasible, and we believe can achieve the water quality protection standards.

Staff's recommendations are that the

Corrective Action Program that's proposed by the discharger be implemented through the adoption of these Waste Discharge Requirements. And we also recommend that the water quality protection standards be set at essentially non-detect, we call it "Laboratory Method Detection Limits."

And that concludes my presentation. I'll be glad to answer any questions you may have.

MR. NAHAI: Any questions?

MS. LYON: I have one question.

After the water is extracted from that, then what happens to that?

MS. PONEK-BACHAROWSKI: There is two possible uses for it.

One, they have reuse requirements for dust control and irrigation on the landfill if it meets certain limits. Or because they're really close to the San Jose treatment plant and they own it, they can discharge to the sewer.

MS. LYON: Thank you.

MS. PONEK-BACHAROWSKI: Thank you.

MR. NAHAI: I have a question.

During your presentation you said the VOC cleaning is now stabilized.

And so that would lead me to conclude

that the corrective actions taken so far are having some positive effect?

MS. PONEK-BACHAROWSKI: Yes.

MR. NAHAI: When is it that -- if we approve the Corrective Action Plan today, how long will it be before the water quality controls are attained?

MS. PONEK-BACHAROWSKI: It may be a long time. And one of the requirements in the Waste Discharge Requirements is that the discharger do like a trend analysis to see if really things are going down or that we see an increase of dark compound showing that there is a breakdown of these VOCs over time. So it does take a long time.

But they will be doing quarterly monitoring to assess the success of this program. If it doesn't work or it looks like the trend is going up on the VOCs, then certainly we are going to have to revisit this whole issue may.

MR. NAHAI: Okay.

MR. COE: I have a question along those lines.

This monitoring will include a monitoring off site?

MS. PONEK-BACHAROWSKI: Yes.

MR. COE: And that's how we're going to get off this experience on this natural tenuation --

MS. PONEK-BACHAROWSKI: Yes.

MR. COE: -- which is one-third of the Corrective Action Plan?

MS. PONEK-BACHAROWSKI: Yes.

MR. COE: Do we have any experience now on how natural tenuation in that area based on bacteria or so on?

MS. PONEK-BACHAROWSKI: We know that there is some natural tenuation because, as I said, we basically have source control at the site right now. But what happens, you know, if you believe the gas laws, basically you get to a point where this low level of VOC, you get to a point where it becomes acentotic; that is, you have low levels for a very, very, very long time as this stuff is attenuated.

So I think they will be able to reach the MCL probably very soon. This zero detection may take longer.

MR. COE: I said bacteria and that may be in connection --

MS. PONEK-BACHAROWSKI: Well, bacteria is one of the ways -- there is an absorption and many other factors that go into that.

MR. COE: Have you worked with the owner of this well to find out what their feelings are?

MS. PONEK-BACHAROWSKI: No. Although, I think, from the Waste Discharge Requirement we do have a finding in there that it would take from hundreds to thousands of years given the hydraulic conductivity and the distance for any of these to reach -- if they reached even without a tenuation, it would be like a thousand years.

MR. COE: Thank you.

MS. PONEK-BACHAROWSKI: Thank you.

MR. NAHAI: Thank you.

I have four cards here. I would like to call first Mr. Thomas LeBrun. Presentation is limited to three minutes.

MR. LEBRUN: I will do my best.

Is it possible to have a slightly additional time? I believe my presentation may answer some of the questions that were posed to staff members a few minutes ago. I will try and be as brief as I can, but I'm not sure I can do it in three minutes.

MR. NAHAI: I'll give you some, but then afterwards if there are follow-up questions from the Board, then additional items can be discussed at that time.

MR. LEBRUN: Yes, I understand. I will.

My name is Thomas LeBrun. I'm a division engineer with the Sanitation Districts of Los Angeles County.

We will go quickly then to the first slide.

The work has been completed and has been accepted with this Evaluation Monitoring Program. It's been ongoing since 1994 and was approved in late '98. During that time period, we spent over $2 million trying to study the area that is in question.

We also completed a proposed Corrective Action Plan, which included enhancing some of our protective features in 1996. We completed an engineering feasibility study. We held a public hearing in which we received no testimony. We had a 30-day period for submission of written comments.

We did see one or two letters of written comments which we included in our document, along with our responses to those which have also been submitted to every interested party. And we're currently under design right now to enhance our landfill gas control. Some of those we will spend over a million dollars on this issue.

I think an important thing to note is the landfill is outside of the main San Gabriel Valley groundwater basin. This slide came from the basin plan prepared by the Regional Board. And you'll see the area in black known as Puente Hills. Our landfill is within the Puente Hills area outside the main groundwater basin. The natural groundwater quality is very poor, water is limited in quantity, and this has been established as a non-water bearing zone since the early '60s by the California Department of Water Resources.

The next slide shows a little bit more closely the Puente Hills Landfill in relation to the basin. The colors you see are existing contamination of industrial sources. We put this up only for comparison purposes. The landfill has not caused any of this contamination, as we'll get into.

Whatever plumes of VOCs we have are very close to the landfill and are nowhere near in size or as much concentration as you see that exist in the groundwater basin today. And I think Blythe showed you this slide, so I'll skip passed it. The

Main Canyon is the area in question.

This is a historic photo to explain how we got to building the corrective actions that we have.

The Main Canyon -- this is an aerial photo from 1952. There is four canyons shown in blue, which drain to the north or to the top on the slide. The water would then be collected in the San Jose Creek, which you see in blue. And that would be the surface water drainage before the landfill was put in.

Our studies show that groundwater tends to also accumulate in the canyon bottoms shown by those yellow lines going again northward.

The subsurface (inaudible) is one in three that you see which were constructed many, many years ago to cut off this hydraulic pathway from the landfill into the basin.

Under the studies that we've conducted for evaluation monitoring, this will give you an idea of the hydrogeologic studies and borings that we've done. As you can see, there are a huge number of exploratory borings that were done at Barriers 1 and 3. We've received comments in the past about potential pathways to the north leading to some production wells. And we had a lot of borings that were done there and we did groundwater sampling at many of these locations mapped for testing.

These reports were submitted to the Regional Board and were approved, and this documentation is available in public record.

The monitoring program we currently have approved and the evaluation monitoring, which will continue, shows these 16 monitoring wells which are located basically across the same area of concern. I don't know if you can see it, but there is a dashed red line that shows a historic creek bed in relation to the monitoring wells.

And the two areas of concern that we did detect are shown in this Area 1 in blue and Area 2 in the green. And I have two monitoring wells that I want to speak to right now.

One of the questions you had is: Is natural tenuation effective? At Well EMP 5, which is the most downgradient well, which is closest to the drinking water well, the VOC concentration we see range from non-detect to no higher than 0.8 parts per billion.

We think that the corrective actions that we've taken and natural tenuation have made this one -- it's the only one we see -- present at less then one part per billion to date. M 10 B, going through the Barrier 1 area, had higher levels of VOC concentrations and did install additional water extraction wells in '96. And I'll show you the documents of that.

This next presentation will show you the groundwater pathway that was determined from the work that we had done. And basically it's following the historic prechannel and going, in this case, to the west.

We did a mathematical model as part of the engineering feasibility study. And the model is shown in the box that's dashed. And the white dot is monitoring well M 10 B, you'll see it's right adjacent to the Pomona Freeway. And the zone of contamination that you saw basically exists in this area underneath the Pomona Freeway, if you will. That's the extent of it laterally and also vertically.

So as part of the modeling program, we were able to calculate the decrease in VOC concentrations at this one well, that is the well that has the highest VOC concentrations at the site. And it's not real clear, but we plotted in the green the actual decrease in VOC concentrations since 1996 when we started the extraction. You'll see it's coming down rather dramatically. It's pretty much following the curve that was predicted by the computer model. This curve does not represent what will change, if and when, we construct the enhanced landfill gas control.

So we are on a steady decrease. We have seen decreases of the dramatic concentration at this well since 1996.

MR. NAHAI: Well, how much more time do you need? It's going on seven or eight minutes now.

MR. LEBRUN: Okay. Let me just flip to the last two slides now.

Our only objection to the -- is not really an objection. We had not asked that this matter be removed from the consent agenda. We believe that the Regional Board's proposal establishing laboratory detection limits, which in this case could be five times more restrictive than drinking water standards, is unnecessarily restrictive for groundwater that will never be used for drinking; it's in a non-water bearing zone; and it's outside the basin.

We think the control systems that we

have would allow this Board to give us the concentration greater than background. And that would be our recommendation.

We think the requirement recommended by the Regional Board staff is a little restrictive. We need something that is five times more restrictive than drinking water standards.

I'll save the rest of my slides. I'm open for questions.

MR. NAHAI: When this matter was going to be included on the consent calendar, did you ask for it to be removed?

MR. LEBRUN: No, we did not. We asked that it remain on the consent calendar. We indicated that we felt that these standards that were being proposed were overly restrictive. And in our discussions with Staff we said we want the opportunity to come back at a future date when we have actual performance data from the monitoring wells that you saw on the graph.

And we think at that point we can make a more compelling case for a different and more reasonable standard of drinking level limits. So we did not request this be removed from the consent agenda. We actually agree with the discharge standards, with the one proviso that I just mentioned.

MR. NAHAI: Pending further monitoring so that we can all find out what is happening there?

MR. LEBRUN: That is correct.

MR. NAHAI: Any questions?

Thank you very much.

Next card I have is from Mr. Thomas Stetson.

MR. STETSON: Good morning. I'm Thomas Stetson. I'm senior consultant to Stetson Engineers, which is a firm that I founded back in 1997. I'm also the district engineer for the Upper San Gabriel Valley Municipal Water District, which is the agency which I'm representing here today.

MR. NAHAI: Mr. Stetson, would you please limit yourself to three minutes.

MR. STETSON: Three minutes? I'll try, sir.

First of all, I would like to know whether our letter of January the 8th has been received by the Board? We wrote a letter dated January 8th to Mr. Robert Berlein, the manager of the Upper San Gabriel Valley Municipal Water District, which we understood was submitted to the Board and the Staff.

Is that in the package? They've seen that letter?

MS. PONEK-BACHAROWSKI: We do have as part of the file that was received during this County Sanitation District workshop, of which the County Sanitation -- you know, they made comments on those. So we have that, but however, that was not a part of our public comment. But it was taken into consideration by Staff when they developed this Corrective Action WDRs.

MR. STETSON: Well, in that regard, as you know, there is the -- the basin is on the Superfund, has been since 1984. I'm also the engineer for the (inaudible) Watermaster and the San Gabriel Valley Municipal Water District. I've been studying this basin since 1959 when the downstream area of central basin sued for water rights.

Subsequent to that lawsuit, there was a lawsuit entered in 1972 that adjudicated the water rights in the basin. And that's under a nine-member Watermaster service.

We did not have water quality problems -- at least we didn't know we had them -- until December 1979 when the VOCs were discovered.

Since then, basically, there was the Superfund in 1984. And under EPA's studies, they made lots of studies, but they haven't treated cleaned up any water yet. The only water that got cleaned up in the basin was done by producers with well-head treatment. And that's probably 12 or 15 water treatment plants.

Right now we're trying to put together a plan with the Watermaster of the lead agency and the district and the water quality authority and the state Department of Health Services and the causers, the responsible parties for the pollution, to develop a large project called the "Baldwin Park Project," which would clean up the basin. It will probably cost $100 million and it's probably going to take 30 or 40 years.

In fact, there is a meeting this morning at 10:30 with all of those people discussing that, and trying to get that study started.

Now, both Blythe Ponek and Tom LeBrun showed you how bad the water is in the basin. And they said their water is no more than 8 times the MCLs. Any way you look at it, we don't want more MCLs, more contaminate, in the basin.

And our concern is with proper monitoring of the landfill and its activities to see that that doesn't happen. We agree that downstream barriers can be effective when disposing of waste in a canyon because you can monitor both sides of the barrier. And if you detect something, you can do something about it. It's much better than a landfill and a gravel pit in the middle of the basin, which they've had in the past.

My understanding is that the Staff has adopted what was alternative to a Corrective Action Report prepared by the Sanitation Districts. We objected to that. We did not recommend that as a solution in our letter. In fact, we said we wouldn't support it.

However, if that plan can be modified in one respect by adding more shallow wells to the program, we would be willing to accept that. The program now has mainly deep wells. And we've prepared a list of wells, some existing and some that would be new shallow wells, that we would like to recommend be considered as an exhibit that we present as an amendment to the Staff's recommendation. And I have that copies of that here.

We've been monitoring the operations of the landfill now for probably six or seven years. Some of the constituents of Upper San Gabriel Valley

Municipal Water District came to the Board and asked them to look into some of the reports being prepared for the District or prepared by the District and have the District engineer review those reports.

We've been doing that on an ongoing basis since about 1993. And that's why we reviewed this report by the Sanitation Districts for the Corrective Action Plan. And we write frequently a letter of report to our District and the District then passes that on to the Regional Board and the Sanitation Districts.

We've also recommended in the past that an oversight committee be formed, including water district persons, sanitation district persons, Regional Board persons, so we have some kind of a group that oversees these activities as they occur. New reports come out, review them, comment on them.

We're not trying to be critical, we're trying to cooperate with the system. And, again, the reasons we suggest and somehow we think could be done to improve their operation.

Is my time up?

MR. NAHAI: Do you have any other suggested modifications apart from what you have --

MR. STETSON: That's the only one we

have at the present time.

MR. NAHAI: Thank you very much.

MR. STETSON: Do you need copies of this?

MR. NAHAI: Yes. We would like to see copies. If you would please give them to the executive officer.

The next card I have is from Mr. Royall Brown.

MR. BROWN: Thank you.

My name is Roy Brown. I'm a past director of the Upper San Gabriel Valley Municipal Water District. In that capacity, I worked with the Hacienda Heights Improvement Association on these leakage problems for many years.

We have seen the indications of leakage beyond Barrier 1 for more than 10 years. We watched the Sanitation District and Regional Board staff accept many excuses for why this leakage was here.

Although the Waste Discharge Requirements said it should not be, we watched them drag their feet on investigations and withhold the results of those investigations during the State Board review.

We believe that the history of

uncorrected contamination from this landfill has gone on long enough. Each report that has been prepared over the past seven years has showed a growing plume of contaminated groundwater. In 1992, only one or two wells near Barrier 1 were effected. Now most of the Barrier 1 wells are impacted with effects extending off site.

In 1993 there was no mention of contamination in Barrier No. 3. A few years after its construction, contamination because noted in both shower wells and off site and Well EMP 5 and potentially in M 16 A. The reason for installation of monitoring wells is to determine a need for corrective action when leakage is detected. We do not believe natural attenuation of this long-term problem is appropriate any longer.

We support a pump-and-treat alternative with new wells installed outside the landfill. We recognize that this program may not now be easy to build given the wide-spread nature of the contamination; that is exactly the reason why the contamination should not have been ignored before it got off site.

Gas withdrawal and natural attenuation have not worked so far. The hydraulic connection between the landfill and the aquifer has been ignored long enough. It is time to protect the public with a proactive treatment plan.

We do not agree with the deletion of Well M 1680 from the monitoring program. This well has detected some VOCs that are identical to those found in other landfill monitoring wells.

It is not acceptable to dismiss these results without understanding how they got there. The formations underlying the landfill are complex. Some are quite permeable, while others are less so. All of them extend through the San Gabriel River Basin.

North of Whittier Narrows, the river basin is more than a thousand feet deep. The monitoring wells are shallow compared to that. Contaminants migrating through permeable bed rock layers do not follow straight paths. Lines on a map are easy to draw, but they must be carefully considered in light of the fact that they represent conjure rather than rigorous definition.

Contaminants could easily bypass a shallow well, like EMP-5, and show up in a deeper well some distance beyond. It does not make sense to put in off site wells to detect far-reaching landfill effects and then abandon it when those effects show up.

If anything, more monitoring should be done; landfill effects at this location would indicate, as we suspect, that the extent of contamination continues to be poorly understood.

Before you agree to further reduce public protection, I request that you require a much more scientific analysis of how these contaminants got here. Lacking that, monitoring Well M 16 A should be reinstated in the program. Thank you.

Any questions?

MR. NAHAI: Any questions of Mr. Brown?

Thank you very much.

The last card I have is from Mr. Jeff Yann.

MR. YANN: Good morning, my name is Jeff Yann. I chair the Environmental Water Quality Committee of the Hacienda Heights Improvement Association.

As an engineer, who used to work in a highly regulated industry, it is disappointing to me that concerns HHIA has been raising over the years still have not been answered by this regulatory body.

In 1995 in response to our appeal, the

Water Resources Control Board remanded the landfill Waste Discharge Requirements back to the Regional Board for further investigation.

Now, it seems we find ourselves back here today with the investigation presumably complete; many new questions raised; few answered; and apparently your Staff anxious to get this matter behind them without having to challenge their permittee.

First, we still do not have agreement on location-specific background water quality standards. A final Corrective Action Plan cannot be developed before all sources of leakage have been identified.

We've been told for the past 16 years that Barrier 1 is a nearly impenetrable dike keyed into bed rock. Now we find out this is not true. In fact, the formations underlying the east end of Barrier 1 are quite permeable. The pumps inside the barrier can now be used to pump contaminated water back into the landfill from outside.

The ERR (inaudible) when this barrier was built committed to repair it if water quality downstream ever indicated it had been breached. Now that we know water has been flowing beneath it for years, that commitment has been forgotten.

Not only that, leakage is being detected on a broad front along Barrier 1 and is now being picked up along Barrier 3, with little explanation of the cause and no proposed corrective action.

In addition, these same permeable formations penetrate completely under the underlying landfill. Worse yet, they run to the west where they're intercepted and drained by the San Gabriel River. This is spelled out in the new investigations.

As recently as 1993, we were told permeability of formations underlying the landfill were less than 10 to the minus 6. That's one millionth centimeter per second. Now we know that recent borings in these formations are showing permeability thousands of times higher.

It is inconceivable that knowing this, the Regional Board staff is content to let this situation go uninvestigated and unmonitored

These are not trivial concerns. In fact, HHIA has little to gain in coming here to tell you this, except to express our concerns that this threat exists to a major drinking water source.

As a former project engineer, I understand why the Sanitation Districts are not investigating this on their own. What I don't understand is the appearance that this regulatory body seems to believe it should spend our tax dollars defending its permittees.

I urge you before you accept the provisions of this CAP to ask your Staff to do their own review and answer conclusively to the public satisfactions these questions we have been raising.

Issues contained in HHIA's comments to the Sanitation Districts in January have not been properly addressed. We've received no response from a letter we sent to the Regional Board at that same time.

On behalf of HHIA and water users in this area, I request that you have your Staff prepare a direct and comprehensive response to our concerns. I request that you satisfy yourselves by looking at these facts to make sure water users are truly being protected before you make your determination in this case.

Taking time to develop a comprehensive solution that assures protection of groundwater supply is far better than a rush to judgment that ignores the deep-seeded problems presented by this landfill that does not have to be here next to the river.

Are there any questions?

MR. NAHAI: Any questions of Mr. Yann?

I had one question.

The monitoring program that is being proposed, when infinitely will that not detect leakages from Barrier 1 and Barrier 3?

MR. YANN: It will detect leakage from Barrier 1.

What we're concerned about is the fact that the new results have shown very high permeability for the formations that extend underneath the landfill. They've gone deeper into those formations out in front of the landfill, but those same formations extend under the landfill. They also drain following the hydraulic radient toward the San Gabriel River, which is where you would expect them to drain. There is no monitoring on those pathways.

The concern we have is no water -- there is a lot of water that goes into the landfill, very little comes out in the leachate tracking system. Where is that water going? That is the pathway that we're concerned about that is being missed by the shallow monitoring program out in front of Barrier 1.

MR. NAHAI: So your proposal, then, would be that there should be additional monitoring?

MR. YANN: Exactly.

We believe if there are contaminants going through those permeable formations, they should be found before they get into the river and corrected on sight, rather than be shown -- some of them may be showing up in monitoring Well 16 A that Royall Brown talked about. So those are the areas that we're concerned about.

MR. NAHAI: Thank you.

Are there any questions?

MS. DIAMOND: I have a question.

Do you have some suggestions that would go towards protection of the public health?

MR. YANN: Yes. I think first -- as I mentioned, there is a lot of water that has gone into the landfill. Very little has been drawn out. It may still be in the landfill. I think we need to make an inventory to find out if it's there or we need to find out if the formations are as permeable underneath the landfill as they appear to be.

Perhaps that water is migrating through these formations. In which case, we would need to analyze those travel pathways towards the river and sink borings down into the sandstone conglomerate parts of the formation to assess whether contaminants are traveling through those formations at some depth, 200 feet, 300 feet potentially beneath the landfill.

So those are the types of things I would like to see investigated.

MS. DIAMOND: Thank you.

MR. NAHAI: Thank you.

I think we would like to have some Staff response.

MS. PONEK-BACHAROWSKI: We will see if I got this all down.

We would very much like to see what Mr. Stetson has proposed in the way of shallow groundwater monitoring. The monitoring program that you have attached to the Waste Discharge Requirements is by no means a stagnate program. That's going to be changing over the years. And it can be done by the Executive Officer's signature. And the reason being is as conditions change here, we definitely are going to want to see how effective the Corrective Action Program is.

And so if there need to be more wells, there are going to be more wells installed. At this time we feel this is a very conservative starting point on the wells -- on the detection wells and the corrective action detection wells.

Mr. Brown is correct in saying that there have been more detections in wells because they've been installing wells to chase the plume. So the whole idea behind putting additional wells in is to put them where you think the plume is going and then you delineate the boundaries. So that's why there are more detections.

And as far as MW 16, that well is pretty much centered in the San Gabriel Valley. And it has the same fingerprint VOC as you see in the problem areas in the central portion of the valley not caused by landfill. Wells between the landfill and that landfill do not show the same constituents in the same concentration.

So we believe that MW 16 are wells that are picking up the main San Gabriel Valley VOCs contamination unrelated to the landfill.

It is true that higher permeable strata has been investigated at the eastern edge of Barrier 1. And that's why the additional extraction wells were put in that area. The idea is, if you extract out the groundwater behind the barrier, then there is no polluted groundwater to go anywhere. And so that was the purpose for the installation of those four wells. And I think I mentioned to you that we see a great deal of improvement in that area since those wells went in in '96 or '97.

And I want you to know that we've reviewed all comments by all parties. And I think you can see we have kind of extremes in ideas about what is going on at this landfill. And what we've tried to do is bring things to the middle and adequately address the comments, but also not be overly burdensome on the discharge, but be reasonable.

And, again, this is not a staffed program. If this needs an update or additional extraction or whatever, that's what is going to occur.

MR. COE: I have a question.

I believe Mr. Stetson recommended an advisory committee being created, as I understood it. And what is your response to that?

MS. PONEK-BACHAROWSKI: Yes. Actually that came up a few years ago. And at that time it was the Executive Officer's idea that because we have to abide by a strict set of federal and state landfill regulations, that that's what dictates the way we look at these problems and the series of events that happen.

And although an advisory committee may have some really important things to bring to that, I mean they can bring that to us also in the way of a letter. We certainly look at every single comment that's ever been received.

And I mean that's always up again if that pleases the Board, that can be looked into.

MR. COE: We're trying to improve our two-way communications. And rather than meet within the 12 individual meetings or 12 individual letters --

MS. PONEK-BACHAROWSKI: Well, although the Regional Board staff have been kind of removed from this, I believe there is a citizen's advisory group that meets on a regular basis, concerned parties, with the discharger and they meet on a regular basis also.

MR. COE: Thank you.

MR. KESTON: I just have one question.

Did you comment or could you comment on

the Sanitation Districts comment about levels of detect.

MS. PONEK-BACHAROWSKI: Again, the regulations say that the water quality protection standards shall not exceed background concentrations unless it's shown to be technically infeasible. And in order to show that basically you need more data showing that, you know, selected remedy is not going past a certain point.

And I think it's reasonable for them to ask down the line as we get more and more data and more trend analysis, that perhaps we review all the groundwater data to see what is going on here and maybe in the future bring it back to the Board.

This is what we've done with other landfills if we used the non-detect as the protection standard. As you can see, the water that's being discharged is not really being discharged in our drinking water aquifer; although, it has potential to reach it sometime down a point if it's not -- there is no source control. So I would say that we could revisits that in the future.

MR. KESTON: Is that a very costly -- are they requesting that change because it's very costly or time consuming or what is the reason?

MS. PONEK-BACHAROWSKI: It's a possibility that they are -- because of the low non-detect that they could be in corrective action forever. And that they may have to enhance the corrective action down the line if they're not achieving those non-detect limits. So it would cost them money in the long run, yes.

MR. KESTON: Thank you.

MR. NAHAI: I have a question regarding the timing issues of this thing.

When exactly is it that you think that the data from the monitoring will be sufficient to ground the decision as to whether additional monitoring is required; as to whether additional corrective action is required; whether it be appropriate to go to a feed program rather than barriers? Do you expect that in six months' time as to what the monitoring reveals? A year's time?

MS. PONEK-BACHAROWSKI: Well, you know, the regulations have not really caught up to reality because the regulations say that the discharger has to report at least semi-annually about the success of their corrective action. That's not really reality. Because if you've got four quarters of monitoring, I mean you couldn't even start with statistical analysis until you have four, six, eight quarters of monitoring. And trend analysis may take even longer than that.

So I would say in the next couple of years with eight quarters of monitoring we should certainly see something happening or should be able to tell it statistically.

Also, if it continues to follow the modeling, I mean, we can see that right away. If the levels continue to follow the curve on the modeling

Also -- well, I'll stop there.

MR. NAHAI: Would it be feasible to ask Staff to come back to the Board perhaps in six months with a report as to what it is that monitoring -- or eight months or six months as to what monitoring in two quarters. I think we're seeing some real concerns expressed here.

MS. PONEK-BACHAROWSKI: Sure.

MR. NAHAI: And I'm not sure that they're that extreme. And to let it go for another two years and gather data and then in two years we discover that perhaps our thoughts about how much leakage was happening and where this was hydrologically connected to or in error, that would put us back two years. I don't think we should have to wait that long.

MS. PONEK-BACHAROWSKI: The time lag will be caused by the installation of additional gas extraction wells, which is going to take some time. And the discharger will be, as part of the WDRs, will be giving us an implementation schedule.

So it's going to take a little while to get these extraction wells or gas extraction wells built and online. So that's one of the biggest time delays right there.

Also, the idea of putting extraction systems out under the 60 Freeway, I mean we have civil engineers here that can tell you that's probably not a very good idea since we have substantive subtypes every time that you start extracting large amounts of groundwater under a structure.

MR. NAHAI: I'm not talking about the extraction wells. I'm talking about reporting back to the Board as to the results of the monitoring.

MS. PONEK-BACHAROWSKI: We certainly can do that, of course. We receive those reports quarterly.

MR. NAHAI: Okay. So that in two quarters we will hear back from you on this issue?

MS. PONEK-BACHAROWSKI: Yes, sir.

MR. NAHAI: Thank you.

Any other questions?

I think that concludes that item. Our agenda calls for the Board to take a break at 10:15. We can take that break now.

MR. LEON: Are you going to vote on the item?

MR. NAHAI: Do we need to include reporting back to the Board on the item?

MR. LEON: Part of the motion, direction to Staff.

MR. NAHAI: Okay. Then that will be the approval of the motion as recommended by Staff with the amendment that Staff report back to the Board in six months' time as to the results of the monitoring obtained between now and six months from now.

MR. KESTON: Could the reporting back be reporting by the director executive officer instead of at a public hearing? The truth is normal monthly reporting technique, I think that might be more effective; and then if we see an issue, we can then schedule it rather than having it as a public hearing.

MR. NAHAI: That's fine.

MS. DIAMOND: Could I also ask that the reports that we get respond to the comments that were made today, particularly about the modifications that were suggested; and whether, in fact, it makes sense to abandon some deep wells or delete any wells so that we have a response to those comments that were made today which I also think were educational and not terribly, extreme.

MR. KUYKENDALL: Mr. Chairman, members of the Board, if we could have that report back after two quarters of reports are submitted and it can be analyzed by Staff; so it won't be within six months. Technically we receive two quarterly reports and can they be analyzed?

MR. NAHAI: And how much time to be analyzed?

MR. KUYKENDALL: We're talking roughly a month for the second report, so we're talking about a month after the submittal of the second quarterly report.

MR. KESTON: If that's a motion, then I'll second it.

MR. NAHAI: All in favor?

BOARD MEMBERS: Aye.

MR. NAHAI: It's a good thing we have a lawyer as the chairman here to keep all my motions in line and stuff like that. I apologize.

MS. LYON: I do think we should take a break because Staff and our audience would appreciate that.

MR. NAHAI: You probably think I should take a break.

We will see you in about 10 minutes.

(Brief recess.)

MR. NAHAI: Can we come to order, please.

Okay. We're going to move to Item No. 11, which is the consideration of a Municipal Storm Water Permit for the City of Long Beach and a consideration of a proposed settlement agreement.

I would like the executive assistant to read the statement.

MS. HARRIS: This is a public hearing to receive evidence and consider Board action on the following items: Consideration of a Municipal Storm Water Permit for the City of Long Beach; and 11.2, Consideration of a Proposed Settlement Agreement.

Copies of these items were sent to the

dischargers, the Environmental Protection Agency, the State Water Resources Control Board, and other interested agencies, persons and organizations.

The order of presentation of testimony at this hearing will be Board Staff, the dischargers, public agencies, and other interested agencies and groups. Anyone so desiring, will be heard.

If you have not filled out one of the blue cards located on the table at the back of the room, please raise your hand and we will get a card to you to fill out.

It will be appreciated if all persons appearing before the Board today will leave written copies of testimony if available. The Board will consider all testimony; however, in the interest of time, it is requested that all repetitive and redundant statements be avoided.

The setting of time limits for the presentation of evidence is at the discretion of the Board.

Mr. Chairman, will you now open the hearing and administer the oath.

MR. NAHAI: I shall.

Would all those who are going to give testimony with respect to this item rise and repeat after me.

(Oath was given.)

MR. NAHAI: May we have the Staff presentation?

MR. DICKERSON: Mr. Chairman, Members of the Board, the next item City of Long Beach Municipal NPDES Stormwater Permit, represents the culmination of a long period of discussions between Regional Board staff, the City of Long Beach, the County of Los Angeles, USEPA, and representatives from several public interest organizations. What is before you is a proposed permit that addresses the stormwater pollution in the City of Long Beach. As you can see it is a comprehensive permit that addresses an array of issues in what is hopefully a succinct and clear fashion.

Its format may very well serve as the foundation for subsequent stormwater permits to be presented for Board consideration. This permit is, of course, a departure from the existing stormwater permit with the County of Los Angeles. It essentially removes the City of Long Beach from coverage under that permit and provides Long Beach with a stand alone permit. How we got to where we are today requires a few words of clarification.

The County stormwater permit was adopted by this Board in July of 1996. While I and some of you do not participate in that permit hearing, by most accounts it could not be described as warm and fuzzy. Unfortunately, the process embraced by Board staff to seek consensus on the permit's content failed to achieve consensus from all participants, most significantly, the City of Long Beach.

Following the Board's adoption of the permit, the City of Long Beach exercised its appeal rights to the State Board and to Superior Court. Currently, there is a case pending, City of Long Beach versus Los Angeles Regional Water Quality Control Board, which challenges many aspects of the Board's adoption of the County stormwater permit.

Shortly after joining the Board as Executive Officer, I recognized that the ill will generated by the adoption of the County permit was shared by others and represented a source of misunderstanding and resentment. In response, I made it one of my key priorities to do everything that I reasonably could to change that perception and to successfully resolve the pending Long Beach litigation in a way that would be fair, equitable, and would result in a step forward in addressing stormwater pollution.

That process started with my gaining a clear understanding of the permit itself and reaching out to various local government entities and interest groups to listen firsthand to their concerns. It continued through the adoption of model programs under the County permit and to building a foundation of trust with the City of Long Beach. Over the many months that have transpired since, I have had the opportunity to build a strong relationship that I believe is one of friendship and mutual respect with the City staff who are charged with implementation of the stormwater program.

The permit before you today is the outcome of an intensive effort that began in earnest late last year. There have been many drafts of permit language, representatives of the major environmental groups were consulted early on and they actively participated or had the opportunity to help draft the language that you have before you.

While not every issue is resolved to everyone's complete satisfaction, the permit does represent a very credible and comprehensive permit that clearly places the City of Long Beach among the forefront of cities addressing this challenging problem. They've reached out to other cities to learn from their experience and they have engaged in an open and honest dialogue on what we're trying to achieve. It has been one of the most demanding, yet fulfilling experiences in my career.

So today we have a permit for your consideration. Assuming it is adopted today, what happens to the pending litigation? We've worked with the City to draft a settlement agreement which I'm requesting your authorization to execute.

This elegantly simple agreement has this essential provision: It calls upon the City of Long Beach to immediately move to dismiss the pending litigation once two events occur. First, that the Long Beach Stormwater Management Plan is approved by the Executive Officer pursuant to the existing County Permit. This has been done. Second, that the Regional Board and USEPA adopt the permit. I believe that we have a representative from USEPA here who will offer comments to the effect that USEPA endorses this permit and intends to act on this matter expeditiously.

With those two actions, the litigation can be resolved and both we and the City can move forward to implementation. I should note that the City retains their rights of appeal of the draft permit now before you, once it's approved. However, I fully expect that the outcome of today's hearing and Board action will render that provision unnecessary and I know that the representatives from the City share that sentiment with me.

Xavier Swamikannu will shortly be walking you through the permit and some issues that have been raised since we issued the tentative draft permit. Xavier's involvement in this process has been exemplary and essential. Quite frankly, it simply could not have been done without his dedication and efforts and I have the greatest admiration for his knowledge of the County permit and his willingness to get this job done.

Thank you very much, Xavier. I appreciate it.

In addition, our Counsel Jorge Leon played a critical role in getting to this point as did our Assistant Attorney General Marilyn Levin. My sincere thanks to each of you.

From the City, Ray Holland, Director of Public Works and Ed Putz, City Engineer, have been in every respect men of fairness and dignity. They were open to a bridge to resolution and we've shared many hours together to achieve that result. I consider gaining their professional friendship one of the best outcomes of this process.

Barbara Munoz had the difficult and overwhelming task of developing a stormwater management plan for the City of Long Beach. That document served as the critical element that allowed this process to move forward. She did the yeoman's work and deserves no small amount of recognition for her contribution.

Finally, this permit will be implemented principally by Rose Collins and Tom Leary, who greatly helped in the stretch to wrap-up this permit. The final version of this permit that is before you was the product of a marathon meeting -- and a very long meeting indeed -- between Rose and Xavier to take a document with all the essentials and to make it presentable. Thanks must also go to Mark Gold, Steve Fleischli, Jacqueline Lambricts, Terri Grant, and many others who all devoted no small amount of time to this project.

With all that being said, I can recommend a permit to you for your approval, with a number of technical revisions that are in the change sheet before you. These changes should resolve many, if not most, of the comments that we received.

Dr. Xavier Swamikannu will now brief you on the elements of the permit and he'll be followed by the City of Long Beach and others who wish to comment.

Finally, I would request that the Board waive its normal 3-minute rule to allow additional time to ensure that the comments that we receive today are well documented for the record.

Thank you.

MR. NAHAI: Mr. Dickerson, could I have an additional copy of that change sheet, please, if you have one.

MR. DICKERSON: Yes.

MR. SWAMIKANNU: Mr. Chairman, Members of the Board, my name is Xavier Swamikannu. I'm an engineer on Board staff.

First, I'm going to describe the permit structure, the things that are in it.

The first section is the finding section. The findings basically lays a basis for issuance of the permit. It talks about the history of permitting in the Los Angeles region. And it directs you to the appropriate state and federal laws that implement the permit.

The second section is a section on receiving water limitations. And the receiving water limitations we basically say that some are discharge and must comply with water quality standards. Water quality standards were established to protect beneficial uses.

In addition we have a prohibition on some discharge causing nuisance. We also have statewide language that has been recently adopted by the state Board that lays in a process in case you have exceedance of water quality standards. It basically goes past -- the city goes through a series of process to update the BMPs in order to resolve any exceedance that they find.

The next section is a section on discharge prohibitions. Dischargers permitted under the NPDES. Dischargers that are exclusively authorized in the permit. There is also a process laid out for the executive officer to consider any use for the discharger to be authorized under this permit if they do not cause problems.

We have a section stormwater management. And I'll go through briefly in my next Icon the components of that.

We have special provisions. Special provisions are provisions specific to the City of Long Beach. And these are generally random targets that we've agreed on, for example, training or planning in the next six months. Those kinds of provisions.

We also have a section standard provisions. Standard provisions are provisions that go into all NPDES permits.

We have appendices. And in the appendices is the outline of the Long Beach Watermaster program as well as the Long Beach monitoring program. It also includes a few drainage maps that depict drainage in the city.

Stormwater management. Basically this component of the permit requires that the city implement best management practices approved by this Board under previous permits since 1990. They're explicitly called out in the permit.

It also requires the city to possess legal authority to prohibit or control pollutants to the storm drain. The city has told us that they have adequate legal authority at this time. It is a separate ordinance. They have also expressed a willingness to consolidate all those codes into a single ordinance at a future time after considering the need for such consolidation.

The city is required to implement a Stormwater Management Program. And I'll briefly go over it, but the details I shall leave to the city to discuss.

The city is required to implement a monitoring program basically to assess the amount of pollution that is coming out of the stormwater to study impacts and to study the effectiveness of BMPs that are being implemented.

The city is required to conduct reporting on the program to us and evaluate progress on implementation.

There was also a subsection on budget specifically allocated to the stormwater program and they're trying to provide us with an annual update of the budget.

Next I shall briefly go over the federal regulations that require us to approve the Stormwater Management Program.

Under the regulations the city is required to reduce pollutants from residential and commercial areas. They must find these elements in development plan, development construction sections, as well as public information participation.

The city is also required to control illicit connections and illegal dumping in the discharge permit and that comes out of federal regulations as well

The city is required to control pollutants from municipal and industrial facilities. You'll find this comment on the public agency activities, as well as public education where they're required to visit Phase 1 industrial facilities and other facilities.

The city is required to control pollutants from construction sites. And you'll find these requirements under development planning and construction. I should make note that the regulations are 40 CFR 122.26.

Now, Long Beach Stormwater Management Program, public agency activities; these are activities associated with the municipality. They're required to implement BMPs on their facilities in their planning programs and such. The city will provide an elaboration.

Development planning, development construction. This section is a primarily private program, primarily construction. And they're required to implement -- approve local plans for controlling stormwater pollution on sites 1 acre or more, but less than 5.

The city is also required to eliminate illicit connections and illicit discharges to the storm drain system.

The public education and public information component, this is an outreach to the general public, but it also includes city employees as well as business.

Next, briefly I'll go over each of the sections. I want to highlight certain things that are different from the L.A. permit that we entered into in 1976.

Under public agency activities, the city is required to clean up catch-basins that are 40 percent or more full between October 1 and April 30. So during that period, they're required to clean out catch-basins that reach that capacity.

Next the city is required to landscape areas with 25 percent of vegetation. When they are required to do landscaping, they'll landscape with xeriscape vegetation, which is dry vegetation.

Next, street saw-cutting and paving will be prohibited when it rains when the rain fall is more than a quarter of an inch. You don't want that activity going on because there is a lot of pollutants associated with asphalt.

Under development planning, the city will train its planning department employees under requirements no later than six months and will conduct an annual refresher course thereafter.

The city has also required specific BMPs for automotive repair, service stations, restaurants and hillside projects. This is different from the county-wide program where we require a separate plan because the BMPs have been designated. Since the BMPs have been designated, we have removed the requirement for a local plan. And I think that's an evolutionary step.

Under public education information, the city has stated that it will achieve a certain new number of impressions on the public via multi-media. Again, this is a measure of the outreach message. And the number that they've agreed to is 1.5 million.

The city will also conduct walk-through of businesses visited to provide consultation on recommended BMPs if invited by the facility operator.

The city will conduct a separate study to survey private parking lots with 10 or more spaces to evaluate trash and other pollutants generated and will send recommendations to the Board on any action necessary.

The city will implement a monitoring program. This is the first time any city is implementing a monitoring program separate from the county-wide program.

The city will determine mass-emissions, the amount of pollutants coming out at Dominguez Gap, which is to the Los Angeles River, Bouton Creek and Alamitos Bay, these additional two sites are fully within the city, so they're lead contributors.

In addition they have agreed to monitor Los Cerritos Channel beginning year 02. And the city is the largest contributor to the watershed. But there are other cities. They will mass-emissions at the out-fall. And when we consider future permits for other cities, we would bring them to allocate their contributions, or at least to understand their contributions.

The city has agreed to evaluate stormwater toxicity to see if it has an impact. And if it has an impact, there is a protocol in there to follow-up, identify the cause of toxicity, and then to identify sources as well.

The city will also evaluate effectiveness of dry-weather flow diversion at one of the locations, Alamitos Bay. And they want to demonstrate that that's a good BMP.

We received comments from municipalities, including the City of Azusa, Claremont, Diamond Bar and the City of L.A.

We received comments from environmental groups, The Natural Resources Defense Council; a letter cosigned with American Oceans Camping; and Friends of the Los Angeles River; and we also received comments from Heal the Bay.

We received comments from the Petroleum Association. We had an issue with one of the provision requirements that I'll discuss on the main issues.

First general comment was the period for comment. This comment came from cities as well as the environmental group was insufficient. By law, we're required to provide 30 days' notice. Given the fact that we had code deadlines before us, we did the best we could. But in the future, we should consider giving people more time, more time is always better.

On the Long Beach Stormwater Management Program, there was comment that it was not circulated; what we have in the permit is simply the outline of it. In our public notice that was published in the Los Angeles Times on May 28, it mentioned the availability of these documents. These documents are in four volumes and so it's impractical to circulate them. There was a number provided in the public notice. And the city or the Natural Resources Defense Council could have contacted us to review the documents.

In addition a civil issue was raised before the state Board and petition in 1996 when a stormwater permit was issued to Santa Clara Valley and the state Board simply dismissed -- did not recognize that the circulation was essential; did not comment on it, but the document says under California Code of Regulations that where an issue is not commented on a decision, then the issue is considered dismissed.

So in my opinion there was not a substantial issue of law or process that was applicable according to the state Board.

The next issue, one city and perhaps a few more will consider what a strict applicability to other cities of the requirements of this permit. This is a format. We have a general format for future stormwater permits.

The cities were concerned about the fact that they had no opportunity for discussion or negotiation. What we're offering today is we're offering a change in the finding that caused concern. And the finding basically says -- it's in the change sheet -- and it says the Regional Board will ensure that Stormwater Management Programs within the County of Los Angeles that bring to the City of Long Beach complement requirements of the offer.

So any future permits that are issued we will not issue permits that contradict or make the City of Long Beach violate this order, as opposed to imposing the same requirements on them.

That, to me, is a substantial change from the City's point of view.

The next issue, this is an issue that came up very close to the final days of negotiation. And it has to do with the requirement of development planning, new development. And the environment community generally wanted a requirement in there that at least some measure for new development.

And they proposed infiltration and/or treatment of runoff from new development projects. These are three of the options at the time. One is

100 percent treatment of stormwater runoff from the property, from the new development. The second standard is the one that's being proposed by the county, which hasn't come to that. It's in the draft document. It talks about treatment of the first six-tenths of an inch of storm runoff. And treatment means infiltration, buffers in any form. They're not basically specifying the following treatment. All they're saying is the first six-tenths of an inch undergo some type of infiltration or treatment.

The County of Los Angeles, under a settlement agreement with the Natural Resources Defense Council for the unincorporated area of Los Angeles County, have agreed to the treatment of the first three-quarters of an inch of storm runoff.

The Staff issue on this point is simply that we haven't had time to look at these numbers. Obviously monitoring them is good. From the technical documents that I've seen, anywhere between .04 of an inch to an inch treats first flush, which is the lower pollution that comes off, perhaps 80, 85 percent. But we haven't had the opportunity to analyze the effectiveness or the cost effectiveness associated with these different numbers.

And I believe that we will have that

opportunity when the standard mitigation plans come to the executive office of our approval. And I will request that we consider it at that point other than hold up the permit now.

The next issue, this is an issue that was brought to us by the Western States Petroleum Association. There is a requirement that on new gas stations and new service stations that the discharge from hazardous maintenance storage areas, repair maintenance areas be prohibited. The dischargers now may be prohibited. The tentative also includes fueling areas.

And it was brought to our attention that that's probably irrespective. What you have generally VOCs, prohibition may not be necessary. It was also brought to our attention that through a consensus process, the state stormwater task force, which is a coalition of municipalities, had come to some agreements on BMPs for these kinds of activities.

And so we have recognized that and our recommendation is the fact that we take fueling areas out of the prohibition and allow BMPs to be applied in accordance with this stormwater task force.

The next issue, main issue has to do

with the monitoring program. As I mentioned, this is the first time a city is monitoring for stormwater under a permit. One of the comments submitted expressed concerns that some of the major shared watersheds, like the Los Angeles River or San Gabriel River, there is going to be no monitoring until the year 03; when the city has expressed an interest in being part of the group effort.

Similarly, the comment was also mentioned that there is no protocol to identify sources and perform evaluations of BMPs, whether they're working or not.

Something that has come to our attention recently, there is an influx in Southern California from all the municipal county programs to enter into an agreement to ensure consistency as well as regional issues like protocol for testing; protocol for salmonella contaminants and such.

And the City of Long Beach has expressed an interest to be part of that. That effort is being put together by a Southern California Coastal Water Resource Project, Regional Board's executive officer is commissioner on that organization, which is sort of an independent research organization of regulators as well as the

Sanitation Districts.

And it's my opinion that any resources that the city permits will be well commended to do it on a Regional basis as opposed to the City of Long Beach.

Next we will go to recommendation. We have a change sheet before you. And they're separated into substantive changes, substantive to the commenters and non-substantive changes. I'll just briefly go over the substantive changes. I've addressed some of them already and I've touch on a couple of non-substantive changes that came to my attention today.

The first substantive change we discussed that there is a finding that we say that the Board will ensure that the programs in areas within the County of Los Angeles will complement the requirements of this order.

The next change, it was also brought to our attention that there is no default date in the permit. In some cases, we've provided that something be done by a certain date. So the changes that are -- we go to an implement date -- a default date of six months from the permit option. And we've discussed that with the city and they've agreed to that.

The next substantive change is the one to do with the fueling areas at gas stations, and I've discussed that.

I'll also briefly mention the next one on public information parking spaces, the tentative requirements of minimum of 100,000 per year of the general public. We've changed that to 1.5 million. We've talked to the city and they've agreed, took that higher number.

On the non-substantive changes in the permit, monitoring at one of the channels, Los Cerritos Channels, not the only one. The requirement in the permit was beginning in the year 03. We are now moving that ahead to year 02. And this is something that the city has said that it's agreeable to.

In addition, one more non-substantive change. I have a definition for ecological sensitive areas. And that's probably the last page under definitions, it's the last definition.

And I had recommended an addition based on comments received that we add any ecological area designated. My understanding, perhaps that's opening a can of worms, just too broad. And we would rather leave it as is in the tentative.

If at some future point there is an appropriate agency that's identified with the ecological areas, we can just define it through the executive officer's authority to include that entity.

So with that, my recommendation is that the Board adopt the permit with the changes that are proposed in the change sheet as well as what I've voiced before you today.

Thank you.

Any questions?

MR. KESTON: Mr. Chairman, yes, I have two questions if I could.

Some of your comments today talked about standard urban stormwater mitigation plans for the L.A. County permit. And I think you mentioned that the county -- whatever you ever call them -- something, SUSMPs are not yet approved and will be heard before this Board in a short period of time, so you want to defer whether it's four-tenths, six-tenths, seven-tenths, or whatever, until they're heard.

Could you just tell us when that will be heard? Do you have any feeling for that?

MR. DICKERSON: Mr. Chairman, Xavier

and I really haven't talked specifically about scheduling that, but it's my understanding it will be coming to our office very shortly. And given the timing of having it before the Board, we want to have it, of course, before the Board here in Los Angeles County, not in Camarillo.

Earlier this morning and just thinking about the issue, the thought crossed my mind as to whether or not we should even have a special meeting. Because I suspect that that particular item may have quite a bit of interest associated with it. And we may even need a good portion of the day on that one item.

So I think that's a possibility. So I would like to discuss that with the Board.

MR. KESTON: So you're talking about 60 or 90 days or something in that time period?

MR. DICKERSON: Oh, I would expect either late August or early September.

MR. KESTON: So that's 60 days or so?

MR. DICKERSON: Right.

MR. KESTON: Okay. That was my first question.

My second question, as you read the change originally proposed, on the last page of the change sheet pertaining to environmentally sensitive areas, you define them as a special biological significance by the state Board Resources Control Board, and certainly that's an agency that we believe sets special biological areas by the California Research Agency, and certainly we don't have a problem and the County of Los Angeles. And since we're dealing in the County of L.A., that's appropriate too.

And I think your comment was these words, "or any other ecological area designated by any other government body," you would like deleted?

MR. SWAMIKANNU: Yes. The tentative has it without.

MR. KESTON: Without it? Okay.

MR. SWAMIKANNU: Yes.

MR. KESTON: Because obviously "any other government body," could include a school board, a mosquito abatement board, groups that have no jurisdiction and no interest and no responsibility to that.

MR. SWAMIKANNU: There is a possibility that that can be interpreted that way.

MR. DICKERSON: And we may have some comments on those items as to the justification, which may offer some clarification. Right now the language as included in the change sheet just seems to be a bit broad, but we're open to hearing more clarification on that.

MR. KESTON: Personally, I think it should identify those agents that have responsibility and are identified; and that if anyone comes up in the future, you can add them, but certainly not to make it so broad that anything becomes an agency. I think the way it was in the original permit sounds fine to me.

MR. COE: I have a comment or two.

I think it's apparent that a lot of work has gone into this. It's also apparent that it's been sort of a rushed effort. The Regional Board members received a four-page change sheet this morning when we arrived here. And I would like to ask Jorge Leon a legal question.

As I understand it, the rush is tied in with the litigation and a deadline apparently set by the judge. What is the situation? And could it be changed by some kind of extension by the judge to avoid this appearance being perceived for true here that we really would like a month or two more, and then have it come back in either August or a special meeting to finalize it.

Could you tell me about that?

MR. LEON: Sure. As you know we have been basically in litigation with the City of Long Beach since the issuance of the permit; they appealed to the state Board; the state Board dismissed; and the City of Long Beach appealed to the court. And there have been various legal maneuvering and wranglings over discovery. And just usual kinds of litigation activities ongoing between the filing of the litigation and now.

There was at least one request that was granted by the judge to move the previously set hearing date in the litigation. And the current litigation start date is, I believe, it's July 12. Is it July 12 or the 16th? The judge in his order granting the extension basically said very firmly, very sternly, there will be no further extensions. And we've taken that statement very seriously.

And so we worked with the judge's admonition that no further extensions would be granted, to move this permit along. And as Xavier, I think, indicated; sure, it would have been great to get additional time, but it does appear to me that adequate notice was provided to the public.

Certainly minimum legal notice was provided to the public and all documents have been available to the public.

We've been moved too far a fetched, just an attempt to explain why we're here today and not two months in the future.

MR. COE: If all parties of the litigation come before the judge and both agree to it, there is no advisary --

MR. LEON: Normally that's what our belief would have been as well, but we were basically in conference with the city's attorneys -- and you can ask them as well when the City of Long Beach comes up -- but we pretty much agreed that we would not be able to get the concurrence of the judge even if we requested it together.

Normally we would have expected that, yes, but we didn't believe we would get it in this case.

MR. COE: Even though the plaintiff withdrew?

MR. LEON: Well, a withdrawal is completely different. The petitioner was not in the position to withdraw the litigation. They were only in the position to request an extension.

MR. COE: Okay. Thank you.

MR. LEON: Thank you.

MR. COE: I would like to ask Xavier, looking over these changes quickly, it doesn't seem to me -- and I may be incorrect -- you haven't taken care of the comments -- the two main comments by Heal the Bay on the development planning and the monitoring of permits.

Is that true or do you think you've taken care of it?

MR. SWAMIKANNU: I've taken care of the monitoring issue that Heal the Bay has raised. And probably there are better alternatives in terms of keeping in line the efforts of conducting monitoring sooner than later. They agree that monitoring for monitoring sake is useless.

And my opinion is there is a regional effort which has just begun and they probably weren't aware of it. And Long Beach has agreed to participate in that effort. That will be a better use of their resources.

MR. COE: And the monitoring changes in the change sheet --

MR. SWAMIKANNU: Oh, the monitoring changes is something that was brought to my attention here this morning. And so my recommendation is that we move up the monitoring of the Los Angeles channel to year 02.

MR. COE: Okay. That's change sheet No. 2?

MS. DIAMOND: Did you say the year 02?

MR. DICKERSON: That was actually approached by Heal the Bay and the city this morning.

MR. COE: I'm going to ask Heal the Bay if the changes take care of their problems.

MR. SWAMIKANNU: And I'll be happy to respond to them.

MR. COE: How about the development program?

MR. DICKERSON: If I could just comment with regard to the fact that this is an issue that is going to be coming to us shortly, it's the time frame that we talked about earlier. We did not resolve Heal the Bay's concern with regard to this permit. However, this permit contains language that in essence says that once that language is adopted for everyone else, the City of Long Beach will conform to those provisions.

And so I do expect that when those come to us and before the Board, it will be a very interesting discussion.

MR. COE: Dennis, do you feel that this new information that's coming in on those two things, and others, that the permit permits by reference to submit to the executive officer who will approve this or something like that, that those things can be accommodated and the permit can be more satisfactory to more people?

MR. DICKERSON: I'm not quite sure I'm following you.

MR. COE: The new information that's coming in --

MR. DICKERSON: Right.

MR. COE: -- you just said that you're waiting on this development plan.

Does the permit very easily accommodate without coming back before this Board and having hearing changes in the permit that --

MR. DICKERSON: Oh, that, bringing that matter to the Board is actually something that's not going to be specific to Long Beach. It's more reflective with the county permit. So we're not going to be reopening the Long Beach permit. And we're not going to be reopening the county permit.

The permit right now -- as Xavier

pointed out -- the county permit, allows the executive officer to approve those what we call SUSMPs, Standard Urban Stormwater Management Plans. And at a meeting -- several meetings ago we made a commitment to actually bring that to the Board in response to some of the questions that were raised. And so that is the genosis of that particular commitment.

MR. COE: What is approved in the county permit will also apply in the Long Beach permit?

MR. DICKERSON: Yes.

MR. COE: Thank you.

MR. NAHAI: Any questions?

I had a couple.

First, with respect to this issue of new development -- I hate to revisit it again, but you kind of just lost me.

I understood that with respect to that issue what is going to happen is that hopefully today we would set a deadline for that to come back to us, be it September or whatever is a reasonable time, we would actually try to decide on that today. And that when that happened, it in effect if not reopening this, we would be supplementing it.

Because it seems to me on the one hand you're saying that Long Beach is not going to be completely taken out of the county permit regime. And yet the new development matters that you were talking about, you were saying would pertain to the countywide permit from which Long Beach is being expressly excluded under this permit. And so it is a legal comment that Jorge can sort out for us.

In other words, I think what I'm saying the issue of new development and the regulation of stormwater runoff is a critical issue. And we need to make a decision today. That's not going to be before us today. And if we're going to adopt this permit without those critical aspects, then we need to know exactly when they will brought before us. And we need to know that they will be brought before us in a legal form that will in effect supplement this, so then there won't be any question as to the effectiveness of those provisions once they find out.

MR. LEON: Mr. Dickerson, I think, wants to make a couple comments after finding a point in the permit. But I agree with you that the concern is valid. And I see it as a process that will supplement the petition -- I'm sorry -- permit because otherwise you would have a gap.

MR. COE: That was really one of my questions.

MR. DICKERSON: On page 16 of 33, paragraph 6 (a), the language is that SUSMPs will incorporate the following requirements: A. Provision associated with SUSMPs adopted by the Regional Board.

And so that is the reference by which when future action adopting actual provisions of SUSMPs, Long Beach is obligated to conform to that.

MR. LEON: Did you want to make perhaps a statement -- make a modification that makes that absolutely clear? And from your question I also hear a request for a statement with respect to timing about when that will be brought back.

MR. NAHAI: Yes.

MR. LEON: Dennis, do you know when that will be brought back?

MR. DICKERSON: Would September 15 at the latest be acceptable?

MR. COE: What date is that?

MR. DICKERSON: September 15th. So we would bring that to you at some point before that.

MR. NAHAI: Okay. That will be hopefully when we get to it and a motion is made, this will be one of the issues that will be -- you know, I anticipate as we go through this process that there are going to be many other modifications. And someone should be noting them so when we get to our motion --

MR. DICKERSON: I'll so designate myself.

MR. NAHAI: I have a couple of other questions.

First, I would like to compliment you, and the Regional Board staff and Heal the Bay and Friends of the Los Angeles River and everyone else that spent so much time; of course, the City of Long Beach in bringing this to this place. I know it was a difficult process and a time-consuming one.

MR. SWAMIKANNU: Happy to have a happy ending.

MR. NAHAI: Well, having said that -- who talked about a happy ending?

Whenever I'm in court and the judge says nice things to me, that's when I begin to get happy. But here are the couple of questions that I have.

First, with respect to the timing issue. I appreciate the fact that a time limit has been put in here because there just wasn't one before. On the other hand, the timing that's been put in now is a general one, six months for implementation where no other time has been specified.

But as we go through the permit, there are provisions and requirements which don't lend themselves to a six-month time frame. And I wanted to ask you about a couple of things if you have this in front of you, because I see that they're not specifically, you know, addressed.

For instance, in Part 1(c) on page 6 of 33, "The permit shall be part of part 1 and 2 in the permit in timely implementation of controlling measures, et cetera," is that supposed to fall under a six-month deadline? And what does is contemplate in there?

MR. SWAMIKANNU: The six-month deadline is for implementation of the Stormwater Management Program, which is their program to achieve. But it doesn't give them a six-month waiver on compliance.

MR. NAHAI: But this is my question, Xavier, because if you take a look at the change language, it says "Implementation of the requirements of the permit and the LBS WMD," so that's where my confusion arose from.

For instance, we've got things here like -- I don't know -- in page 11 (b)(1), "The permittee shall participate with the County of Los Angeles, the City of Los Angeles, et cetera."

Do they have six months to do that or is that something that should become effective immediately?

MR. SWAMIKANNU: That should be effective immediately. Because they're part of the countywide program, they will continue to participate. And that's laid out in the Long Beach Stormwater Management Program. I realize that that confusion can arise based on the change that I recommended.

MR. NAHAI: Okay. Well, we need -- just another example -- and all I can do here is give examples -- and then we can go through it paragraph by paragraph. But on page 18 paragraph 4, "The permittee shall not issue a grading permit for developments that would disturb areas of five acres or greater," that's not a six-month time frame. That should become effective immediately.

So what do we need to do? If we take your six-month deadline and we make that applicable only to the stormwater plan, then that leaves all of these other provisions without a deadline.

I mean, I'm happy to be a pain and go through each paragraph that I've marked here if that's the thing to do.

MR. DICKERSON: Perhaps what would be best is -- and it's clear that we're going to probably have to break for lunch, then reconvene in order to close out all the public comment -- over lunch, Xavier, I'm sure, can go through that and identify any items that need to be clarified in that manner.

Will that be okay?

MR. SWAMIKANNU: Yeah.

MR. KESTON: Is it possible if we don't break for lunch, we can get through this and be done by 1 o'clock?

MR. DICKERSON: I doubt that very much.

MR. KESTON: We don't have to make this until 5 o'clock today; right? I mean, it's not a requirement that we do that? I would surely like to see if we could really move this along and make things happen here earlier.

MR. NAHAI: I would like to do it as quickly as possible, but if you think that we've agreed to give 10 minutes to the discharger on this and five minutes to each of the commenters and we've got eleven cards here and not even allowing for questions --

MR. KESTON: I mean everybody takes five minutes? I mean usually we have two minutes of speaking.

MR. NAHAI: But Mr. Dickerson suggested and requested that given the fact that this permit, you know, may well be the model permit for other cities, it deserves -- it really deserves all of the areas of scrutiny that we can give it. And we have a responsibility to do that.

MR. DICKERSON: We can certainly have a shorter lunch, if that would help.

MR. NAHAI: Well, shall we take lunch now and then come back and hear from the discharger?

MR. DICKERSON: That makes sense.

MR. NAHAI: Okay. So we break for lunch until 12:30, say? Let's do that then.

(Lunch recess.)

MR. NAHAI: Let's come to order then.

And we're continuing Item No. 11.

And we've heard from Staff and now we're going to hear from the representative of the discharger. And we've agreed that we will provide 10 minutes to the City of Long Beach and thereafter five minutes to each person.

MR. HOLLAND: Thank you, Mr. Chair, Members of the Board. I'm Raymond T. Holland. You can call me Ray. I'm the director of Public Works. I've been with the city for over 15 years in that capacity. And I'm honored to be here to talk to you today. And I'm here on behalf of the city council. And I would like to thank the Water Quality Control Board for working so diligently with us over the past several months in creating the proposed permit presented for adoption today.

I especially would like to thank Dennis Dickerson, Xavier Swamikannu and staff, for their dedication and technical expertise in working with the environmental groups, other public agencies and our city staff to produce a document that not only meets, but exceeds the intent, technical aspects and legal requirements of the Clean Water Act.

I would like to say -- and it's not in my written notes here -- that I want to say about Dennis and Xavier that in my over 30 years of experience in public administration, I've never worked with more consummate professionals than the two of them. That's from the depths of my heart. They're honorable men of integrity, good will, and it's been a privilege to work with them. And I count it as a blessing to consider them as friends and I want to continue that friendship.

I would also like to thank the environmental groups and the scientific research community for their participation during this process.

And on our presentation over here you see the names and so forth, you might want to follow the presentation to my right, your left.

Thanks are also extended to the public agencies, such as EPA Region IX and the Los Angeles County Department of Public Works for their assistance in the development.

The content and quality of this proposed permit has been greatly enhanced by the concerned parties, and I would like to say "linking our arms." We've linked our arms, the environmental community on one side, your staff on the other side and us in between. We've been working together over the past several months to create a document which is designed to protect and preserve our valuable water resources.

It is important to adopt this proposed permit not only for the City of Long Beach, but for the region.

The City of Long Beach is committed to protecting and preserving the quality of its waters and beaches. As you may know, Long Beach recently received an A plus rating in the Heal the Bay's "Beach Report Card." Clean, uncontaminated waters and beaches are vital to the quality of life for our residents. Safe waters and clean beaches provide many recreational opportunities and are important parts of Long Beach's appeal to tourists and to our economic prosperity. Adoption of this proposed permit provides for protection and preservation of our valuable water resources.

Long Beach has worked cooperatively with all concerned parties to develop a permit that serves to protect and preserve our waterbodies and beaches. When adopted, it can provide framework for other cities in the region to follow, not only for their particular city, but also for a cooperative cost-efficient watershed approach.

Adoption of this proposed permit in 1999 instead of 2001 allows a two-year "jump start" towards achieving water quality standards. It includes items such as implementation of TMDL's, monitoring for quality water in the City of Long Beach and incorporation of specific elements in planning, development and construction, just to name a few. All of these items are designed to reduce pollutant runoff and improve water quality.

Adoption of this proposed permit allows us to fully implement a comprehensive program to expand upon and integrate all components of the permit concurrently with the approved Long Beach Stormwater Management Program, into our environmentally based programs in a cost-efficient manner.

Let's take a look at some of our programs.

The Long Beach SWMP approved May the 27, consists of the following elements:

Program management, which outlines the areas of responsibility for each department within the city structure for implementation.

Geographic characteristics describes the storm drain system, channels, and waterways.

Development planning and construction provides for stormwater quality guidance for developers.

Illicit connections and illicit discharges is designed to eliminate illegal connections and discharges into the storm drain system.

Education and public information programs for heightened awareness of stormwater runoff and its potential effects on our waterways.

And annual reporting for benchmarking, trend analysis and setting future stormwater quality goals.

This plan is the foundation of our Stormwater Management Programs and provides a method of implementation and integration of the clean water elements with existing programs for maximum efficiency and cost effectiveness.

Let's look at how our Long Beach SWMP integrates with current environmental programs associated with the stormwater management.

The city has many proactive stormwater quality related programs that can be expanded and used to integrate the elements of the Long Beach SWMP concurrently with the implementation of the proposed permit.

Some examples of these programs are street sweeping; automated trash collection;

Southeast Resource Recovery Facility, that's our waste energy facility; pump station cleaning, 45 percent of the city's stormwater runoff drains to pump stations allowing us a unique opportunity to remove debris prior to outfall into our waterways.

We have programs for catch basin cleaning; catch basin stenciling; litter receptacles on streets, in parks and on beaches; and a beach raking program, takes the debris and rakes it up before it gets into the water.

Beach clean up after storms. And I would like you to look at that picture. I hope you can see it. That's the kind of stuff that comes down the rivers onto our front door. And I've shown many of these kinds of pictures to Dennis and that's why we're concerned about clean water. We want this region to do something about what comes down and gets on our beaches.

We have recycling programs. Extensive. I think we're a leader in that field. Oil collection program. Again, we're a leader in that area. This is a curbside collection of oil for our residents so that they don't get dumped into the storm drains.

We have special refuse collection programs. Again, we're trying to get the citizens to not put their trash out in the street or someplace where it will blow into the street. We provide that. We have litter abatement and property maintenance ordinances, and we enforce those. We have household hazardous waste collection programs. I think you know about those.

We have what we call our "Traveling Recycling Education Center." This is a very elaborate trailer with up-to-date kinds of devices that we take out to the schools and we educate them on environmental programs, including stormwater education.

We have what is called "Protect Our Watery World" programs for children. This program is a hands-on interactive children's education class on the negative effects of trash and pollutants on marine life and our oceans.

We have the City of Long Beach Nature Center, which conducts various and environmentally-based classes, including education on the protection of our waters and appreciation of aquatic life. We have composting and vermiposting programs; water conservation programs; reclaimed water programs.

If you look at the green shaded area,

our areas where we irrigate with reclaimed water. We have Adopt a Beach program; we have Beach Clean Up Days. And we participate in countywide events of all sorts that are environmentally oriented, particularly water quality oriented.

Ash can/litter can ordinance. Long Beach has established an ordinance which requires the placement of ash cans and litter cans in appropriate places, such as you see here in front of restaurants, fast food establishments and markets to prevent litter and cigarette butts from ending up in our streets and on our beaches.

I hope you all have visited our Aquarium of the Pacific, there is a picture of it there. We have many cooperative programs with the aquarium folks to educate children and adults about water pollution prevention and protection of marine habitats.

And this I think is interesting, we have an Environmental Crimes Investigation Unit. The city has a unique Police Department/Fire Department Environmental Crimes Unit, which officers have police authority and hazardous waste materials training combined. This unit works with various agencies to investigate and prosecute environmental crimes, including stormwater pollution.

These are but a few of our environmental programs. Together all programs will serve to protect and preserve our waterways and beaches in a cost-effective manner.

Now let's look at some innovative items in the tentative order.

The tentative order provides for TMDLs. These are new permit items that provide for TMDL's for trash and other pollutants when adopted by the Regional Board.

Monitoring of the City of Long Beach waterbodies. There has been quite a bit said about that already. I won't go into that unless you want me to later.

We're working to cooperate with other agencies for regional waterbody testing monitoring. And we have 25 percent Xeriscape requirements. Pervious area requirements. New developments must have areas designed to reduce or absorb stormwater runoff. Proposed projects cannot exceed pre-development runoff in those areas where the potential for increased stormwater discharge rates can result in an increase in downstream erosion.

Proposed parking lot study. By July

15th, 2000, survey private parking lots with ten or more spaces, exposed to stormwater runoff to determine the amount of pollutants generated by these sources and the measures taken to remove litter by the parking lot operators.

Increased parking lot sweeping to a minimum of one time per month for public agencies, for uncovered parking lots with spaces greater than 25.

Uncovered parking lot washing program to be developed by October 1, 2000, and implement an uncovered parking lot washing program for public agencies.

Increased litter can placement.

We're running out of time. I'll just keep on going.

Provisions for covered trash areas; increased street sweeping; pesticide application on an "as needed" basis, rather than routinely. Provisions for GIS, Geographic Information System, database recordkeeping. Increased education for commercial businesses; developers; the general public where we've committed to make 1.5 million impressions per year; school children; city employees.

We're trying to reach out to everyone

we can. These are items that are over and above the current 1996 municipal NPDES permit and will allow a two-year jump start towards improving water quality, especially in the area of water quality monitoring with Long Beach and regionally.

At this time, I would like to address Regional Stormwater Monitoring Program agreements as we previously mentioned.

The trend is to have more regional monitoring. Currently, counties and cities are meeting to development cooperative agreements. The Los Angeles Watershed cities have been developing a draft agreement since March of 1999.

Also, seven counties have recently conducted two meetings, with Southern California Coastal Water Research Project as the lead, to develop agreements for cooperative monitoring, similar to the Santa Monica Bay project between the city, the county and the scientific research community.

The purpose of these agreements are to set the parameters for consistent, meaningful data collection and for shared funding for these regional monitoring projects. The current participants of this project are SCCRWP -- which we've already talked about -- Orange County, Riverside County, San Bernardino County, San Diego County, L.A. County, San Barbara County, Ventura County, UC Davis, Cal State San Diego, Camp Pendelton, EPA, the Regional Board and even Caltrans.

This activity serves to validate that agreements between public agencies are currently being proposed to improve water quality, and could be modeled for the City of Long Beach in our proposed cooperative regional monitoring agreements in permit year three.

The City of Long Beach has received the support of many public agencies on our request for our proposed permit.

The following are a few examples: The Executive Advisory Committee; the City of Azusa; City of Claremont; City of Covina; Diamond Bar; San Dimas; Irwindale; and we received Lakewood today; South Bay Council of Governments, which is 16 cities; and others.

And we would like these to be put in the public record as support from the above-mentioned cities. Many cities support our request for adoption of our proposed permit, as it provides flexibility in implementation of programs and sets the stage for other cities to apply for their own permits.

In summary, the City of Long Beach is very proud of the proposed permit and request its adoption today. Not only will it allow the CIty of Long Beach to better protect, preserve and improve water quality, but also it can serve as a model for other cities to do the same.

We sincerely believe that the adoption of this permit will protect our waterways and provide a means for regional cooperation in the implementation of the requirements of the Clean Water Act, which can improve water quality for the entire region.

Thank you.

I would be happy to answer questions or at least attempt to.

MR. NAHAI: Do we have questions of Mr. Holland?

I would just like to say on behalf of the Board that I understand that you and your staff contributed significantly to the atmosphere and cooperation in order for these negotiations to be brought to us this day. And it is sincerely appreciated by us.

And it goes to show that when people

from state agencies and local agencies and the environmental groups cooperate together that a great deal can be achieved.

I had one question to ask you, though. And it goes to page 15 of the permit.

And it reads -- it's Section 2 and it says: "The permittee shall inspect" then (a) says, "those portions of the storm drain system consisting of storm drain pipes 35 inches in diameter or greater for illicit connection within five years."

That seems an awful long time. Why is it five years is necessary for those inspections?

MR. DICKERSON: Which paragraph number, please?

MR. NAHAI: I'm a page 15.

MR. DICKERSON: 2 (a)?

MR. NAHAI: 2 (a).

MR. HOLLAND: The water department -- which we had one of our water Board members here this morning. He had to leave and go to another meeting. He was hoping to be here and hear the deliberations.

This water department is headed by the water Board, appointed by the mayor and council, is responsible for maintaining our storm drains. And they have a comprehensive program. And to go through and to do this, they had asked us to give them a five-year period because we have a tremendous number of these.

And I was just told that they are asking that the program would be moved up more than five years. But it was based upon the resources available to go through and do video checking of all the lines and to do that visual inspection analysis and then the determination of what needs to be done. So it was based upon the resources that they had that they committed to it to a comprehensive program.

MR. NAHAI: What would the inspection program commence?

MR. HOLLAND: It's underway right now. They've been doing it as we were developing this.

MR. NAHAI: So it's ongoing?

MR. HOLLAND: Yes. And they're hoping to beat five years. But five years is what they laid out in their work plan is what they felt that they could do it with the resources that they had available and they're trying to implement it sooner than that, they've already started it.

MR. NAHAI: Thank you very much.

MR. HOLLAND: Thank you very much.

MR. NAHAI: Going now to the cards.

The first one I have here is for Mr. Moore.

MR. MOORE: Good afternoon. Gary Moore with the City of Los Angeles. I wasn't laughing at the opportunity to comment. After hearing two hours of wonderful cooperation, it's hard to be the first person that has a concern. So that's why I was chuckling as I walked up here.

MR. NAHAI: That's what the public hearing is for.

MR. MOORE: Right. Thank you for that opportunity.

We have some concerns regarding provisions of the Long Beach permit, which indicates that the requirements in the separate permit would be applicable to all cities. We appreciate the change that was made, but we don't think it's gone far enough. We believe it should be deleted completely.

The City is a strong advocate for improving stormwater quality with limited resources and several court mandates, we must be sure that the programs we implement are cost-effective and complement one another to the maximum step possible. With that in mind, several of the provisions of the Long Beach permit would prove inappropriate to the City of Los Angeles.

The permit was publicly noticed as a Long Beach permit and not as a standard condition for all stormwater programs.

Furthermore, we're concerned that the requirements included in the permit are applicable to business and industry, and as we are all aware of this morning or this afternoon now, that only one commenter from industry is here today.

We received in the City of Los Angeles comments and concerns from business as we've been moving forward in implementing our permit. We have several concerns, including cost effectiveness of the proposed BMPs and controls.

Three of the examples that I have for you this morning are -- in the permit they called out for street sweeping to be done twice a month. The City did a study and found that street sweeping had limited benefit towards reducing stormwater pollution. With the number of miles in the City of Los Angeles, it would be prohibited to do this in the City of Los Angeles. Our current permit requires us to do it once a month.

Secondly, there was a requirement, as we've talked about this morning, to do an uncovered parking lot washing program. This may be appropriate to the City of Long Beach, but it's contrary to the City's ordinance that bans such activities as part of our water conservation program.

I think also during the general public comments we heard this morning, that to clean one parking space, it would take 2 to 7 gallons of water. If you look at this on a regional basis, you're talking about a lot of water.

Third example that I have for you is regarding the 25 percent use of the Xeriscape. It's inconsistent with the City of Los Angeles's policy, which is to enhance the urban forest for air quality and other beneficial quality of life issues.

One other thing I wanted to talk about was that since it was brought to our attention this morning about the SUSMP -- is the acronym we call it, so everyone has their own take on it -- is that we want to go on record that we have very serious concerns by putting in the requirements that we discussed this morning. And we are working with the County of Los Angeles and we've submitted comments to them.

Just a little bit more here.

Several of the proposed requirements may have multi-media impacts. And what I mean by this is that the City is very concerned about the potential of solving one environmental problem by creating another. We must have the opportunity to review and evaluate control options for environmental impact.

Because of the unique needs and requirements of local government, it is important that each city participate in the development of their own individual permit.

Since the City did not participate in the Long Beach negotiations, and as discussed, the City has several difficulties and concerns with the conditions in the permit, we respectfully request that the requirement that has been modified, note 16, be deleted completely.

And I want to thank you for the opportunity to comment.

MR. NAHAI: Thank you, Mr. Moore.

The next card I have is from Ms. Eileen Ansari.

MR. KESTON: Should we hold all comments until -- or if we have a question --

MR. NAHAI: We can ask questions of the individuals.

MR. KESTON: Maybe this is a question

of Jorge.

If the City of Los Angeles has an ordinance that says, "Will sleep" -- "will sweep" -- excuse me.

MR. LEON: I'm sorry. Will do what? Will do what?

MR. KESTON: If the City of Los Angeles has an ordinance that says, "We will sweep one time per month," and if they have a water conservation ordinance that says, "We can't clean the parking stalls with water because it uses up too much water," or if they have an ordinance dealing with air quality that is inconsistent with these ordinances, what do we do?

I mean, do we prepare an overriding ordinance and then the City must comply and change their ordinance? Or do we go and find out as to each of these instances what the City's ordinance -- they may have absolute good reason and that reason may not be water quality. But it may be -- from the City's point of view, it may be an overwhelming reason which might take precedents. How do you deal with that from a legal point of view?

MR. LEON: Well, I think what we would do -- I'm going to suggest that what we would do is negotiate with the City and try to work it out. But clearly your question stems from the comments with Mr. Moore who just said you're tying us into a whole bunch of predicaments here.

And rather than answer your question, I would like to say that Mr. Moore's comment, while well taken, I think we have a good answer for it. This permit does not bind the City to do anything, the City of L.A. Rather, the finding -- first of all, it is a finding -- as Xavier pointed out during his presentation, findings don't bind anybody to do anything. It's just a factual basis for where we go with the permit, No. 1.

No. 2, the City will have its opportunity to negotiate with Xavier, with Dennis and the staff to work out problems like the one that you just pointed out, if it happens to exist, when we get to working out the City of L.A.'s permit; whether it happens to be an individual or group permit.

You know, I think that's the best way to answer your question that we wouldn't be forcing something on them that would create a legal issue for them. We don't want to create an issue for them or for us. But the finding is merely a finding. And the City of L.A. and the other cities will get their day to negotiate appropriate permits for those other jurisdictions.

MR. KESTON: I guess Mr. Moore ended his comments by saying he would like something deleted and I didn't pick up exactly what it was. But is that something that you're going to address from a legal point of view because you want to make sure we don't wind up in lawsuits with every city across Southern California because of ordinance problems?

MR. LEON: Sure.

MR. DICKERSON: To make that particular issue hopefully very concise and resolve, it's the first item on the change sheet, No. 16. And as Jorge pointed out, it's really just a factual basis. It has no binding authority. It's really just kind of nice language to kind of set the stage. And I don't think it's mandatory, not required. And unless Jorge has a strong objection, I would just say take it out.

MR. LEON: Take out the language?

MR. DICKERSON: Yeah, on 16.

Okay. I guess I better talk to my attorney.

MR. SWAMIKANNU: If I may just add a little bit.

The final objective of this is for water quality. And when this issue comes up for the City of L.A., if we issue one in the future, we would consider that. We would make whatever adjustments are necessary to achieve the water quality objective.

For example, if there is a conflict with the water conservation ordinance, then we would suspend the requirement when the water conservation ordinance is in effect. So there are adjustments, but we cannot deal with that right now because we don't have the City of L.A.'s permit with us. We have the City of Long Beach's permit with us.

MR. NAHAI: I think it's important that that be clear on the record. What is before us today is the permit for the City of Long Beach, not the permit for the county or City of L.A.

And the language, as I understand it, before read "That the Regional Board will ensure that Stormwater Management Programs for areas within the county that drains into the City of Long Beach would be consistent with the requirements of this order" and that was changed -- or the proposal is that that be changed to state that the "Stormwater Management Programs for areas within the county that drains into the City of Long Beach will complement the

R0073548

requirements of this order."

Now, I understood Mr. Moore's concerns to be truthful. The first concern was that this permit is going to serve as a model. It may serve as a model, but that doesn't mean that it's going to be verbatim binding on other jurisdictions.

And the second issue is whether the statement that the Regional Board will ensure that Stormwater Management Programs for the County of L.A. will complement the requirements of this order, whether that would obligate us somehow to impose upon the City the requirements that are similar to those here.

I think the word "complement" appears innocuous to me. But we also need to consider from our point of view whether -- because we can't be put in a position as well for the City of Long Beach, that we're committing to them that we're going to impose something else on other jurisdictions. We don't know if we're going to impose something else on another jurisdiction.

So given that, what is the recommendation? That we delete the language altogether or --

MR. KESTON: If it's an "objective" as

opposed to "ensure," that's a different thing.

MS. LYON: I would like to make a comment.

I'm very concerned, though, that the City of Long Beach is going to be stuck with things coming downstream. I mean, they're receiving everything that's coming down from further north. I would think that they would want to keep this language in. I don't know. I need to hear from them.

MS. MUNOZ: Yes. My name is Barbara Munoz from the City of Long Beach.

And I would like to say that we do have storm drain systems within our jurisdictions that are not only City of Long Beach, but also the County of L.A., Caltrans.

So, in essence, we would like to keep this language in to make sure that their systems are also maintained on stormwater quality.

MR. LEON: Now, that pretty much squarely hits the issue that I think you said, can we commit ourselves to do something in future permits. I would recommend that you do.

But on the other hand, it does provide a certain amount of -- the statement as stated in there currently with the innocuous phrase "complement" versus "consistent with," I think it provides the City of Long Beach a certain amount of assurance that you're going to consider what action is being taken today in the future permits.

On the other hand, if you learn in the negotiations and discussions with future cities that there are some inappropriate provisions in this permit, then it would not be applicable to those future permits or shouldn't be. You don't have to do it.

I think the City understands that a finding isn't a commitment that binds anybody, but it is a statement of assurance. And maybe that kind of statement here on the record is what all the parties need to hear.

From the City of L.A., No 1., you're not going to be bound by what is in this permit. Although, it certainly does look like a model and we planned it that way because we want to do the leg work now to set up the base for the future permits.

MR. NAHAI: What if the word "ensure" were to be changed to "will employ reasonable efforts to ensure"? That way it's not a legal commitment on our part, but it does mean that we will use our efforts to make sure that it's all complementary.

MR. HOLLAND: Mr. Chairman, may I say something?

We've been working on this in a goodwill basis. And I have every expectation that that will continue to be the norm, not only with your staff, but with all agencies. I think one picture -- and I could have shown you lots of pictures showing what we deal with, what comes down those two rivers. We want whatever can be done, but it needs to be done in a cooperative fashion.

I think our own personal experience, the City of Long Beach, and the way we've approached this when we sit down and we talk about the issues and we work in a goodwill basis, a good faith effort. I think out of that, good people will come up with the right solution.

So the kind of language you just talked about, Mr. Chair, is fine with me because I trust your staff. I trust the staffs of the other cities and the environmental groups that we all work in a good faith effort to deal with the issue that I showed you on that one slide, all the debris and trash and the sediment and everything that comes down those rivers. We've got to work together.

I would hope that we would not get hung up on the language today, per se, that there will be an agreement among us all that that's an objective we need to be working on in a reasonable way.

MR. NAHAI: Thank you.

MR. KESTON: Mr. Chairman, I am not a lawyer, but somehow the words "best efforts" is a legal phrase. And I would like to -- if we go and change -- if we decide to change it, I think it would be better to change it to say it's our "objective" that everything is consistent, as opposed to "we will ensure that we use best efforts."

That would concern me from the point of imposing something that we don't intend to impose and then somebody downstream comes and says, "But you said that's your best efforts and you haven't gone out of your way to do that."

MR. NAHAI: We can deal with that when we come to the language of the permit.

Thank you for your patients.

MS. ANSARI: Thank you very much. Mr. Chairman, Members of the Regional Board and honorable guests, I'm Eileen Ansari, council member from the City of Diamond Bar, delegate to the San Gabriel Valley Council of Governments, and also a director of Southern California Association of Governments where I serve as the chairman for the NPDES committee.

I would like to say that the City of Diamond Bar supports the Long Beach permit for the process by which any jurisdiction and the county can operate its own permit.

The City of Diamond Bar, a city of 68,000, is not quite the same as the City of Long Beach with 450,000 people. However, clean water is the objective of all of us.

The Long Beach permit addresses several concerns that the San Gabriel Valley Council of Government expressed in a letter to Dennis Dickerson last year. We're pleased to see that the Long Beach permit contains a reopener clause that allows the permit to be modified any time during the term of the permit; allows potable water to be discharged to the storm drain system; and model programs, especially development and construction, have been simplified, made more reasonable and easier to understand.

Executive Director Dennis Dickerson, the Regional Board members and the environmental community should applauded for the work on this permit with the City of Long Beach.

Still we ask that the Regional Board correct two problems that the San Gabriel Valley had raised several months ago. And I'm asking it because I think it's setting a precedent with the City of Long Beach.

That it can remove from the legal authority the section prohibiting untreated wash water to the storm drain system. This provision can be interred to mean that it's permissible to discharge treated wash water to the storm drain. The problem is that there is no way wash water can be treated before it goes to the storm drain.

First, discharging wash water through some type of treatment device, such as an oil/water separator, would violate the discharge prohibitions section of the permit. The discharge of wash water to the municipal storm drain system constitutes an illicit discharge under the permit.

I would like to say that we support the City of Long Beach permit. And we realize that this is not a cookie-cutter permit for every city, but we also have to realize that every city is individual. And the main objective is clean water under the Clean Water Act.

Thank you.

MR. NAHAI: Any questions?

MS. LYON: Do we have a change for that or not?

MR. LEON: A change regarding best efforts and goals?

MR. NAHAI: The remarks about untreated water.

MR. SWAMIKANNU: The section she's talking about is the section on legal authority. And what we have defined legal authorities as is the municipality has the legal authority to enforce against the discharge of untreated --

MR. NAHAI: Which section are you on?

MR. SWAMIKANNU: Page 9 and 10.

This section basically says if the city has demonstrated legal authority, these are the kinds of things that it has to be enforcing. The discharge of treated wash water is okay because they're removing the pollutants. And so the legal authority prohibition should be, again, the discharge of untreated wash water.

Now, untreated wash water can be sent to the sanitation system, or they could use some kind of treatment system to remove oil. What we're asking the City is to have the capability to enforce against situations where wash water is released to the storm drain without undergoing any process.

One thing that would take that out of the process is if it has an NPDES permit. And occasionally we do issue NPDES permits for wash water.

So I do not really understand what the concern here is. I think what the City is trying to say is if there is an illicit discharge when you discharge wash water and so it should not have to demonstrate legal authority to enforce against untreated wash waters released to the storm drain.

My recommendation is basically that since it's only a legal authority requirement and if the wash waters are directed to the sanitation system, you have no problem. If they have some kind of treatment device, you have no problem. You could make a decision at that point whether that needs an NPDES permit or not.

Any questions, Mr. Chairman?

MR. NAHAI: Thank you, Xavier.

Let's move on. The next card I have is from Ms. Terri Grant.

MS. GRANT: Good afternoon. My name is Terri Grant. I'm employed by the Los Angeles County

Department of Public Works, but I'm here today speaking on behalf of Mr. Desi Alvarez, chair of the Executive Advisory Committee, to provide the letter of support that Ray mentioned earlier in his presentation.

The Executive Advisory Committee for the Los Angeles County Municipal National Pollution Discharge Elimination System permit wishes to express a support for the City of Long Beach's application for their own NPDES permit.

We support the concept of local control for stormwater programs as we feel that greater progress will result in the City's tailored individual requirements for their unique needs and abilities.

As such, the EAC understands that the Long Beach permit is city-specific and many parts may not be applicable to other municipalities. Nonetheless, we support the City's efforts to create its own unique program.

MR. NAHAI: Thank you very much.

Any questions of Ms. Grant?

Next card I have is from Mr. Ron Wilkniss.

MR. WILKNISS: Good afternoon,

Mr. Chairman, Members of the Board. My name is Ron Wilkniss. I'm with the Western States Petroleum Association with the trade association in the western United States, California and several surrounding states. And it tends to be the majors of the industry that are our member companies.

Many of our members own and operate retail gasoline outlets, also known as RGOs, that will be impacted by the requirements in this NPDES permit.

I would like to preface what I expect will be brief remarks with an apology to the staffs of both the cities of Long Beach and the Los Angeles Region. Regretfully, I became aware of this issue only fairly recently. And I do hope that my relatively late arrival on the scene has not caused them undue inconvenience.

Our own interest is focused on the proposed requirements for retail gasoline outlets. We have submitted a comment letter. And I would like to thank the two staffs for giving our comments favorable consideration.

I would like to underscore for you that we did not suggest that there should be not requirements for retail gasoline outlets. Rather, we did suggest that the requirements be made consistent with those from the retail gasoline outlet stormwater best management guide published as a consensus prereviewed document on the California Water Quality Task Force. It's quite a mouthful, isn't it?

In March of 1997, they participated in that process representatives for the independent marketers, as did EPA; the State Board; the Los Angeles Regional Board; the Santa Ana Board; numerous other local regulatory agencies.

And, again, I would like to emphasize, what we produced back in '97 was a full peer review consensus document.

You have partially addressed our concern for consistency, however -- and it's only slight "however" -- I do note that there now appears to be an inconsistency -- I guess more accurately a direct conflict -- with some of the requirements of the source controls that are contained in Table 5-1 of Appendix B.

And I'm specifically referring to measure SC 2. SC 2 requires, among other things -- and SC 2, by the way is not contained in the package. SC 2 is from an earlier California stormwater -- and I may have the incorrect title, but basically it's a

BMP handbook also produced by the California Stormwater Task Force.

There are several requirements within SC 2 that were evaluated and specifically rejected by the task force when they subsequently published -- that is to say four years later -- the BMP guide specifically for service stations.

I would like to offer one suggestion in this regard. It occurs to me that a few simple words in what would be a new paragraph 12 to the effect that in the event of a conflict, it is the March '97 task force that will take precedents.

And once, again, I would like to emphasize that both BMPs -- that is to say, the BMP handbook from which SC 2 derives, as well as the later retail gasoline outlet stormwater issues were both published by the California Stormwater Quality Task Force. It is merely that the RGO BMP guide represents more current thinking.

Thank you.

And once, again, I would like to thank Dennis and Xavier very much for their assistance. And give my apologies for coming in the scene so late.

I would be pleased to answer any

questions that you have.

MR. NAHAI: Questions for Mr. Wilkniss?

MR. KESTON: Do you know what page he's talking about?

MR. SWAMIKANNU: B 1 Appendix.

MR. KESTON: 1146.

MR. NAHAI: Xavier, I would like to hear your response to Mr. Wilkniss's indication that there is a conflict between a reference of the BMPs in the new paragraph 12 and a requirement that are in the appendices.

MR. SWAMIKANNU: I think I have a simple solution to the issue that has been raised. What he has raised is the fact that there is a reference to a source control best management practices from an earlier addition or an earlier handbook. And that's referenced in Table 5.1 in the Appendix B 1.

And one way to deal with that conflict that he talks about is remove SC 2 and put in the reference to stormwater quality task force handbook from '96.

That would take care of the conflict and we don't have to make any other adjustments.

MR. NAHAI: On the Appendix B Table 5.1

in what is the third line after the words "vehicle and equipment fueling," in the column corresponding to that, you would remove SC 2?

MR. SWAMIKANNU: SC 2 and put in the reference to the handbook, which is actually in your change sheet. On the first page, did you look -- we would put in that reference as opposed to SC 2.

MR. NAHAI: Right. The 1990 --

MR. SWAMIKANNU: Exactly. That would make it consistent, there would be no conflict.

MR. NAHAI: Does that take care of the issue?

MR. WILKNISS: An elegant solution.

Thank you, Xavier.

Thank you very much.

MS. LYON: Thank you.

MR. NAHAI: The next card is from Mr. Ted Morton.

MR. MORTON: Thank you very much. My name is Ted Morton. I'm the California Policy director for American Oceans Campaign, which is a non-profit organization based in Santa Monica, California. I just joined the staff here in California in February. And this exercise provided a wonderful opportunity for me to learn about the local stormwater issues here.

And I wanted to extend my congratulations to the officials of the Board, the County of Los Angeles, and the City of Long Beach and other environmental representatives who participated in the past few weeks of intense negotiations. I just want to particularly point out and thank Steve Fleischli from the Santa Monica Bay Keeper and Mark Gold from Heal the Bay. They provided the leadership of the general environmental community.

That being said, I do have some concerns that I would like to address. And one was mentioned earlier this morning about the need for clear performance standards and requirements for the development section of the proposed permit.

And I would strongly recommend that you specify the requirements and the context of the permit and make that decision rather than wait for another process to come down the line when we're not quite sure what date the elements of that process would be; and you're making some kind of reference sort of into the future, looking into a crystal ball to sort of see what those types of provisions would be.

I think it would be fair and clear if

we go ahead and make those decisions today and put that into the language of the permit.

And the other issues I have relate to the monitoring section of it. I think that there needs to be a greater emphasis on source, identification, and a greater emphasis on the effectiveness of the BMP. Both of those were listed within the permit. The Appendix C that identifies the monitoring program as before, it is a little unclear about what kind of commitments the City is making in terms of what they will be doing to identify the sources of pollutions going upstream to try to resolve the problems related to those problems. And also, what they will be doing on examining the effectiveness of best management practices.

What I saw in the appendix was they were going to be doing this in some kind of annual report where they would be listing potential sources of impairment.

And then also, they would be proposing special studies for BMP implementation. I think those should be strengthened a little bit in a firm commitment from the City to do more of those two issues.

The other one addresses monitoring sediments for toxicity. And I understand that there is an effort underway -- a regional effort underway to do some work on toxic sediment testing. But, again, the other two points I think it should be clear in this permit -- in this program that Long Beach is putting forward that they are going to be committing to working with others to do these sediment toxicity studies rather than just proposing that that would be one element of a larger regional study to do.

Thanks for taking my comments.

MR. NAHAI: Do we have any questions of Mr. Morton?

Xavier, do you have any responses to Mr. Morton's comments?

MR. SWAMIKANNU: I mentioned this earlier. I think this whole stormwater monitoring is preview science. And a study conducted a couple of years ago by the Southern California Coastal Water Resources Project that looked at stormwater monitoring in Southern California among the different municipal programs, there was no consistency.

The methods of measuring the pollutants that were measured, source identification, all those have not been standardized. Which is why there is a statewide effort now through legislation to bring more consistency so that we're able to come back.

The fact that we find toxicity because of a particular protocol might not mean anything unless you standardize the process. And that is why I think the participation of regional efforts in Southern California will go a long way to identifying the issues that have been raised by the environmental community.

Monitoring for monitoring sake is just not good enough. It's a waste of dollars. And I think a little more patients and a little more direction will go a long way towards answering the kind of questions they want answered.

So my recommendation is that we encourage regional participation where those entities exist. And for certain monitoring, like establishing trends. Mass emissions, those are already being required under the monitoring program. It's the unknowns that we want regional efforts for. And I think that's the action the Board should favor.

MR. NAHAI: Thank you.

MS. DIAMOND: I have a question. One more question.

When you talk about regional monitoring, do you have any time lines in mind? I mean, how long would we have to wait to get some good information?

MR. SWAMIKANNU: Let me take one example I think that's the clearest example and probably the best example of what is beginning to happen.

Southern California Coastal Water Research Project has performed regional monitoring for the treatment plants, waste water treatment plants for perhaps 30 years.

So in the last three or four years they have established a regional protocol for monitoring sanitation waste water treatment plants. The same entity is now bringing together an effort to monitor stormwater. And what they're in the process of developing is a five-year cooperative agreement to study these issues. First of all, prioritize the questions that need to be answered with regard to stormwater and then begin within six months to answer those questions.

And I think that's a concrete example of what is before us that wasn't there in 1990, it wasn't there in 1996 when we adopted the countywide program.

So time frame is in the next five years. But many of the important questions, like: If I find toxicity, how do I trace the source? Those protocols could be established, I would think, within the next two years.

MS. DIAMOND: Thank you.

MR. NAHAI: Okay. The next card I have is from Mr. Ray Tahir.

MR. TAHIR: Mr. Chairman, Members of the Board, my name is Ray Tahir and I represent a number of cities on NPDES matters.

I have four letters here that offer support for the Long Beach permit. And I would like to read one of them into the record. It's a very short letter. And it basically echoes what the sentiment is, I believe, from a majority of Los Angeles County.

"Dear Mr. Dickerson, the City of Lomita urges the members of the Los Angeles Regional Water Quality Control Board to approve the City of Long Beach's application for an NPDES permit. The City understands that the new permit is specific to the City of Long Beach, parts of which might not be applicable to the

City of Lomita or other cities.

"Nevertheless, the City supports Long Beach's application for the following reasons; one, it would allow the City of Long Beach to have an NPDES permit, free of the several problems associated with the existing permit.

"And beyond that, it would establish a precedent that would allow this City and other cities in Los Angeles County to also opt for a new, less problematic permit prior to the expiration of the existing permit, which is due to expire in July of 2001, hopefully at least.

"As you know, the current permit has been of no small concern to municipalities of Los Angeles County. A corrective NPDES permit, such as the one proposed by the City of Long Beach, as described in the accompanying Stormwater Management Program, would make compliance a less difficult and uncertain experience.

"Further, it would facilitate this City's efforts to improving the quality of runoff of our receiving waters in a more cost-effective manner."

Beyond this, I would like to revisit the issue of the treated runoff from the associated wash water provision, which is on page 10 of 33. And more specifically, is covered under provision F and G.

I understand Dr. Swamikannu's response. The problem with it is that this particular provision has nothing to do with discharging wash water into the sewer system. And let me run through this and see if it makes sense.

Under F, the Department says "Prohibitive discharge of untreated runoff in the washing of toxic materials from paved or unpaved areas (inaudible)."

From this it can be inferred that it's okay to discharge treated runoff associated with the washing of toxins or any other material, for that matter, to the MS 4.

MS 4 here, as defined in the existing permit and as defined in federal regulations, includes streets, gutters, catch basins, storm drains, or any conveyance natural or man-made outreach to convince stormwater to receive water. It does not include the sewer system.

There is no way, by the way, that you

can treat wash water before it goes into the stormwater system.

As a matter of fact, in order to do that -- and you could do that conceivably by routing the water through a treatment-control device, such as an oil/water separator or a catch basin enter. But that would be in violation of the discharge prohibition section of this permit, which does not exempt wash water as a permissible discharge to the storm drain system. That needs to be made clear.

If you were to leave the language the way it is, it would invite certain dischargers to use those devices or water separators and catch basin inserts as a means of discharging impermissibles in the storm drain system. I think the environmental community would agree that this is something that they don't want to happen.

And lastly, now that I have put this little bur in the permit, I would like to extend my congratulations to the Regional Water Quality Control Board staff, Dennis Dickerson and Xavier Swamikannu, in particular, and to the environmental community who have obviously lent its support to this permit.

And I'm more than happy to entertain any questions if you were to have them.

MR. NAHAI: So your suggestion really echoes Ms. Ansari's suggestion, which is that the word "untreated" be deleted from Subsections F and G --

MR. TAHIR: And Dr. Mark Gold suggested that.

MR. NAHAI: Okay. We haven't heard from Mr. Gold yet.

MR. TAHIR: He mentioned that. I don't want to put him on the spot.

MR. NAHAI: But in terms of the amendments to this, you're proposing that the word "untreated" be deleted from 7 and G?

MR. TAHIR: Right.

MR. SWAMIKANNU: Mr. Chairman, I have no problem with that.

MR. TAHIR: Thank you so much.

MS. DIAMOND: So that's a new change?

MR. SWAMIKANNU: Yes.

MR. NAHAI: Okay. The next card that I have here is from Mr. Eugene Bromley.

MR. BROMLEY: Good afternoon. I'm Eugene Bromley from EPA Region 9, stormwater coordinator for EPA Region 9.

I'm here today to urge the Regional

Board to adopt and propose the stormwater permit for the City of Long Beach. We've reviewed the draft permit and we think it's consistent with the Clean Water Act.

And we're also prepared to send you a letter of endorsement for the permit as was requested.

And the changes that we've heard about today, I don't think would effect our endorsement of the permit.

There are a couple of issues that I wanted to talk about here today in regard to the permit.

One of them is the receiving water limitation language. Things I want to clarify. As many of you know, this has been a contentious issue in California for nine years now, ever since the first permits were issued back in 1990.

And the draft Long Beach permit uses the language which EPA worked out through discussions with California taxpayers, the State Board and environmental groups. And as was mentioned, the State Board has now adopted that language in the order of June 17th.

The order says that you have to have

that language now. That's the same language that we used for Riverside County and Vallejo in California.

So the point I wanted to just make very clear is is that we support the Long Beach permit on this issue.

Also, we've looked at the Stormwater Management Program that has been talked about, was described by the City of Long Beach. We think it's thorough and consistent with the regulation and covers the main components of the regulation and we support it.

And it's good to also see that it's detailed and descriptive in a lot of areas like how many industrial inspections you have to do. And exactly when you have to clean out the catch basins. Exactly how much public education to do.

We think that helps with the enforceability of the permit and it also helps define what MEP is. Cities and counties have been clambering for many years about: What is MEP? How much do we have to do? Now they know.

Also, we looked at monitoring. And EPA is encouraging less chemical monitoring and more use of alternate monitoring tools, like bioassessment tools; habitat assessment tools; toxicity testing.

Some of the alternate measures of the effects of still water dischargers.

And we think that the permit appropriately is moving in that direction. So we would support the permit in that area as well.

One last issue that hasn't been raised yet today, but I have been told by Board staff that this issue has been raised by some commenters. It is a matter of: Should the city have to go through this part-one, part-two permit application at this time?

And we would say, no. We consider Long Beach -- we consider this to be a reissuance of the permit that was originally issued in 1990. Because Long Beach, was cited in the 1990 Los Angeles County permit, so this is a reissuance for Long Beach. And EPA came out with an interpretive policy in 1996 as to what a reissuance application should consist of.

And what you should do is submit an updated Stormwater Management Program and monitoring program, which will reflect your experiences during the previous permit term.

We think the City of Long Beach has done that. And so we would support the permit issuance on that issue as well as.

So I guess that's about it.

MR. NAHAI: Any questions of Mr. Bromley?

Thank you very much.

The next card is from Ms. Jacqueline Lambrichts.

MS. LAMBRICHTS: I'm Jacqueline Lambrichts with the Friends of the Los Angeles River. And I would like to just say "ditto."

The second largest density of our members live in the City of Long Beach, many along the Los Angeles River as well as the San Gabriel River.

And all want clean air, clean water to drink, clean water to recreate in, greenspace for recreation, aesthetic and quality of life reasons. All these many hopes and desires are not that unreasonable. And the expectations for this municipal stormwater permit were high, especially with the City involved in a lawsuit. And the lack of participation by its members in the process.

Unfortunately, this permit does not live not up to the expectations. And especially if it is to be considered as the model for new permits. And I think that's really one of the big concerns and issues we have.

I may be new to the black box of municipal stormwater permits and monitoring for landuse impacts, but the monitoring design is inadequate to address either upstream contributions or Long Beach contributions and those of individual businesses. The City of Long Beach is an integral piece of the puzzle of the Los Angeles/San Gabriel watersheds, and it's not setting a precedence to effectively evaluate the upstream and sidestream sources and to subtract these from those emanating within Long Beach. Once this is in place, it is easier to point the finger upstream.

Our members in Long Beach are involved in a review of the Open Space Element of their general plan. Some are involved in the process as part of the Environmental Strategic Task Force. The sustainable cities concept for Long Beach resulting from the work of the Environmental Strategic Task Force is not well represented in the new development and pre-development design and structural Best Management Practices requirements of the permit before you.

There appears to be a disconnect between what our members and friends of Long Beach desire in this permit, and what the environmental community desires in this permit, and what is actually before you.

I am aware that the monitoring can be modified by the Executive Officer after the introduction of this permit. And through the Environmental Strategic Task Force we have put language for ordinances to address the means development and pre-development issues.

Thank you.

MR. NAHAI: Dr. Mark Gold, please.

MR. GOLD: Good afternoon. My name is Mark Gold from Heal the Bay in Santa Monica, 2701 Ocean Park, Suite 150.

A couple of things I want to say right off the bat, which is that we felt that the negotiations themselves with the City of Long Beach I thought went very, very well for the most part, considering the fact that people seem to forget that the only reason we are here is because Long Beach sued over the fact that they didn't like this permit to begin with.

So facetiously I would like to thank Jim Hankla for taking a new job and also for getting a new City Council there. Because I think that really makes a big difference in negotiating with

Long Beach. It seems to have definitely opened their minds for environmental protection purposes. And we think that, by in large, the stormwater permit is a pretty good permit.

Now, that being said, we're still opposed to the permit because we came in day one of negotiations, which was in a very accelerated time line; I think we must have met for 50 hours in a six-week period or so. And we said that new and redevelopment was the No. 1 issue to Heal the Bay.

And as you can tell within this document, new and redevelopment is basically not adequately addressed. And I think it's a very dangerous precedent for this Board to defer what the requirements are going to be, quote, on page 16 on No. 6, "The SUSMP will incorporate the following requirements: A, provisions associated with the SUSMPs adopted by the Regional Board."

Now earlier you talked about maybe that will be by mid-September, but we have no idea what those requirements are going to be. I can tell you right now, based on how vehement I think some of the cities are going to fight over this, I doubt it's going to come out what our position was; which is that we were willing, as a compromise, mind you, not from our original position, to accept the NRDC L.A. County Department of Public Works agreed upon on 100 percent of the runoff from a 0.75 inch storm must be either treated or infiltrated. That was actually a compromise for us to agree to do that.

During negotiations, of course, we were told it was too late in the process; that the City of Long Beach, even though the County was willing to do that, felt that it would still put them at a competitive disadvantage on attracting new business; and that they wanted to really defer to see what the Regional Board had to do with the other 84 cities within the region.

We find that absolutely unacceptable and poor permit writing to defer something as major as this to a later date. You've heard Heal the Bay talk here time and time about where we're really going to make the long-term mark on reducing stormwater pollution is going to be through changing the way we do development and redevelopment in the region where we're really trying to keep more of the runoff on site and treat more of the runoff on site rather than building basically from property line to property line and having the polluted runoff go on parking lots and go straight into the storm drain without any treatment whatsoever.

So I thought we were very, very clear on that within our comments -- I mean our comment letter. And basically it has not been addressed. And, in fact, it's just being deferred to a later date because of some artificially imposed judicial deadline that, frankly, Heal the Bay and the rest of the environmental community have nothing to do with.

We're not party to this lawsuit. So it made the negotiations, as you can imagine, quite difficult when really you're being told that some judge, who we have nothing to do with, is really who is imposing the time line.

Also, if this goes forward, I really feel like the organization, Heal the Bay, will have no choice but to appeal the permit to the State Water Resources Control Board. And as you know, we only have 30 days to appeal this permit. And doing the math, I'm sure you can figure out that we will have to file the appeal long before the Regional Board is going to have the opportunity to review the model program for SUSMPs.

And so that's going to be a pretty unfortunate circumstance as well that really the environmental community, as this permit is written, will probably have -- at least Heal the Bay anyway; I don't want to speak for the other groups -- will have no choice but to appeal this permit to a statewide Resources Control Board.

That being said, on monitoring there is a couple of issues.

We're very grateful for the fact that there was a compromise made this morning on adding Los Cerritos monitoring one year rather than two years out. I think that's very, very important.

This whole reference which we've heard probably about 15 minutes of presentation on for SCCWRP and the regional stormwater efforts, that's all well and good and I applaud the effort, but I fail to see it anywhere in the stormwater permit. So that's a nonenforceable commitment. And, of course, we are looking to write permits that are enforceable, not something that we promise to do something in good faith.

Where you are going to hear me say that time and time again because the compliance record on stormwater permits from 1990 on for municipalities has not exactly been the best. So good faith isn't really enough to make sure that our receiving waters are actually being protected.

The other thing in regards to monitoring is referring you to page 11 of 33 in the requirements where it says, "Six items that the City of Long Beach monitoring program shall do" and one of the things is Item 6 "Evaluate BMP effectiveness." In no way, shape or form does this monitoring program do that.

And there is also a number of other items in here that are not adequately done; "evaluate water quality and toxicity in receiving waters," et cetera, et cetera.

So if you look at those requirements, most of where that gets addressed is three years down the line with some monitoring program that will be negotiated with upstream cities within the watershed. We have no idea what the dollar amount is. We have no idea of what "fair share allocation" is going to be.

And so we're basically being asked to buy off on a monitoring program that we have no idea what it's going to be.

And as we've seen with the TMDL lawsuits and the settlement requirements and those who developed TMDL, I don't think I would be very comfortable as a Regional Board knowing that you're not going to get any new information that's going to be of any use whatsoever for the L.A. River and San Gabriel River from this permit for at least the next three years.

And that's pretty troubling in light of, as I recall, some of the L.A. River and San Gabriel River TMDL requirements to kick in in years four and five. So I wonder what data is going to be used to develop those TMDLs.

So with that being said, I know there is obviously severe limits on time, and so if you have any questions, I would be more than willing to address them at this time.

MR. NAHAI: Yeah. I would like to try to summarize, if I could, your areas of concern so that we can have them respond.

MR. GOLD: Sure.

MR. NAHAI: The first area of concern and the most important one, obviously, is with respect to the redevelopment and new development. And I'll ask for a response on that in a second.

But the second area of concern, as I understood it, was with respect to participation in regional monitoring programs, you would like to see a reference added specifically to SCCWRP?

MR. GOLD: Since we've been hearing that, that would be one thing that would be an improvement to the permit. But beyond that, I think it's a dangerous precedent to basically defer permit conditions, especially as part of a settlement, three years down the line.

MR. NAHAI: I understand. I'm going to ask you a specific question about that.

The third area of concern was just how much monitoring this provides and especially the fact that it defers to allocating in the future sometime monitoring responsibilities and allocation of costs between Long Beach and other cities.

MR. GOLD: Correct.

MR. NAHAI: Regarding the issue of new developments and redevelopments -- I want to get some more explanation from Staff on that -- but if we're really in a position that our Staff feels that they just simply do not have adequate information at this point to impose the 100 percent .75 inch requirement that you alluded to, but that by September 15th they will be in a position to bring back to us specific proposals and recommendations regarding new developments and redevelopments, wouldn't it be wiser -- from an environmental point of view -- to take the permit that we have now, to adopt it, and then supplement it when the additional information is with us?

Or if we don't do that, do we not run the risk that what we have in hand may be lost by the time of all of that information actually becomes available?

MR. GOLD: The reason why I disagree is that if you had 20 cities here basically saying that they don't want any firm commitment for new and redevelopment from the standpoint of -- whether it's the .75 inch storm at 100 percent treatment or infiltration, or the .6 inch storm, or the 1 inch storm, or whatever it might be, it's going to be a politically dicey position.

And it's not going to be just the City of Long Beach's permit you're talking about. You're going to see 20 other cities lined up basically saying why they can't do it for their particular site conditions. You know you're going to hear that.

And that to me is troubling. And it seems to me that the precedent has been set with the L.A. County. And it seems that that's something that was negotiated. We were not party to that negotiation whatsoever. We literally found out about this a few days before the last negotiation session that we were allowed to, in this artificial deadline period, have with Long Beach and the Regional Board.

And it just seems to me that Long Beach's original concern was they didn't want to be so far out there on a limb that they were having this competitive disadvantage. Well, if the county is already going to do this, then it seems to me they're not going to be the only one on that limb. Those are two pretty big parties that are out on that limb, L.A. County and the City of Long Beach.

So it seems to me that clearly that what you need to do is provide the consistency and go forward and finish this permit right now and provide new development requirements.

MR. NAHAI: You mean today?

MR. GOLD: Today.

MR. NAHAI: What are you suggesting that we put in as the development requirements?

MR. GOLD: Well, the thing that we would suggest is the .75 inch, what the county, basically, has already set precedent by adopting internally. So it's there.

Believe me, we gave five other different choices. You know how Heal the Bay negotiates. We don't just say "We're opposed." We gave five different options from various different regions around the country. We didn't get responses on any one of those. It was one of those, this is going to be Long Beach's toughest issue. Let's save the hardest thing for last. And to be candid, we never got there.

MR. NAHAI: So I understand what you're saying, you're not saying, let's defer the entire permit until we're ready to deal with the new development and redevelopment issue. You're saying we're ready to deal with that issue right now; we have standards that can be implement -- not implemented, but that can be included in the permit today, that's what you're saying?

MR. GOLD: Absolutely. But the thing that would have to be taken into consideration -- and I know I'm playing Jorge's role here -- is that that would probably be constituted as a "substantial change." So you better seriously take into consideration that since that was not something that was in there previously.

And I know all my environmental community people are stabbing me in the back right now.

But the reality is that, you know, this is something that we proposed throughout negotiations with other alternatives. And it's not precedent setting because the county has already adopted it.

MR. NAHAI: The idea is to do something that's going to be effective. So I'm sure they're not stabbing you in the back.

Any other questions for Dr. Gold?

MR. KESTON: I guess the point, though, is if you do something like that, you then have to notice -- you have to go out and notice everybody and come back here again and have another hearing.

MR. GOLD: But if you adopt this as is, we're going to appeal. I mean there is no ifs, ands or buts, we will appeal.

MS. DIAMOND: Explain again what would happen if we adopt it with this suggestion from Heal the Bay today, if we wanted to do that?

MR. KESTON: I think you have to ask Jorge. But the effect is that we have to notice this to everybody and have another hearing so people can comment on new issues that are brought forward.

MS. DIAMOND: I understand. So that's basically the answer?

MR. SWAMIKANNU: Mr. Chairman, may I

just comment on what Mark said?

MR. NAHAI: Yes, please.

MR. SWAMIKANNU: He said that the precedent had been set between the County of Los Angeles and NRDC. And that number was negotiated in a separate agreement.

Now, for an agency like this to adopt that number, we have to do independent review. That has not been done. So it's not a precedent for us. It's simply another option that's out there. That's how I would see it. That's how I think Staff sees it.

MR. GOLD: But where was the independent review of our other three options? I mean, that never happened either, even though we provided those six weeks ago -- I mean six weeks before the 30-day notice.

MR. DICKERSON: Our representative from EPA may have a very salient comment.

MR. NAHAI: Let's hear from Mr. Bromley.

MR. BROMLEY: I wanted to say --

MR. NAHAI: Mr. Bromley, you're going to address us on this issue of new development and redevelopment?

MR. BROMLEY: New development.

I just wanted to say that we have already been through something like this in Arizona where we still issue NPDES permits. And we issued permits for the cities -- the one in Arizona needed a permit just like Los Angeles. And for some of them, new development standards were deferred pending new information.

And the way it works, is you issue the permit, like the Phoenix and Tucson, and then they develop new development standards and submit them later.

But the point is that as long as you preserve everybody's right to comment on those standards and appeal those standards in accordance with NPDES regulations and whatever the state procedures are, everybody's rights are preserved by the process that's laid out by the Regional Board.

So I don't really understand -- I mean, I think that there is a concern here that just isn't real. I think that the Board has procedures which address the concerns that have been raised here.

If somebody doesn't like the new standards or what is in these SUSMPs, which were developed later, then all of the appeal procedures remain available to them. And as long as that's the case, nobody's rights are compromised.

So I think that the process that is underway here does preserve everybody's rights and addresses these concerns. Again -- is that clear?

MR. DICKERSON: If I may respond directly.

First off, the impression is that we're ignoring the issue. We are not. The whole redevelopment issue is built into the permit. The framework is to bring it back to you in the very near future, as we've already discussed.

Very likely at that time we will have specific provisions in place that are applicable to Long Beach. And quite frankly, I think Heal the Bay's appeal is going to be moot at that point, because the standards will be in place even before it gets heard by the State Board.

The implication is that there is something in the County permit right now that specifies standards that are in effect now. That's not the case. They're subject to approval and they're to be submitted to us very shortly. So the requirements built into the permit years ago in '96 come borne with these proposals basically now. And we're at that point. So we really don't lose a lot in terms of time.

We've already covered the NRC negotiation issues, how that is built in. So that's really my comment. I just wanted to emphasize, we're not ignoring this issue at all.

MR. NAHAI: Any questions of Staff?

I did want to hear Staff respond to Dr. Gold's concerns about the monitoring issues.

Could Xavier comment on that?

MS. DIAMOND: He just stepped out.

MR. NAHAI: I can see he didn't want to talk about that, did he?

MR. DICKERSON: We are going to need Xavier to respond to that, but one of the major issues that I was aware of was the Los Cerritos Channel is now incorporated and will be through part of the change that we have, which the City agreed to today. So that was a major hurdle that was still outstanding.

MR. NAHAI: But in the interest of getting everything complete, Dr. Gold had additional concerns about monitoring the well.

MR. DICKERSON: Perhaps we can come back to that question shortly.

MR. NAHAI: In that case, the next one is Mr. Steve Fleischli.

MR. FLEISCHLI: Good afternoon, Mr. Chairman, Members of the Board, Steve Fleischli, executive director Santa Monica Bay Keeper, P.O. Box 10096, Marina del Rey, 90295.

I would thank a lot of people. There are people that need to be thanked. But I want to make sure we don't lose sight of what this is all about today.

Today is about ensuring that a frivolous lawsuit results in a constructive settlement. That's really what we're here today to do. We can't lose sight of the lawsuit. I want to talk a little bit about the new development that Mark Gold raised.

Early on in the settlement negotiations, both Mark and I drew lines in the sand on our main issues. My main issue happened to be the water quality limitation language. I'm satisfied with the way that's played out at this point in time.

The new development, though, is a concern in the environmental community. And I want to respond to a couple things that were said. In particular, I want to respond to one issue raised by

EPA on this with regards to your ability to simply preserve these other rights as long as everyone has the opportunity to comment, then it will be consistent with the Clean Water Act and move forward in that fashion.

Unfortunately, what Mr. Bromley is not aware of -- because their office is in San Francisco -- is what has really transpired over the five years with this.

Essentially, we had a permit in place that took a year and a half to negotiate that was supposedly a consensus process. Unfortunately, that didn't prove to be the case and Long Beach sued on that.

When Long Beach sued, what happened was everything in the municipal stormwater context from the Regional Board staffing prospective stopped; it stopped right there. And every single resource and every Staff member was diverted to defending the Long Beach issue. Members were in depositions; they were preparing responses to motions. Things like that.

So to say that we can wait even longer and simply preserve everyone's right to comment on these issues is somewhat disingenuous because, in fact, this program should have been done a long, long time ago. And one concern is that we continue to delay these things.

In the original permit we could say, "You come back to the Regional Board in a year, in two years, and we will approve your plans and we will move forward." That seemed to prove very ineffective, at least from my prospective. It's better to address the issues up front.

And so I would encourage the Board to adopt new standards now or simply push the permit -- which I know no one wants to do because of the judge and getting on the bad side of the judge -- but either do it now or push the permit.

And please recognize that when we did negotiate this -- and for several months Mark was very firm on this issue. And I have to back him up on it. We said 100 percent treatment for all runoff from certain types of new developments.

At the last moment, we did realize that the position had been negotiated for .75. And out of good faith and because I think the folks of Long Beach have been very cooperative throughout this whole process, we were willing to stick with it at that point in time.

But I think after today, at least from

many groups' prospective, .75 is going to be out the window and we're going to go back to 100 percent.

If we're going to take and move forward, we need to move forward. .75, you know, it comes up to snuff with the county, but we really have an opportunity -- especially now that we're two years behind on this particular program in Long Beach -- to move forward even farther.

So I would encourage you to consider that very carefully.

A couple of other issues I wanted to respond to.

Mr. Wilkniss raised the issue of the parking lot -- or excuse me -- the gas station fueling areas. We're opposed to that change in the change sheet on that.

We think -- and this goes back to an issue that we talked about a couple months ago with regard to BMPs.

What we have here is a reference to a management practice guide that Mr. Wilkniss has represented of being a consensus document. And it's interesting to note in the listing of those folks who participated in the consensus process of building that document, there was not one environmental group named in there because there was not any environmental representation in preparing those documents.

So what it is in my mind is simply a list of BMPs. And you might remember on the County, when we adopted that order with regards to the list of BMPs, the Board made a modification to say that they would choose from that list in the maximally effective manner, as opposed to just having a list and individual facilities could do whatever they want. They could choose the least restrictive; they can choose the most restrictive.

And so what we would encourage is that instead of making reference to this guide, you simply make reference to that they will implement BMPs that will prove maximally effective of preventing polluted runoff from those fueling areas.

And if they want to come back and respond, if their handbook, in fact, does provide them the opportunity to reduce pollutants in a maximally effective manner, then that's fine. And that issue has been preserved for them. And we still have the opportunity to ensure that people aren't just choosing the easiest thing on the list to move forward there.

I agree with the comment that was made earlier on page 10 to take out the word "untreated." That makes a lot of sense to me.

The last thing I would like to express is I don't want people to get the impression that this permit and this negotiation is an invitation for 85 separate permits throughout this region. I think that would be a tremendous burden on Staff. And I don't want people to get their hopes up that every single person is going to have -- or excuse me -- every single municipality is going to have their own permits.

I do think this is a somewhat unique situation. We did review all sorts of things we should look at on a watershed basis to make it a little bit easier for Staff to manage and for everyone to comment on these things.

I would like to close by thanking Ray Holland and Rose Collins, in particular, from the City of Long Beach. I thought they were very cooperative. And I appreciate their professionalism and courtesy. I don't think we would have seen that two years ago.

Thank you.

MR. NAHAI: Questions for

Mr. Fleischli?

I have a question about the .75 percent standard.

What happened in this issue in your discussions and negotiations with the City?

MR. FLEISCHLI: Well, I'll tell you, the way it started out was -- and Mark can speak to this as well, this was his biggest issue.

It started out with 100 percent of the runoff needs to be treated or infiltrated in some way, shape or form to address the issue before it becomes a problem. And the development stage is really the time to do that.

Now about -- oh, I guess it was about three days prior to the close of negotiations, we got word from L.A. County and from Xavier that some language had been negotiated between NRDC and L.A. County that had not, to that point, been available to anyone because it just came out at the last minute that they had agreed to this .75.

And so we sort of scrambled and said well, okay, we had our 100 percent standard for unlimited runoff and let's now play off what the County has agreed to. Because Long Beach's biggest concern with 100 percent was we don't want to stick our neck out too far. We don't want to discourage development in our communities. We don't want to be there all alone to have people pointing fingers at us.

So this actually -- while it made us feel somewhat awkward -- it actually gave us an opportunity to say, okay, well, you're not going to be out on your own anymore because L.A. County has done it. And hopefully, the Regional Board will recognize -- as Mark said -- that there are now two large entities out on a limb.

And when the time comes for you to adopt this SUSMP, you'll say, look, these guys are doing .75. And let's all get on board here. That's what BMPs are. That's the best that's out there, at least in Southern California. So let's move forward.

I think Alex Halperin can talk about it a little bit more. According to their consultants, some cities go as high as one inch and a little higher even.

MR. NAHAI: But in the negotiations, Long Beach was not amenable to the .75 inch standard?

MR. FLEISCHLI: No, they were not. They were not for either end. Their concern was still that they would be too far out in front; that when the other city comes up, they might get a .6 standard or something like that and then Long Beach is going to be too far out in front.

And I think one of their concerns -- I'm not sure that Mr. Holland would represent this -- is that the county is a different situation because it's a county government rather than a city government. And they don't want to see them being the only city government that's out in front.

And I would also say for Mark Gold to comment on legal issues of substantial change and things like that from this, I think the .75, it's been out there; Long Beach is clearly aware that that was an issue that was going to be discussed today. I don't think there is a substantial change that would require 30 days due notification.

For Mark to make statements like that is like me commenting on monitoring programs. It's not within my purview.

So Thank you.

MR. KESTON: Could I ask you a question, Steve?

This stormwater permit or all stormwater permits are very significant. And I know they are to you; and they are to Mark; and they are to the Staff and everybody else.

Could you give us an idea of what -- is there any general percentages of where the major pollution -- is the new planning and development 50 percent of it? Is the car washes 40 percent?

I mean we're talking about 30 or 50 things across a pretty broad spectrum. And if we take an action here today to deal with one, do we then give up immediately dealing with the 95 others that are maybe 98 percent of the problem? Is there any percentage or any concept that you have that you can share with us, Steve?

MR. FLEISCHLI: You know, to my knowledge right now on the broad scale issues, there are not. There are some breakdown of what particular industries might contribute. EPA's general sector for industrial; stormwater (inaudible) breaks down; some of those significant contributories for those things; and things like gas stations and refining operations; and those sorts of things are certainly on that list.

In terms of what new development contributes and whether we might be missing other opportunities, I think one thing that has not been expressed today, but should be clear from the lack of expression on it, is that most of the other sources that we think are contributing to the problems have been addressed in some way, shape our form in this permit in a manner that makes I think most people fairly comfortable that we're doing what we can on a lot of those, like restaurants and other sorts of things.

And so new development, while we don't have a number, I think some of that stuff will come out in TMDL development hopefully. But it really is the unique opportunity to deal with the situation beforehand.

And unlike most of the other things that we're trying to regulate through this permit, whether it's a restaurant or a shopping center or a gas station fueling facility, we don't really address it before the problem is created in the first instance.

If we can design these facilities to accommodate polluted runoff and to treat it in some way, shape or form, then we won't have to deal with these other types of things like diverting storm drain systems. We'll have dealt with that type of facility up front.

And there are only certain facilities

that are covered within this requirement, the proposed requirement; certain large development projects, things like that.

MR. KESTON: Thank you.

MR. NAHAI: Well, then, let's hear from Mr. Halperin first.

And then, Xavier, Dr. Gold's comments regarding monitoring, would you give us a response on that in a second?

Last, but by no means least, Alex Halperin.

MR. HALPERIN: Thank you. Alex Halperin with the Natural Resources Defense Council, 6310 San Vicente Boulevard, Suite 250, L.A., 90048.

Mr. Chairman, Members of the Board, we're at a significant turning point in the development of the L.A. municipal stormwater permit for the entire L.A. area.

As we all know, this is being considered as a model for future permits. And I think it should be considered very carefully.

For the most part, there are a lot of advances in this permit, which I think are commendable. And I think that the process that Long Beach and Heal the Bay, Bay Keeper, and the Board went through have produced some significant advances.

However, there is one big whole and that is the redevelopment/new development area.

The question here is whether we create a permit and leave an issue open and go through who knows what kind of process in the next few months to come to resolution or whether developing this permit now will result in the permit.

And the only major remaining issue seems to be the size of the storm that needs to be captured. That doesn't need to be revisited here. That issue has been resolved. The county and the principal permittee of the permit has already resolved the issue. I was the one who negotiated it with the County. They wanted larger than .75 inch threshold for storms to be captured.

There are many cities across the country that do a one-inch storm. Generally the ratings are decided based on the size of storm in an area; based on the hydraulic in the area. Many cities do it based on the one-year 24 hour storm, which is the largest average storm any area gets in one year over 24 hours.

Los Angeles has less rainfall than a lot of other things areas. So the one-inch standard adopted by many of the cities around the country is even a little bit low for the Los Angeles.

Nevertheless, we negotiated with the county and were willing to comprise and to go down to .75 inches. There is absolutely no reason that any city in this area should be adopting a standard any lower than that. And to impose a standard lower than that would be to really unjustly put the county out on a limb.

So I think there is every reason to simply wrap this up, adopt the standard that's been adopted by the County of Long Beach and to have a completed permit.

In addition, I would just like to comment on one other point. The proposed change with respect to the gas station fueling stations. I would just like to agree with Steve Fleischli.

This is, again, language that was negotiated with the County. We negotiated rather than simply having a list of BMPs, that the language state that the performance standard be to adopt that BMP or combination of BMPs, which will prove maximally effective in having a list. This would actually create a performance standard that would be meaningful for the fueling stations.

I would also agree with the removal of the word "untreated" in the waste water section.

One other point. I'm sorry. I'm just collecting these as we went through the day.

You mentioned that the five-year period was -- it seemed awfully long for a review of all the City of Long Beach's sewer systems, storm drain systems.

Again, we have a precedent for that at County. The County has agreed (inaudible) within one year. And I believe it's three years for their enclosed systems. I think you're correct that five years is, again, going backward from what we have already worked out with the County, imposing weaker standards and leaving the County out on a limb.

Thank you.

I'll be happy to take any questions.

MR. NAHAI: How do you react to Dr. Gold's view to put into this permit the .75 inch standards at this time will constitute a substantial change and therefore cause the entire permit to be --

MR. HALPERIN: Have to be renoticed. Yeah. I don't think that that's correct actually. Yes, it was brought up with Long Beach and is already in the county program, which is a public program. I don't think that it would need to be renoticed.

MR. NAHAI: Thank you.

Any questions?

MR. SWAMIKANNU: Mr. Chairman, you wanted me to address monitoring issues that were brought up by Dr. Gold?

At first he requested that there be some kind of recognition, the regional monitoring resource project if indeed that's what Long Beach intends to do. This came to the attention of Regional Board staff very recently. And I had encouraged Long Beach to investigate that opportunity.

And they had told me that they're willing to be part of that effort. So adding a statement to that effect in the monitoring section is not an issue. I would like to ask Long Beach to raise any objections to that, but I don't think they have any.

MR. HOLLAND: No.

MS. DIAMOND: What about the comments from Mark Gold that the regional monitoring is not enforceable because it's not part of the plan?

MR. SWAMIKANNU: That's the issue that I was addressing. We can make it part of the plan at today's meeting. We can add in language that says "Long Beach will participate in that process."

And then it becomes -- any results from there apply.

The other issue is that the monitoring program is sort of a dynamic program. As you find more, you tend to make modifications.

And under the permit presently, the City is required to report to us on the monitoring program on an annual basis and make modifications to the Stormwater Management Program.

Now, when those reports come into the Regional Board, the Executive Officer has the authority to make modifications to what you see before you today.

So it's not cast in stone at this point. At least the monitoring program is not, because the whole process of monitoring is to be able to monitor in the right circumstances and make the appropriate changes.

Now, on the second issue of the fact that some of the monitoring is being delayed under three years, hence, for example the Los Angeles River and San Gabriel River. And that comment has to do with the fact that the rest of the county and the cities have 1996 permit, which expires in two years past.

So at that time where the monitoring for those permits would be modified to accommodate different parties and any new information we have. If Long Beach comes out today and monitors the Los Angeles River or San Gabriel River, let me remind you that these rivers are already being monitored by the County under the countywide program. This is an add-on.

So it's probably not reasonable to expect the City of Long Beach to pick up monitoring for the rest of the permittees, only because it's the other permit that's under discussion now.

They have accepted reasonable monitoring for what comes off their city. And that's where the monitoring should lie. I think they're providing a piece to the larger equation of issues in the region.

In addition, the way we constructed the countywide monitoring program is to provide answers, for example, like Mr. Keston asked: How much does new development contribute? The counties are developing a model based on what is coming out.

In a year's time we'll be able to model

and answer some of those questions. Those same land uses in the City of Long Beach, we will be able to make those kinds of estimates based on those models.

So those models are applicable in Long Beach as well. So what we should see from Long Beach's monitoring program is providing additional answers to this countywide effort.

Questions?

MR. NAHAI: Yes, I had a question on a different topic.

So any other questions on monitoring?

Regarding the RGOs, how do you respond to the position that the 1997 document was basically a document negotiated between state agencies and the business community; that it did not have input from any of the environmental groups and therefore should not serve as the model that is being inserted into this permit?

MR. SWAMIKANNU: The answer to that is the opportunity to comment on the document was there for the environmental community. There was no participation. But the document itself is what is being applied by other municipalities statewide.

And there was representation from the Regional Board staff as well as State Board Staff to make sure that the BMPs that were negotiated in that is something that's reasonable.

Now, we can the elevate the requirements, the level of BMPs that are required for that particular issue. I think a larger concern for the environmental community is that they have not read the document. And so they're a little uncomfortable agreeing to something they've not seen.

And so there are two options here, either they disagree and leave -- let's not change it. Or the other opposition is to go with the fact that -- I was on the task force as well making sure that the requirements were reasonable.

So they just have to trust that they are technically sound.

MR. NAHAI: Your position is that it's technically sound and it's a sensible environmental regulation?

MR. SWAMIKANNU: Yes.

MR. NAHAI: And it would adequately protect?

MR. SWAMIKANNU: Yes. Any elevation will have to have sufficient cause. And this is sort of a base line and we're just talking.

MR. NAHAI: Thank you.

MR. SWAMIKANNU: Thank you.

MR. NAHAI: Those are all of our public comments.

I did have one question to ask Mr. Holland.

Mr. Holland, if the standard of 0.75 inches has been accepted by the County, why is it not palatable to the City of Long Beach?

MR. HOLLAND: Let me make a brief statement first.

You can see it's been a difficult negotiation. Even though we've done a lot of thanking and we've had our arms linked, we've had some very intense discussions. But I think it's a positive thing that we stand here today with this being the main issue that we're talking about, and all of the things that we're talking about. We are advancing the cause for clean water.

As to the .75, that was negotiated between the county and NRDC with none of us involved, even Heal the Bay or Santa Monica Bay Keeper, to my knowledge. In fact, they said here that they were not aware, they were not part of that. So we were not part of that, we're not sure -- I think as your Staff has indicated -- I believe the technical foundation for that, the technical basis for it.

And as I understand it, it only applies to the unincorporated areas of the county. It does not apply to any of the other cities. And I'm sort of going to give you a lesson in government here, and probably some of you already know that, but unincorporated areas are not the same as cities. Cities, this issue really hits home at the problem in the state; and that is, how cities are funded.

And what has happened with the way the things happened in the state is development is one of the key funding sources for cities to provide the services to their cities. And cities are competing against one another for development.

You heard big box developments. You've heard of entertainment complexes. And all these kinds of things. Cities were spending money to bring developers in because that generates revenues to pay for the services for the average citizens. Because the citizens taxes in no way pay for the services they receive.

And the county in unincorporated areas are funded differently than the cities. If the City of Long Beach is out on the point all by itself, we cannot be compared to the unincorporated areas.

We're at a competitive disadvantage. And developers -- some of you may know developers, some of you may be developers -- they go to the bottom line.

Now that's what they will look at. And if we have a requirement that costs them to do more development, they're going to if given a location in another community, go to another community. And that may be just across the street to do their development and we lose the revenues from that development. It's critical to the funding of a city.

Now, all that said, we, Long Beach, are not opposed in the concept to consider this issue. And we look forward for it to be discussed. And it may be that .75 is the appropriate number.

But I think there needs to be some technical analysis of that. We need to hear from your staff. We need to hear from other experts. We need to hear from other cities. And we need to determine if .75 is, in fact, a good number; not just a number that was negotiated over here in secret to try to settle a lawsuit.

It needs to be shown that it's reasonable and practical and can be accomplished and meets the clean water goals.

And we want to be part of that. We're not going to resist that. We're going to work and try to see that appropriate standards are in place. But to put that on us right now is a major, major issue. It effects our funding. And I can tell you that the City Council understands this, not just Staff. They understand because this is at the heart of how cities are funded.

We understand what they're trying to accomplish. We don't disagree with what they're trying to accomplish. We think the points that have been made are good points. But we cannot afford to be out there all by ourselves. Okay?

MR. NAHAI: Thank you for that explanation.

MR. HOLLAND: Any other questions?

MS. DIAMOND: Well, I guess just to sum it up for myself, we're basically saying we're back where we started, in a sense. Because we could deal with this issue, except that we have this lawsuit, which is this line that we have to deal with. We could take the time and come up with the standard for all the cities, but if we took the time before issuing this permit, we would have a problem with not having this lawsuit settled.

MR. HOLLAND: Well, as I understand, I think your Staff indicated that. And I said, I think it really boils down to basically one issue. I mean, there have been some other questions, but we're basically willing to work around with those concerns.

It seems to me that we've heard that there are ways that this can be dealt with. Go ahead and prove this and indicate that we will work along the lines of trying to come to a conclusion on that. And then what is resolved in that process, a public process, not private settlement negotiations, but public process is brought forward here and it's aired out in the public way

That's the only piece of our permit that is put off to the future. And that's just -- we've heard September the 15th. It's not that far off. And we're standing here before you saying we want to work and cooperate in that process.

I think I need to let your legal staff and your technical staff tell you how that can be done in the permit process. But I think to run all the risk -- I've heard the city attorney; I've read the order from the judge. I can't help that.

We wish that we would not be in that situation, but we're there. And the judge has been very firm about this. And we think this one issue can be resolved by putting forward to this process and it will be hopefully resolved in the September time frame. Maybe I've said too much.

MS. LYON: I would like to ask Jorge a question.

By waiting until September 15th and publicly noticing this and inviting all the rest of the cities that would like to know about new development language with regards to these permits, can we at that time incorporate that new language into Long Beach's permit and make it enforceable?

MR. LEON: Yes.

MS. LYON: I don't see any problem with that. To me, in the long run this is going to give us better water quality, better everything. Municipalities don't like being left out of the process. I sat on a City Council. I know what it's like to be included. And the problem with the original county permit, the cities felt like they were left out.

So I would say that -- my feeling is that I would like to go ahead and approve the permit today and then add the language later in September when we can get this all aired out.

MR. LEON: As drafted, the permit requires that -- it contemplates that as soon as we deal with that issue, it becomes an enforceable provision in the Long Beach city permit.

MR. HOLLAND: And we agree to that. We just think it needs to be a public process where all the issues are laid out there. And we understand from a technical standpoint; from an environmental water quality standpoint; and from a physical standpoint. So we just weigh all those issues and we do it all as a group.

MR. LEON: And if we do put off adopting any permit today, one of the consequences, of course, is the other many, many permits don't come into play.

With that said, may I do a little bit of record housekeeping?

I didn't hear a response. I assume it's okay.

MR. NAHAI: No.

MR. LEON: I would like to move the Staff files for the Long Beach stormwater permit into this record.

I want to make clear what the record consists of because that was an issue in the earlier litigation. And in order to avoid that as an issue on any further appeals in this matter, I want to make sure that those files are part of the record.

And in addition, since they're referred to in the findings of the permit, Volumes 12, 16 and 23 of the administrative record for the Los Angeles County permit, I would ask that those files be admitted into the record of this matter. They have to do with water quality references, respectively, MS 4 permits and guidance documents. And they are all relevant to the adoption of this permit.

MR. COE: Do you need a motion?

MR. NAHAI: Do you need a motion to include them in the record?

MR. LEON: If the Chair says, "So be it," that's all we need before you close the hearing.

MR. NAHAI: Well, with that, we will close the public hearing.

(Whereupon the proceedings were adjourned at 3:20 p.m.)

STATE OF CALIFORNIA)
) ss.
COUNTY OF LOS ANGELES)

I, Lori D. Casillas, CSR 9869, a Certified Shorthand Reporter in and for the state of California, do hereby certify:

That the foregoing proceeding was taken down by me in shorthand at the time and place named therein and was thereafter reduced to typewriting under my supervision; that this transcript is a true record of the testimony given by the witnesses and contains a full, true and correct report of the proceedings which took place at the time and place set forth in the caption thereto as shown by my original stenographic notes.

I further certify that I have no interest in the event of the action.

EXECUTED this 26th day of July, 19 99.

Lori D. Casillas

Lori D. Casillas, CSR, RPR

BEFORE THE STATE WATER RESOURCES CONTROL BOARD

STATE OF CALIFORNIA

PETITIONS OF THE CITIES OF BELLFLOWER, ET AL., THE CITY OF ARCADIA, AND WESTERN STATES PETROLEUM ASSOCIATION (REVIEW OF JANUARY 26, 2000 ACTION OF THE REGIONAL BOARD, AND ACTIONS AND FAILURES TO ACT BY BOTH THE REGIONAL BOARD AND ITS EXECUTIVE OFFICER PURSUANT TO ORDER NO. 96-054, PERMIT FOR MUNICIPAL STORM WATER AND URBAN RUN-OFF DISCHARGES WITHIN LOS ANGELES COUNTY)	SWRCB/OCC FILES: A-1280 A-1280(a) A-1280(b)

TRANSCRIPT OF PROCEEDINGS

June 7, 2000

10:00 A.M.

Community Meeting Hall
Torrance Cultural Arts Center
3350 Civic Center Drive
Torrance, California

REPORTED BY:
Terri L. Emery,
CSR No. 11598
Our File No. 1-64806

R0073624

APPEARANCES:

STATE WATER RESOURCES CONTROL BOARD

ART BAGGETT, Chairman
JOHN BROWN, Board Member
MARY JANE FORSTER, Board Member
PETER SILVA, Board Member

OFFICE OF CHIEF COUNSEL
BY ELIZABETH MILLER JENNINGS
P.O. Box 100
Sacramento, California 95812-0100

FOR CITIES OF BELLFLOWER, ET AL. AND
CITY OF ARCADIA:

RUTAN & TUCKER
BY RICHARD MONTEVIDEO
611 Anton Boulevard, 14th Floor
Costa Mesa, California 92626-1950

FOR WESTERN STATES PETROLEUM ASSOCIATION:

MAYER, BROWN & PLATT
BY LYMAN C. WELCH
190 South LaSalle Street
Chicago, Illinois 60603-3441

FOR LOS ANGELES REGIONAL WATER QUALITY
CONTROL BOARD:

LOS ANGELES REGIONAL WATER QUALITY CONTROL
BOARD
BY DENNIS DICKERSON, EXECUTIVE OFFICER
320 West 4th Street, Suite 200
Los Angeles, California 90013

STATE WATER RESOURCES CONTROL BOARD
JORGE A. LEON, SENIOR STAFF COUNSEL
901 P Street
P.O. Box 100
Sacramento, California 95812

FOR NATURAL RESOURCES DEFENSE COUNCIL

NATURAL RESOURCES DEFENSE COUNCIL
BY ALEX N. HELPERIN
6310 San Vicente Boulevard, Suite 250
Los Angeles, California 90048

FOR SANTA MONICA BAY KEEPER

SANTA MONICA BAY KEEPER
BY STEVE FLEISCHLI
P.O. Box 10096
Marina del Rey, California 90295

I N D E X

POLICY STATEMENTS:

TORRANCE, CALIFORNIA, JUNE 6, 2000 - 9:00 A.M.

* * * * *

CHAIRMAN BAGGETT: Good morning. This is the time and place for the hearing to review the actions and failures to act by the Los Angeles Regional Water Quality Control Board concerning the Standard Urban Stormwater Mitigation Plan, or SUSMP, pursuant to Los Angeles Municipal Stormwater Permit.

I'm Art Baggett. I'm Chair of the State Water Board. On my right is Board Member John Brown.

BOARD MEMBER BROWN: Good morning.

CHAIRMAN BAGGETT: To my left is Mary Jane Forster.

BOARD MEMBER FORSTER: Good morning.

CHAIRMAN BAGGETT: And Pete Silva.

BOARD MEMBER SILVA: Good morning.

CHAIRMAN BAGGETT: We're also assisted today by staff, acting Executive Officer, Ed Anton, somewhere out there; staff counsel, Betsy Jennings; and Bruce Fujimoto and Marianne Jones assisting also.

This hearing is being held in accordance with the hearing notice dated May 12th, 2000. The purpose of this hearing is to receive oral testimony and policy statements that will assist the Board in reviewing the actions of the Regional Board. As stated in the hearing notice, the deadline for submitting written evidence has passed, and the Board does not intend to accept any further written evidence today.

This hearing will not be conducted according to technical rules of evidence. The Board will accept any evidence that is reasonably relevant. Hearsay evidence may be used for the purpose of supplementing or explaining other evidence, but over timely objection will not be sufficient in itself to support a finding unless it would be admissible in a civil action.

Questions from the Board or the Board counsel to any participant and procedural motions by any designated party shall be in order at any time.

Following today's hearing, the Board will retire to closed session to deliberate on the evidence the Board has received. The Board's deliberations will include the evidence in the administrative record from the Regional Board. A draft decision on the petition will be formulated and distributed to the public. Considerations of the draft decision will take place at a future Board meeting which will be noticed.

At this time I would like to list the persons who have been granted designated party status. Pursuant to the hearing notice, there are four groups that are designated parties for the purpose of today's hearing. The entities are all the cities named as petitioners, Building Industry Association of Southern California and Building Industry Legal Defense Foundation. Second is Western States Petroleum Association. Third is Natural Resources Defense Council, Santa Monica BayKeeper and Heal the Bay. And fourth is the Los Angeles Regional

Water Quality Control Board.

No other persons submitted a request to be a designated party by the deadline provided in the hearing notice. Therefore, all other persons who are in attendance today who would like to provide comments to the Board are considered interested persons.

Designated parties and their witnesses who will be providing testimony under oath are subject to cross-examination and may cross-examine other parties. Interested persons will have an opportunity to provide policy statements. Interested persons will not be under oath and not be subject to cross-examination but may be asked questions or asked to respond to clarify any questions from the Board, staff or others at the discretion of the Board. Interested persons do not have a right to cross-examine the parties.

I will address the time limit issue. To ensure that all participants have an opportunity to participate in the hearing, designated parties have been asked to limit their testimony to 60 minutes or less, and interested persons have been asked to limit their statements to three minutes or less.

The Board has received copies of all written documents, so all participants are asked to summarize their written comments in their oral presentations. Participants with similar comments are requested to make joint presentations, and participants are asked to avoid redundant comments. I may allow additional time if I believe the speaker cannot reasonably present the pertinent information within that allotted time.

If you intend to speak today and have not already done so, please fill out the speaker cards at the front table.

I must also note that cross-examination of witnesses will not be counted against the 60 minutes for the parties for your case-in-chief.

Assisting the Board today is the staff counsel, Betsy Jennings. I'll ask her first to provide a brief description of the actions of the Regional Board in approving the SUSMP and the issues before the Board. We will then take policy statements from the interested persons. Following the interested persons' policy statements, each of the designated parties will put on their direct testimony in the following order: The cities named as petitioners along with the Building Industry Association of Southern California and Building Industry Legal Defense Foundation; followed by the Western States Petroleum Association; the Regional Board; and Natural Resources Defense Council, Santa Monica BayKeeper and Heal the Bay.

At this point we'll have cross-examination. After the case-in-chief will be cross-examination of each party in the order they spoke. There are two changes which have been requested and granted in the order. That is first Dr. Horner, NRDC's witness, and Margaret Clark, City of Rosemead. Both could only be here this morning and will testify first and second respectively.

Finally parties will each have three minutes' time for closing statements. That's it.

MS. JENNINGS: Good morning, Mr. Chairman, Board Members, and members of the audience. The purpose of this hearing is to consider further evidence and policy statements in the matter of the Los Angeles Regional Water Board's adoption of the SUSMP, or Standard Urban Stormwater Mitigation Plan. The issue of SUSMPs arose from the 1996 Municipal Stormwater Permit issued by the Regional Water Board for discharges throughout Los Angeles County.

The permit required the permittees to develop a program for regulating run-off from development including best management practices, or BMPs, prioritizing types of development and applying specific BMPs to specific types of development through the SUSMPs. The process for developing this program is laid out in the permit, and you will hear much about that process.

The end result was that the permittees proposed SUSMPs and the Regional Board directed its Executive Officer to approve SUSMPs with different provisions than the permittees had proposed. The three major differences are: One, the Regional Board's version requires mitigation of .75 inch of rainfall, while the permittees version has a narrative design standard; two, the Regional Board added two categories of development, parking lots and environmentally sensitive areas, to the original seven categories listed in the permit; and three, the Regional Board's version applies to all development in the original seven categories, while the permittees version applies only to discretionary projects. There are other differences also that you will hear about during the testimony.

The administrative record is lengthy and it contains numerous comments from interested persons. We also received lengthy submittals prior to this hearing. You've all received copies of those submittals.

At the risk of offending parties by omitting some of their arguments, I will tell you that in my view there are two central issues in this hearing.

The first issue concerns procedure. This issue can be summarized by asking if the Regional Board acted properly in adopting its version of the SUSMP. In reviewing the permit, and you will have copies of the relevant provisions in your binders, was the Regional Board authorized to revise the SUSMP the permittees had submitted; and if so, did it do so following the correct procedures.

The second issue concerns technical aspects of the SUSMP. The most controversial provision of the SUSMP is the requirement to mitigate the first .75 inch of rainfall from storm events. Mitigation may involve treatment or infiltration and there are some exceptions and waivers. The permit requires that BMPs, or best management practices, that reduce pollutants in stormwater to the maximum extent practicable or MEP.

The technical questions can be summarized is whether it is beneficial to water quality and practicable to require mitigation of the first three quarters inch of rainfall from these types of developments. The related issue is whether there may be adverse impacts from such mitigation.

There have been several procedural issues raised, most of which I feel that were resolved amicably during the last few weeks, but I know that we did receive this morning one written comment and perhaps other parties may have other procedural issues. So I would recommend before you proceed that we quickly dispense with the procedural issues, if you would like.

And with that, I will end my comments unless there are questions from the Board Members.

CHAIRMAN BAGGETT: Thank you. We have received four written objections. Does the petitioner want to make any comments on your objections?

MR. MONTEVIDEO: No, Mr. Chair. Thank you. I think they're stated.

MS. JENNINGS: Mr. Montevideo, could you approach the microphone?

MR. MONTEVIDEO: Sure.

MS. JENNINGS: Give your name for the record, for the court reporter please.

MR. MONTEVIDEO: Good morning, Mr. Chair, Members of the Board. My name is Richard Montevideo.

I'm here on behalf of the Bellflower, et al. petitioners, as well as petitioner, the City of Arcadia.

The objections that we submitted are four-fold, but primarily they go to timing in terms of receipt of documentary evidence by the Regional Board itself, as well as receipt of a summary of their testimony.

There was also an issue of a videotape that was referenced in a letter that we received from the Regional Board on Monday, whether or not that videotape will be a part of their presentation today. We actually attempted to view that videotape in time for the hearing. We're told because of copyright reasons they could not give us a copy. We then attempted to make arrangements to actually view it at the Regional Board offices and were told that could happen yesterday, but towards the afternoon we got a call basically saying we don't have the tape available, if we wanted to review it we could review it sometime this morning.

Of course, that doesn't give us sufficient opportunities to look at potential evidence. So we ask that that videotape as well as the late submitted documentation be excluded.

CHAIRMAN BAGGETT: This is the overnight package dated June 5th and 6th. I will sustain the objection on that one.

MS. JENNINGS: Just to be clear, there was some further exhibits that I received at my office yesterday afternoon, June 6th, and they were dated June 5th, and I believe Mr. Baggett is saying that as to those records that they would not be admitted.

CHAIRMAN BAGGETT: We have not seen --

MS. JENNINGS: I did not make copies -- I did not see them until 5:00.

MR. MONTEVIDEO: We did receive them yesterday. There are some documents that I believe are pertinent to Dr. Horner's testimony that we may attempt to use in the form of cross-examination to address Dr. Horner's points that he raised in his summary of testimony, but beyond that we would ask they not be admitted for purposes of proving the Regional Board's case.

So there are certain documents that we feel are appropriate for cross-examination purposes and we'll bring them up at the appropriate time and submit them to this Board for admission.

CHAIRMAN BAGGETT: And in terms of your -- my colleagues, we have one copy.

MR. MONTEVIDEO: I have extras, if I may.

CHAIRMAN BAGGETT: If I could, so they understand.

MS. JENNINGS: The tape, the videotape that he was mentioning was referred to in the letter. I've never seen it either, so I assume that the Regional Board has changed its mind. They haven't submitted it.

BOARD MEMBER FORSTER: I have a question. Betsy, I don't know if I understand what Mr. Montevideo said in the last three sentences. We're not accepting --

MS. JENNINGS: We're not accepting.

BOARD MEMBER FORSTER: -- yesterday, but he wants to cross-examine on something that's in that?

MS. JENNINGS: My advice is that we are not accepting new evidence today, period, but any written evidence I would tend to recommend against. And if somebody wants to offer it, somebody this morning asked if he could offer it as, quote, rebuttal. I said all evidence is supposed to be in already. So I will certainly recommend against any new documentary evidence coming in today from any party.

MR. MONTEVIDEO: If I may be heard on that point. The rules specifically stated that rebuttal testimony need not be identified up front and also for cross-examination purposes or to impeach a witness, and if we're able to use written documentation to impeach a witness, it should be able to come in for that purpose.

The other issue I want to point out with respect to our objections, we learned yesterday that the Board is intending on offering to the Board Members testimony from two of the Board Members as a part of the their case-in-chief or response to our case-in-chief. Our concerns with that is that testimony of Board Members, individual Board Members, is frankly not relevant to these proceedings. Unless they're going to testify to an event that they saw, which is unlikely, they simply cannot offer relevant testimony with respect to these proceedings. Only the Board collectively, the actions of the Board collectively, are relevant but not the testimony of individual Board Members in making that decision. And there's case authority cited to that effect.

So those are the objections in short order that we've listed.

CHAIRMAN BAGGETT: We'll hear from opposing counsel.

MR. LEON: Good morning, Mr. Baggett, Board Members. Jorge Leon for the Regional Board. If I may I just have a couple of comments on the objections posed by Mr. Montevideo.

With respect to the video, it was the plan of the Board to consider providing a display of the video if the State Board Members wished to have video background of the subject that we're discussing, which is stormwater, and we thought it might be useful, but we weren't able to get copies to the parties, partly because of copyright problems, but it was never an intent to actually -- as part of our presentation. So we're withdrawing that.

With respect to our Board Members speaking, we do still offer Mr. Nahai's comments as part of our presentation because we do believe that it would be helpful for you to understand the Board Members' consideration of the issues. Despite the fact that Mr. Montevideo says that the issues or the presentation need not be relevant, I believe that it could be something that you would be interested in hearing.

And finally with respect to the summary of respondent's proposed evidence, we did provide a copy of a two-page memo to Betsy Jennings on Friday that indicates who the speakers for the Board would be, and on that line I provided a copy of that, by the way, to each of the parties in the proceeding this morning because they indicated that at least a couple of them had not received it. But with respect to Francine Diamond, we would like to withdraw Ms. Diamond, one of our Board Members, as a speaker and replace Francine Diamond with Alexis Strauss from the USEPA. Alexis was one of the folks who submitted comments before the deadline on this proceeding.

MR. MONTEVIDEO: If I just may be heard on the last issue. Now we're hearing the morning of the hearing that there's another witness from EPA that's going to testify on behalf of the respondent. Had we known that in advance, we would have spent more time looking at the comments from EPA and preparing for cross-examination.

A public participant is not subject to cross-examination. A witness of the Regional Board is subject to cross-examination. It truly is unfair surprise in this case.

CHAIRMAN BAGGETT: I think I'll rule now. I would sustain the first objection. The information provided the 5th and 6th is not timely, so the Board will

R0073640

not be able to hear that as evidence.

In terms of the relevancy of the Chairman, Mr. David Nahai, I consider that relevant testimony and would overrule the objection.

Third, the third objection you had was providing the comments on what testimony the witnesses for the respondent were going to say. I would I guess partially overrule. I think the Regional Board can bring in -- have their witnesses testify to evidence in the record and the evidence which has been submitted to the Board but nothing beyond that, and I think the two-sentence summary, so if they could limit their comments to that information.

The fourth objection has already been withdrawn, the videotape, so that was resolved.

MR. MONTEVIDEO: Mr. Chair, the additional issue that just came up is the replacement witness, adding the EPA witness.

CHAIRMAN BAGGETT: I think I would have to sustain the objection to that. It's inappropriate, that we should have had prior notice. And I notice there will be opportunity under the public policy statements. Federal EPA does have comments on the policy statements, and I think Ms. Strauss will be allowed to address the Board and the public at that time.

MR. MONTEVIDEO: Of course. Thank you.

CHAIRMAN BAGGETT: With that --

MR. LEON: Mr. Baggett, I'm sorry. The

overnight package.

CHAIRMAN BAGGETT: Right.

MR. LEON: With respect to those, just one point I failed to do when I came up the first time. The overnight package was nothing more than supplemental material attachments which were intended to be part of the package that was received by the Board and parties on May 31st. Mostly they were letters and attachments to materials submitted by Western States.

MS. JENNINGS: My understanding is they will not be in the record.

CHAIRMAN BAGGETT: They will not be in the record. They were received too late in fairness to other parties.

With that, if there's no other objections, at this time will be the direct testimony of Dr. Richard Horner.

I think at this point I might as well have all parties who are going to testify today, if all parties can stand and I'll do all witnesses and parties, not policy statement folks.

Do you promise to tell the truth in this proceeding? If so, answer "I do."

(Response by all parties and witnesses)

CHAIRMAN BAGGETT: Thank you.

Dr. Horner.

MR. HELPERIN: If I may. Good morning, Mr. Chairman and Members of the Board. Because

Dr. Horner is a witness, I had anticipated interrogating --

MS. JENNINGS: Identify yourself.

MR. HELPERIN: I'm sorry. Alex Helperin, and I'm with Natural Resources Defense Council representing Santa Monica BayKeeper and Heal the Bay.

Because of the status of Dr. Horner as a witness, I had anticipated examining Dr. Horner. He has not prepared a statement and he will simply be responding to my questions, if that's all right.

Is there a way that I can have access to a microphone so I can ask Dr. Horner the questions and --

MS. JENNINGS: Unfortunately I think we only have one microphone, which also is going to be difficult with cross-examination.

BOARD MEMBER FORSTER: Can you take that one?

MR. HELPERIN: That's fine with me.

RICHARD HORNER,

having been previously sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HELPERIN:

Q. Can you please state your name for the record.

A. Richard Horner.

Q. And can you please describe your educational background.

A. I have bachelors and masters degrees in mechanical engineering from University of Pennsylvania, Ph.D. in civil engineering from the University of Washington with a specialty in environmental engineering and science.

Q. What is your current occupation?

A. Research Associate Professor, University of Washington, and also a sole proprietor.

Q. How long have you been teaching?

A. I've been teaching altogether 31 years of which 19 have been at the University of Washington.

Q. Is there a specific focus of your research and scholarship?

A. My focus has been on urban water resources over the past 23 years which includes urban stormwater and all of its respects, as well as the receiving waters that get those effluents, stormwater effluents in urban areas.

Q. Have you published any reports or articles on these issues?

A. I have something over a hundred total publications of which somewhere around 70 are technical reports and 30-some-odd ones that are refereed journal-type presentations, and some others as well.

Q. Do you also have practical experience with the implementation of structural stormwater controls?

A. Yes. In my sole proprietor work, I work for local and state government agencies, in some cases for EPA as well, and for the consultants that work for those agencies. Mostly those are -- most of the associations that I've had and in that work I do more or less the same kinds of things as I do in my research, and that is the sources of pollutants in urban stormwater, how they're transported through the system, their impacts within the ecosystem, how they are best monitored, and solutions to those problems, what we generally call BMPs.

Q. So altogether you've been researching on these issues, writing on these issues, consulting on these issues for --

A. In the case of urban water resources, for 23 years. And my total professional experience is back to 1966, so that's 34 years.

Q. Are you familiar with the hydrologic conditions in the Los Angeles area?

A. Yes, I am.

Q. Are you familiar with the extent or degree and nature of development in the Los Angeles area?

A. Yes. I have worked in the area for the past approximately seven years, been here dozens of times. I've been in just about all the neighborhoods, most of the miles of freeways, and many of the major streets as well.

Q. Are you working on any projects in the Los Angeles area now?

A. Yes. I am working as the court-appointed monitor on the permanent injunction issued against District 7 of Caltrans, and in that position my role is

R0073645

to interpret their degree of response and evaluate it. I have a similar role in the District 11 case in San Diego, and in the past have also worked on cases involving several cities and two counties, a couple of court facilities in this area.

Q. Do you believe Los Angeles County has a stormwater problem?

A. Yes. I think the documentation and several reports in the past five years, couple of reports anyways, bears out there are ecological problems and problems with human exposure to the stormwater.

Q. And do you think -- if this problem is left unmitigated, do you expect it will get better or worse or stay approximately the same?

A. I understand the projections of population growth in this area are for it to continue at a relatively rapid pace, as we have seen for the last 50 years with fits and starts, and seen it growing still very rapidly because these pollutants that are used in the landscape that every individual is associated with or responsible for are directly associated with population and particularly with the things that people build and what they drive, that the problems will get worse unless they're mitigated.

Q. How does development in particular affect the stormwater pollution problem?

A. Well, development puts down hard surface, I suppose it's its real hallmark, and it's that hard surface itself that begets the problem in that as rain falls and it doesn't have anywhere to go in the natural soil and vegetation system. It runs off rapidly from those hard surfaces and quickly is transported into receiving waters and its ultimate receptacle, in this case the Pacific ocean.

And in going through those water courses, just the volume alone, even if it were distilled water because it's more water, faster than they're accustomed to, and the erosion of those stream channels is a problem to the organisms there as well as sediment load and sediment transport.

And in addition, what happens on those surfaces in driving applications, even on lawns, pervious surfaces, applications of pesticides, fertilizers, all the myriad of activities virtually and residentially and industrially going on. And so what you have is a greater release of pollutants in terms of -- you know, even given drop of water, given a cup of water, how much is there in that volume, but also there's more volume. And so the multiple of those two, volume times the concentration of pollutants, means you have more total mass of pollutants going into the receiving water and collecting into that ultimate receptacle, the ocean.

Q. How does a development planning program assist in mitigating that problem?

A. Well, development planning program in my mind is fundamentally a two-pronged approach. The first prong is what we call variously non-structural source controls, and that is basically to stop the contact between pollutants and rainfall or run-off so that they can't get into it in the first place.

And there are many examples of that particular prong. Just two in industrial areas is keeping the industries' raw materials, products or waste products out of contact with rainfall and run-off just by covering, for example. In the case of residences, it's educating them in how they use products, for example, what they put on their lawns.

The other prong is often what we call structural treatment, and that is recognizing that we're not going to occupy this earth and not ever release anything. So there's a point at which we have to put in further backstops to -- between the point of generation and the receiving water, and that's what we call structural best management practices.

Q. First you keep the pollutants out of the water, then to the extent they still get in you use treatment control that's a fundamental part of the program to get them out?

A. That's correct, yes.

Q. Are you familiar with the SUSMP that's at issue here?

A. Yes, I am.

Q. Does it create the same sort of plan, development planning you just described?

A. In fact, it does create that exact kind of program.

Q. Are you familiar with the list of approved structural best management practices that are approved for use in conjunction with this SUSMP?

A. Yes.

Q. Are you aware of any doubt on the effectiveness of those BMPs in removing pollutants?

A. It's one of the major activities that I have pursued over the past 23 years and so I'm aware of a lot of data.

Q. Can you give me a sense -- have there been studies other than yours?

A. Well, it goes back to approximately the time that I was getting started. I was working as a graduate student at that time with people generating some of the first data, and particular in this case in highway run-off.

At the same time there were others elsewhere in the nation, and the world in fact, that were beginning the same sorts of studies. At that time, also EPA started its nationwide urban water run-off program. It had as a component the effectiveness of ponds as a best management practice. And since that time that work has continued, myself and many others in this content and elsewhere in the world.

Q. There's been widespread study of this issue for 20 or 30 years?

A. That approximate time, and there are now databases assembled by civil engineers, for example. EPA has a summary database that came out last year. The Center for Watershed Protection in Maryland has concerned itself also with this question and the overall data.

Q. Do these studies discuss the pollutant removal efficiencies of these BMPs with respect to specifically the pollutants that are of concern in the Los Angeles area?

A. Yes, they do.

Q. Can you give us a sense of just how effective these BMPs can be, these treatment structural BMPs can be, at removing those pollutants of concern?

A. I'll give you a couple of examples quickly.

Let's take solids, the particulate matter, and we need to recognize that in urban run-off, the other pollutants, generally speaking, are mostly associated with the solids in some physical or chemical connection. And so if you do a good job of getting the solids out, we can get those things that are highly associated with the solids. They include particularly the organic chemicals, industrial origin pesticides and so on, and that array of best management practices that you see up there, including ponds, constructed wetlands and vegetative filters and sand filters and other medium filters, can reliably remove 80 percent of the total loading that goes through them and, in fact, this comes from the EPA database.

I would lean toward the higher end of the ranges that they give there as reliable performance assuming that state-of-the-art or maximum extent practicable design and construction and maintenance is undertaken with them. One of the metals --

MR. MONTEVIDEO: I'm sorry, Mr. Chair. I just want to get some sense as to where this is in the record.

MR. HELPERIN: This was Exhibit K to NRDC's comment letter of January 14th, 2000.

MR. MONTEVIDEO: Thank you.

THE WITNESS: One of the three prominent metals in urban run-off is lead, still though we no longer have leaded gas, and it is heavily associated with the solids. These BMPs can reliably get out 75 percent, at least of the lead. Copper and zinc are the two other prominent metals. They are somewhat more soluble, but reliable performance at 50 or 60 percent is possible with these metals.

I should point out that infiltration is a special case because to the extent that you can infiltrate the run-off, you can remove those pollutants from contact with surface water so the infiltration can be up to 100 percent effective.

Q. BY MR. HELPERIN: Can you tell me -- we've talked about the fact that these BMPs can actually remove the pollutants of concern, but what does that actually mean for the purposes of the beneficial uses of the receiving waters?

A. Well, the -- I think the receiving water that you focus on more than any other in the Los Angeles area is to the ocean, and I started my involvement down here with cases involving Santa Monica Bay, so that's what I know the most about. And as I've characterized that, that's a receptacle body of water. It's a sink. And to the extent the contaminants can be removed somewhere between the point of generation and that ultimate sink, they will not have to -- they will not become a part of the pollutant burden in that sink.

So therefore, it's sometimes said that a removal efficiency of 50 percent isn't very impressive, but that's 50 percent that's not going to get that into that ultimate sink, and in many of these, as I said, many of these contaminants are removed at a higher level than that.

Now, there are other receiving waters of concern. There are the streams and rivers on the way to the ocean, and realize that a lot of these are concreted but they are perhaps subject to restoration some day, but some are still in natural conditions. Their biological integrity remain, Melvin Creek (phonetic) and parts of Santa Clara River, and those water bodies, too, are subject to urban run-off, both the quantity impacts as I pointed out earlier and also the quality impacts, especially as urbanization increases. Up to like the 40 percent impervious level water quality begins to become a factor in those fresh water bodies even though it passes through fairly rapidly into the ocean.

Q. The petitioners are going to be introducing later a report by Scott Taylor and G. Fred Lee (phonetic) which indicates these BMPs are more effective on the dissolved contaminants rather than the particulates and that because of that perhaps they're not going to help us out.

What do you think about that study?

A. I have to correct the way you say the question. Their reports say it's more effective on the particulates than the dissolved, and that so far as it goes is true, but there's several factors we have to recognize.

One, as I said earlier, many of these contaminants are highly associated with the particulates, and as they travel with the particulates and get into the receiving water, they can be released solublized into the water in a more mobile form.

Secondly, these contaminants, even if they stay in the solid state with regard to directly into the sediments in the fresh or salt water are then toxic subject to impacts delivered to the bottom dwelling organisms and there's a lot of evidence in the general literature to that effect, too.

And thirdly, the BMPs do have some effectiveness on the dissolved contaminants. Copper and zinc are partially in the dissolved state. However, lead is a very minor part in the dissolved state, and there is some removal of the dissolved contaminants as well. 30

percent removal is still important.

Q. Can I ask you to give us a sense from your personal experience as to what land use is considered to be at a particular risk of contributing these pollutants to stormwater run-off?

A. The uses that are listed in the standard plan are certainly appropriate, but just to give a couple of examples of those, parking lots, especially those that cycle vehicles in and out rapidly as they -- when they're subject more in the stop-and-go mode of releasing contaminants, and gas stations.

Q. With respect to gas stations, WSPA, the Western States Petroleum Association, will be testifying later that there are significant issues, or problems that is, with the only types of mitigations that gas stations can use allegedly. For example, they'll state that filtration systems often clog and back up. Is that true of all filtration systems?

A. Well, the types of filtration systems that they might consider are sand filters, other medium filters including compost and some other media, vegetation filters, and catch basin inserts are listed on that particularly chart. And I think that they're referring to catch basin inserts which have small scale devices and at the scale of about this lectern top here, and they don't have a large capacity and there is definitely experience with them clogging.

However, sand filters in my own personal experience in one of my own studies clog slowly and the -- the other media filters, such as the compost put on the market five years or more now, also are in that category. It's a rather slowly developing problem.

Q. And even for the ones that do potentially clog, is that an insurmountable problem?

A. I looked at catch basin inserts as sort of limited in their general application, but gas stations have to be one of the best potential places to use them because gas stations are attended. They're out sweeping up the cigarette butts, so it's not really a very -- a great addition to their work load to check every day during the rainy season and after it's rained and find out if it needs to be cleaned out.

Catch basin inserts are greatly improving, or least they seem in the very near future to be putting some very improved ones on the market. Professor Stenstrom at UCLA is testing those in his laboratory and he's getting some very good results on performance.

Q. Let me switch for a moment to the .75 inch standard that's been adopted by the Regional Board here.

Based on your experience with these programs, and with the Los Angeles area hydrology in particular, do you think that standard is appropriate?

A. That standard is appropriate but it's minimally acceptable in my view.

Q. Is there evidence in the literature or otherwise to support using the standard of that size would be effective?

A. Yes. Yes. The performance of a BMP, structural BMP, is directly dependent on its size. It's the most fundamental characteristic that needs to be built into its design, sufficient size to give the residence time for the water so that we can reach these efficiencies that were up there, which have been proven under design conditions equivalent to that or even greater.

Q. Have programs like this been implemented elsewhere?

A. There are hundreds of programs that use a design standard around the country.

Q. And is this chart accurately representative of the -- your experience with programs in other places in the country?

A. Yes. That's a chart that, in fact, I helped to prepare. It comes from a study that I participated in as one of the co-authors. The listed author is Watershed Management Institute. I was one of the four human authors.

Q. So this chart then shows that you're saying there are literally hundreds of places in the United States that have, if you look at the right-hand column, bolded text, numerical standards that are actually higher than the Los Angeles County standard; is that correct?

A. That's correct. And this study was of 32 particular programs, but some of those programs represent many municipalities, such as state of New Jersey or northeast Illinois Planning Commission.

Q. When you worked on the L.A. County program, what size minimum standard did you suggest for the Los Angeles area?

A. I recommended one inch based on capturing and treating a larger percentage of the total run-off volume.

Q. Just a couple final questions. The December 7th, 1999 draft of the SUSMP that is proposed by the Regional Board included a rooftop exemption. What was your opinion of that?

A. I don't subscribe to that because I've seen evidence that roofs, in fact, are not innocuous. We need to realize that there is -- there are airborne contaminants that land on any impervious surface, including roofs, and also there are some rooftop materials that are contributors, but I think the airborne is a bigger issue, too.

Q. Have you ever seen a provision for rooftop exemptions in any of the other programs that you've studied in the country, either this study here or elsewhere?

A. I don't recall seeing such provision.

Q. Finally, petitioners will claim later today the Regional Board should have followed a specific process in developing this SUSMP that was laid out in certain exhibits that would have been a process of further study and consensus building prior to implementing any program.

Do you think that given what we know today about

Los Angeles, about pollutant removal efficiency, that they should have waited and done those additional studies?

A. No. It's past due. As I say, there are many municipalities that have gone through this and established their programs, even in the state of California. We know very well what is the maximum extent practicable with respect to the performance of these BMPs. We know from a couple of studies in southern California coastal water research project and for an earlier epidemiological study that the problems that exist in particularly Santa Monica Bay have both ecological and human impact implications.

So there is no justification for going through a lot of studies, a great deal of additional monitoring. The time is very right now.

MR. HELPERIN: Thank you, Dr. Horner.

MR. MONTEVIDEO: I'm going to object to the last question and the answer, Mr. Chairman, on the grounds that he asked for a legal opinion, in effect, on the application and the permit and this witness is not an attorney, not a judge. He's not frankly qualified to give that opinion.

MR. HELPERIN: May I respond to that?

My question was not for a legal opinion but rather from a technical standpoint whether Dr. Horner believed there was enough information at this point about the conditions in the Los Angeles area, the effectiveness of a program like this, that it was warranted that it would be implemented at this time.

MR. MONTEVIDEO: With that qualification, I'll withdraw the objection.

CHAIRMAN BAGGETT: Before we ask for comments or questions of the Board, if you have cell phones or pagers, please put them on silent or turn them off. It would be appreciated.

Any questions from the Board Members?

BOARD MEMBER FORSTER: I have a question.

EXAMINATION

BY BOARD MEMBER FORSTER:

Q. Dr. Horner, one of the issues raised in some of the testimony was about the impact of infiltration on groundwater. Could you address that?

A. Yes.

Infiltration is a practice you have to approach carefully for two reasons and that is certainly one of them. If the soils are extremely course and if transport is rapid and the water table position is high, close to the surface, there is a potential for contamination to groundwater.

On the other side of it is the other point, and that is that some soils are the opposite. They're incapable of passing the water effectively through the soil and getting it off the surface, so they fail from that respect. So what it means is you have to be very careful with fitting it into the right locations, and neither those that are too restrictive to water passage or too loose in terms of transporting contaminants to groundwater.

There are soils in the modern texture groups, the soils of the same sorts as garden top soil, that are very appropriate for infiltration. It's a matter of how many there are and being sure that you locate them in a particular area with effective -- knowing that what those characteristics are.

So infiltration does have its uses, but one needs to be careful from both of those respects.

BOARD MEMBER BROWN: Thank you, Mr. Chairman.

EXAMINATION

BY BOARD MEMBER BROWN:

Q. Have you done any work, Dr. Horner, working with areas that have more of the regional master plan, regional considerations? For instance, service stations don't lend themselves very well to BMPs. All those are good ideas but they're more intensive and I would expect that, as an example, unless they're really intended to (inaudible), there are other areas that are more than capable of having retention of the .75 inches or greater.

Have you done work or studies that would address the issue more on a watershed basis as opposed to individual sites and how you may take the same amount of dollars a service station, as an example, might spend to do a little bit of help and spend those same dollars elsewhere within the community and do a whole lot more help?

A. Well, I've certainly been associated with the regional approach (inaudible) counties and many municipalities that is under a management plan, water quality management plan, and so there are standard provisions that apply as minimum requirements to all the municipalities.

I'm certainly aware of efforts in the Chesapeake Bay region which are very much watershed driven. There are -- one particular program in that area, City of Alexandria, Virginia, which is one of the oldest and densest cities in the United States, that has a very far-reaching program in applying BMPs in what they call "ultra urban areas," and these include gas stations, they include commercial developments and all matter of development. Of course, there's not much in-fill area. It's mostly redevelopment, but they're applied the same to redevelopment.

I don't necessarily agree that the gas stations are a hard application. They're certainly a hard application for something that takes up much space on the surface, but what we talked about here primarily and have highlighted on the slide there go on the pavement. They don't take up space. They do need maintenance, but again because they're not out sitting in some remote place, they're around all the time, I look at it as a part of the business. It's a new part of the business, but it's one that I think, you know, they can -- they get used to and I don't think it's that much additional burden on them.

And I would add that something else they've done in Alexandria that could be adopted in this case is that they have worked with the local suppliers of the concrete vaults that form the boxes for these things, for the sand filters, and they've gotten them to produce what they need in a series of off-the-shelf sizes, so you can walk in and get what you need for a particular size drainage area and it's approximately half the cost. And I think that it would be a very good project for a trade association like Western States to get involved in that for their members, a program like that.

CHAIRMAN BAGGETT: Questions from the Board Members? Staff?

EXAMINATION

BY MS. JENNINGS:

Q. I had one question which follows up Mr. Brown's, which is do you have experience on, I guess I would say, more effective to have projects on individual properties, sort of basically where the ultimate responsibility is the property owner versus a city, let's say, creating a larger pond that then all properties drain to? Do you have experience comparing those types of projects?

A. Well, I have experience with observation in this area, and this argument has gone back and forth probably ten years or more of regional versus localized. And there are arguments both ways.

The arguments attempt to make the most sense for the use of some regional construction, especially in new developments when it can be done as part of the overall plan and then it gets -- it's a prominent facility and it's more likely to get the maintenance attention and there's one authority that would be responsible for it.

But there are arguments on the other side as well and they concern in some cases that the fiscal fluctuations of the local government agencies over the years and whether they will, in fact, be able to fulfill those responsibilities.

So I can't say that I'm firmly convinced one way or the other. I think it needs to be a case-by-case basis. I think redevelopment only rarely would you get regional to work out very well because redevelopment tends to occur a parcel at a time, and I think that people most likely would choose localized. So I think some of the new developments, especially the residential and commercial projects, would do very well to consider it.

BOARD MEMBER BROWN: I'll help with Ms. Jennings' question.

R0073663

FURTHER EXAMINATION

BY BOARD MEMBER BROWN:

Q. Have you been in the city of Fresno and seen what they've done?

A. I've not been in that city. I've passed through it. I do know what they've done. Of course they've used infiltration to a large extent.

Q. They have infiltration basins all over that city and the flood control district maintains those. And I'm sure they're very effective in accomplishing what our goals would be here.

A. They are. I think they do have a different geology.

Q. The thing is you have one entity that maintains those, and my suspect is the dollars to maintain those types of infiltration basins are not only effective but cost a whole lot less money than individual.

A. There are instances in which you can't go wrong with infiltration, if they're set up right, and they seem to be fortunately in such a pocket. I would say the Los Angeles basin overall is not. There are some places in which it would have that misfortunate circumstances, but I can't offer it as a general hope for the whole area as it is in Fresno.

CHAIRMAN BAGGETT: Any questions from petitioners? Any cross-examination?

MR. MONTEVIDEO: Yes, Mr. Chair. On behalf of Arcadia and Bellflower, I'll be asking questions.

MS. JENNINGS: I think you'll have to stand up here, Mr. Montevideo.

MR. MONTEVIDEO: Do I need a microphone?

MS. JENNINGS: It helps us to take it down and make sure we've got everything.

CROSS-EXAMINATION

BY MR. MONTEVIDEO:

Q. Good morning, Mr. Horner.

A. Good morning.

Q. My name is Richard Montevideo. I'm representing the Bellflower, et al. petitioners, as well as the City of Arcadia today.

I have some questions for you in terms of your testimony and other issues that arose after looking at the exhibits that have been submitted on behalf of NRDC and related to environmental organizations.

It seems from the -- your testimony in the slides that you put up there that you had worked extensively at least in looking at studies conducted in various municipalities across the country. Would that be an accurate statement?

A. We conducted a survey, questionnaire survey of 32 programs.

Q. Did you work with the various cities in the various jurisdictions across the country?

A. I've worked with some of those cities, but some were cities and counties and states. They were all represented, as well as regional entities. I've worked with some of them, but they were throughout the country so I have not had personal work experience with most of the them.

Q. In your opinion, is it beneficial to work with the cities in developing a program of this nature?

A. Yes. I think working together is a good strategy for anybody.

Q. It's important to not only work with cities but the entire affected community; is that correct?

A. Yes.

Q. With respect to the Los Angeles SUSMP program that's been proposed by the Regional Board, have you had any contact with, for example, the City of Rancho Palos Verdes?

A. No.

Q. Have you had any contact with the City of Bellflower?

A. No.

Q. Arcadia?

A. No.

Q. Any of the 33 cities that are identified as petitioners?

A. I couldn't name those cities. I could tell you which cities I have had contact with.

Q. You could, but my question is are you aware of any contacts with many of these cities or any of these cities that are identified as petitioners?

A. Well, I've had contact with three cities.
Q. Why don't you tell me what those cities are.
A. El Segundo, Hermosa Beach and Beverly Hills.
Q. None of whom are petitioners in this proceeding. But you do agree that it's useful to work with the cities in the entire community to put together a program that basically fits the particulars of, in this case, the County of Los Angeles?
A. Yes.
Q. You made a comment in response to the last question that was asked of you on direct examination about the process that was followed under the permit and some contention -- you made a claim that you were concerned that there had been too much delay already and the process was sufficient. Do you recall that testimony?
A. Yes.
Q. Have you seen a copy of the permit for Los Angeles County?
A. I've seen one.
Q. You've seen it. Have you read it?
A. I did at one time. It's been some time.
Q. In your opinion, is it important to understand the requirements in the permit in developing a SUSMP program, particularly if that permit spells out what is to be done for purposes of developing the program?
A. Understanding would be essential, yes.
Q. And is it important before you can make a

statement about whether the SUSMP program that's been proposed for Los Angeles County is a minimal requirement, is it important to understand what the permit says about that requirement?

A. Well, I think we have to back up here a little bit and put myself in my own correct context, and that is I'm a scientific and technical person and I think that all the scientific and technical evidence backs up my statement that I made in response to that direct question.

I -- I am not an institutional consultant in terms of program interpersonal relations, so I'm commenting on the area has allowed its water resources to become degraded and I think the scientific and technical evidence supports that and that the means are available to forestall it.

Q. So when you made the contention about the permit and the delays and the need to move quickly and this is a minimalist effort, you then weren't referring to a minimalist effort?

MR. FLEISCHLI: Can I object to the issue of -- you said move quickly and move forward, and I believe -- I don't know if we can have things read back, but I believe that Dr. Horner said --

CHAIRMAN BAGGETT: Wait. I want to know what the question is.

MR. FLEISCHLI: I want to object on the grounds that he's misstating what the witness has said in the past on very minor issues, but I think -- I understand where he's heading. And when he says that Dr. Horner said we needed to move forward with something in a timely -- quickly, all of this, I think what Dr. Horner said he just repeated it there. Dr. Horner said there's sufficient evidence to move forward now.

MR. MONTEVIDEO: Frankly, this is a witness with a lot of experience.

MR. FLEISCHLI: I understand that but I don't want you to be --

MS. JENNINGS: Gentlemen, this certainly is not appropriate to be arguing back and forth. There is an objection.

CHAIRMAN BAGGETT: Mr. Brown.

BOARD MEMBER BROWN: I'm concerned with the procedure here, Mr. Chairman. When a Board Member speaks, I would appreciate it if nobody else talks. Do you understand? I want to know what the question is before the -- I am interested in the objection. Finish your question and then we'll listen to the objection. When the Chairman talks, let's listen to the Chairman and ask for permission to speak from the Chair.

Finish the question, then I'm interested in your objection. No more arguing. Finish your question.

MR. MONTEVIDEO: Yes.

Q. Let me ask it this way, Dr. Horner.

Would you agree at a minimum the permit should be a starting point before preparing any SUSMP?

MR. FLEISCHLI: I have no objection to the way he's phrased that question.

THE WITNESS: Yes, it's an appropriate starting point.

Q. BY MR. MONTEVIDEO: Now, do you know whether or not in accordance with the permit that we have before us today whether that permit provides for the application of the SUSMP program to discretionary versus non-discretionary projects?

MR. HELPERIN: Objection. I believe Mr. Montevideo is asking for a legal opinion with respect to the contents of the permit. Dr. Horner is not here as an expert on the permit or on the law. He's here as an expert on the technical and scientific issues.

MR. MONTEVIDEO: He has testified about the importance of the SUSMP program. He has testified about how it's overdue, in so many words. And correct me if I'm not entirely accurate in using your words, Dr. Horner, but he's just testified that the permit is the starting point for the SUSMP program. And I'm asking him then if it's a starting point whether, in fact, he knows whether the terms that are in this SUSMP program are actually terms that are allowed under the permit. That's where I'm going with this.

If it's a starting point, then I presume that any scientist is going to pick it up and look at it and base the terms of the SUSMP program with the terms of the permit.

MS. JENNINGS: If I can make a comment, Mr. Baggett. I do think that this witness has clearly been put forth as a technical expert. All of the requirements for expertise are shown and there was no objection. And certainly not a lawyer and certainly not even I gather a citizen of California is entitled to interpret the permit provisions, and it seems like that your statements, your questions, don't go to that and they would be appropriately done in your direct testimony, arguing that. I presume your argument is well, gee, I think it goes further than the permit and that I believe that the testimony was simply that from a technical standpoint.

CHAIRMAN BAGGETT: I'll sustain the objection. Move on.

MR. MONTEVIDEO: Yes.

Q. You have testified with respect to the SUSMP program being a minimalist effort or something to that effect; is that correct, Dr. Horner?

A. I said that the design standard was the minimum that I would consider to be acceptable as a design basis.

Q. Okay. So you weren't talking about the other provisions of the permit dealing with the categories of development, so to speak, that are to be impacted by the SUSMP?

A. That statement pertained potential to the .75 inch of rainfall.

Q. So should we assume that your entire testimony when you talked about the SUSMP program was primarily focused on the .75 standard?

A. I don't believe that we could read back my testimony and conclude that. It was one element.

Q. In terms of the SUSMP program itself, for example, were you offering an opinion on the appropriateness of applying the SUSMP program to redevelopment as defined in the program?

A. I wasn't asked that.

Q. And do you have an opinion on that?

A. My opinion is that it definitely should be applied to redevelopment.

Q. Okay. Do you have an opinion on whether or not it should be applied to discretionary, or I should say, non-discretionary projects?

A. I'm afraid I'm just not up enough on the legal and regulatory definitions of those terms to answer that.

Q. So the answer is you don't have an opinion; right?

A. No.

Q. Do you have an opinion on whether the SUSMP program should be applied to environmentally sensitive areas?

MR. HELPERIN: I'm going to have to object. I'm sorry. I believe Mr. Montevideo has mischaracterized Dr. Horner's testimony. Mr. Montevideo is asking if Dr. Horner believes that the SUSMP should be applied to discretionary as well as non-discretionary projects.

Dr. Horner said that he didn't understand the legal distinction. Mr. Montevideo has mischaracterized his testimony that he does not have an opinion on that. It's not the case that Dr. Horner does not have an opinion. He simply does not understand the distinction and could not very well have an opinion.

MR. MONTEVIDEO: I'm not sure I understand the objection.

CHAIRMAN BAGGETT: Sustained.

Q. BY MR. MONTEVIDEO: Environmentally sensitive areas, do you have an opinion on whether or not the SUSMP program should be applied to environmentally sensitive areas as defined in the SUSMP?

A. Yes, I think it should be applied.

Q. How is environmentally sensitive areas defined in the SUSMP?

A. I do not know that.

Q. But your opinion is that it should be applied irrespective of how it's defined?

A. I can't quote you the definition.

Q. Do you want to tell me generally?

A. I -- no, I don't believe that I can. I have not made an effort to get the words precisely right, but I have an understanding of what environmentally sensitive -- where environmentally sensitive areas lie in the County of Los Angeles.

Q. Do you have an opinion as to whether or not other environmental mandates should be complied with, specifically the California Environmental Quality Act, or whether they have been complied with?

MR. HELPERIN: Objection.

Q. BY MR. MONTEVIDEO: I'm asking whether you have an opinion on it.

MR. HELPERIN: Objection. Whether it should be -- can you repeat the question? I'm sorry. I think it calls for a legal conclusion.

MR. MONTEVIDEO: I asked him if he had an opinion on whether other environmental mandates should be considered in developing the SUSMP program.

MR. HELPERIN: Other legal environmental mandates and whether or not they apply or should apply is a question of law.

CHAIRMAN BAGGETT: Sustain the objection, unless you can rephrase it.

MR. LEON: I would also like to enter an objection, Mr. Baggett.

Mr. Montevideo is obviously on a pattern to continue asking questions that have to do with legal issues and I think it would serve all our purposes much today if he could be instructed to remain -- to stick to the program directly and not get on the legal issues.

MR. MONTEVIDEO: Frankly, in terms of the rules, I am permitted under 11513 to go beyond the scope of direct.

CHAIRMAN BAGGETT: But if you could focus your comments.

MR. MONTEVIDEO: Can we --

CHAIRMAN BAGGETT: We'll be here two full days at this rate.

Q. BY MR. MONTEVIDEO: Dr. Horner, do you recognize this? This is actually Exhibit L. I think you had put this up earlier.

A. Yes.

Q. These standards in other states, do you know if the standards, the numerical standards that are applied in other states, are applied to all redevelopment as well as development?

A. I could not say that it's applied uniformly to redevelopment. It is applied to new development, but I know certainly of instances, particularly in that area, where it applies to redevelopment.

Q. But you can't say that for every one of these programs that each these programs apply the exact same numerical standard to redevelopment as they do to development?

A. I can't say that.

Q. And in fact, you have some studies up there from the state of Florida. Isn't it true that the state of Florida recognizes a need to apply different standards to development versus redevelopment?

A. I don't know that for a fact.

Q. Have you looked at the studies in the state of Florida?

A. Well, this was done several years ago and certainly we looked at them, but I can't answer that specific question at this point.

Q. Let me show you a document which is -- has a cover letter date of May 31st, 2000, but behind it are a series of responses to questions by the Florida Bureau -- effectively the Department of the Environmental Protection Agency in Florida. There's a series of questions, but attached to is an article entitled best management practices for urban stormwater management.

Do you see the attachment?

A. Yes, I do.

Q. This is a document that was actually submitted by the Regional Board, belatedly, but it has in here -- if you turn to the third page of that report beginning with treatment requirements of older systems.

Do you have that in front of you?

A. Yes.

Q. If we can have the next slide please.

MR. FLEISCHLI: Can I object here since there's a pause? We're going to make the same argument that Mr. Montevideo made this morning with regard to his inability to review these documents. Dr. Horner obviously has not had the opportunity to review these documents. This is the first time he's seen them. It's going to be very, very hard for him to make any sort of determination standing up here in discussions with an attorney as to what these documents say, especially what his professional opinions of them are.

R0073676

MR. MONTEVIDEO: Mr. Chair, frankly that's what cross-examination is all about.

CHAIRMAN BAGGETT: Under the rules you can present these documents for cross-examination purposes and also under the rules we take evidence and the weight is given as a Board.

MS. JENNINGS: Just to be clear, Mr. Montevideo, this was one of the documents submitted by the Regional Board; is that correct?

MR. MONTEVIDEO: Correct.

CHAIRMAN BAGGETT: Continue.

MR. MONTEVIDEO: Yes. On page 36 of that report, if we could have the next slide please.

Q. We were just briefly talking about development versus redevelopment in the application of different standards. Can you take a look at the first sentence of this report?

A. The highlighted one?

Q. Yes. Correct.

A. Yes.

Q. Talking about numerous problems inherent to a highly urbanized area make it nearly impossible to apply the same stormwater design and performance standards that are applied to new developments. Do you agree with that statement?

A. We actually have three situations, and I think we're in the third one. We haven't talked about that. We have new development, we have redevelopment and we have retrofitting of existing development that is not going to be development. I believe this is talking about the third one.

Q. So I guess first, do you agree with the statement? Do you believe that's an accurate statement?

A. With respect to a development that's existing, standing static, it's not going to change and not reconstructed, yes, I agree with that.

Q. What about --

A. But not with respect to redevelopment as I define redevelopment.

Q. In terms of a static development, why do you believe this only applies to static development?

A. Because a redevelopment is, according to the definitions that are adopted for that, and they vary, but under your framework and other frameworks there is a substantive change to the layout which permits much more flexibility in what's constructed.

Q. Okay. But in terms of the application of that statement to redevelopment versus retrofitting, why do you believe that that statement is only intended to apply to retrofitting versus redevelopment?

A. It says so.

Q. Okay. You want to point me to the language please, sir?

A. Last word in the first line, B.

Q. You want to give me the word please?

A. Retrofitting.

Q. Why don't you help me out here. I'm looking at the first sentence.
A. I'm looking at the heading.
Q. Okay. So your position is that the application of the design standard to new developments versus redevelopment, that there should in effect not be any distinction between the application of the SUSMP program to development versus redevelopment?
A. No, not as redevelopment is defined.
Q. Even if the redevelopment -- were you finished? I'm sorry.
A. Yes.
Q. Even if the redevelopment is occurring in highly urbanized areas, do you believe the same standard should be applied?
A. Generally speaking I do, yes. There's room for flexibility in all designs, in new development too. But generally speaking I think the standards should apply.
Q. Well, when you said there's need or there's room for flexibility, should there be flexibility in a SUSMP program, different standards for redevelopment as opposed to development?
A. No.
Q. So where do you get the room for flexibility?
A. Flexibility comes in in one way just in the best management practices selected. Not every practice is appropriate for every site. That's true in new development and redevelopment.

Q. Do you believe there should be room for flexibility when you're applying it to redevelopment versus development?

A. No, I don't.

Q. And this statement that you believe should only be interpreted as applying to retrofitting as opposed to redevelopment in general.

A. I not only believe that it should apply to that, I believe that the author of this -- and I know that author very well. He was one of the co-authors of this study we talked about a while ago -- meant it to apply to that because I know how he defines retrofitting, the same as I do.

Q. You think this report is a well-written report?

A. This report?

Q. Yes. You know the author.

A. You only directed me to one sentence.

Q. You were just talking about the author. I was trying to understand whether if you believe the author, in your opinion, had written a good report.

MR. FLEISCHLI: He obviously has not had an opportunity to read the entire report.

MR. MONTEVIDEO: I will withdraw the question.

MR. HELPERIN: Just a point of order as well, Mr. Chair. I believe Mr. Montevideo's cross-examination has now taken up more time than the direct examination. We have made arrangements for Dr. Horner to catch a flight at 12:30 and it is now 11:30. I would like to suggest that the Board may want to structure the cross-examination in a way that's going to make it possible for Dr. Horner to make the flight.

MR. MONTEVIDEO: I will move as quickly as possible.

CHAIRMAN BAGGETT: Realize you're going to be cutting into your time for the other petitioners.

Q. BY MR. MONTEVIDEO: Mr. Horner, you talked about a program -- and can we have Exhibit L back up please -- in the state of Maryland and you have some experience with the program in the state of Maryland?

A. It was one of those that we surveyed.

Q. How long has Maryland had some type of SUSMP program in place?

A. Well, how long it's had a stormwater program in place goes back to the early '80s at least.

Q. 1982 sound about right?

A. That's about right.

Q. Have you heard of the 2000 Maryland stormwater design manual?

A. If it's the same one that you're referring to, I know their new manual, yes.

Q. Is it true that manual has been in the works for five years now?

A. I couldn't confirm that, whether or not that's the case.

Q. Okay. How long has the Regional Board SUSMP program been in the works, as far as you know? The Los

Angeles Regional Board SUSMP program.
A. I don't know that.
Q. Do you know if it's even under a year or over a year?
A. I couldn't answer that.
Q. Do you know if the Maryland program defines very redevelopment as broadly as the Los Angeles program?
A. I don't know that. I would have to compare them statement by statement.
Q. Are you familiar with the results of the Maryland program? That is, does the state of Maryland believe that their program has been effective?
A. There are elements that they believe have been effective and elements they have changed.
Q. Would you agree with the statement they've only had modest water quality improvements?
A. Well, I don't know that I can agree or disagree with that statement, but there are many factors concerned with the Chesapeake Bay outside the state of Maryland.
Q. Okay. Are you familiar with the program in Washington, the state of Washington?
A. Yes.
Q. You talked briefly about a rooftop exemption and your belief that the rooftop exemption was appropriately deleted or that rooftop water should be included in the SUSMP program; is that correct?
A. Yes.
Q. Is it true the Washington SUSMP program provides

for some exemption for rooftop water?

A. I'm not aware that it does.

Q. Let me show you a copy of their program.

MR. MONTEVIDEO: This again, Mr. Chair, is a document that came in just yesterday from the Regional Board. It is a series of responses to questions -- questions from the state of Washington, specifically the Washington State Department of Ecology.

Q. If you could turn to page 2 of enclosure one to the letter.

A. Okay.

Q. Do you have that page in front you?

A. Yes.

Q. Do you see the item B, the draft 1999 stormwater manual?

A. Yes.

Q. Do you see the second sentence there, the draft manual includes definitions for pollution-generating impervious surfaces and pollution-generating pervious surfaces. Non-pollution generating surfaces would include residential roofs, commercial roofs that do not accumulate pollutants in events of fugitive (phonetic) emissions, isolated bicycle lanes, other ground surfaces that are not subject to vehicle use.

A. Yes, I see it.

Q. Do you understand that the state of Washington makes a distinction between certain commercial and residential roofs and provides different standards, if any standards, to those types of -- to run-off from those types of facilities?

A. They've proposed as a draft provision in the new manual to do so. The old manual did not.

Q. Now, do you understand that --

A. But I disagree with it.

Q. But nonetheless, they are proposing it; correct? And nonetheless, it does not exist anywhere in the Regional Board's SUSMP program; correct?

A. I'm sorry?

Q. There is no rooftop exemption presently in the Regional Board's SUSMP program?

A. No. I understand it was deleted.

Q. Very good.

MR. HELPERIN: If I may, Mr. Chair, we have five minutes. Dr. Horner will have to leave.

MR. MONTEVIDEO: I am almost there.

CHAIRMAN BAGGETT: Okay.

Q. BY MR. MONTEVIDEO: I'm going to talk briefly, Dr. Horner, about the application of the SUSMP program in Los Angeles. I want to get your opinion on whether you believe -- how you believe this SUSMP program will apply to actually individual homeowners within the County of Los Angeles for a moment.

Let me give you a hypothetical. Under the Los Angeles SUSMP program as proposed and adopted by the Regional Board, if I owned a 25-year-old home in what is called an environmentally sensitive area and needed a permit for a new roof, would I have to comply with the numerical mitigation requirement of .75 inches of rainfall, captured and retrieved?

A. I can't answer --

MR. FLEISCHLI: Can I object as well?

MR. MONTEVIDEO: I have very little time.

MR. FLEISCHLI: I understand that, but this is again layer upon layer of definitions. Obviously Dr. Horner is here to talk about the technical expertise, not the definitions in the SUSMP of -- I'm not so worried about environmentally sensitive areas, but redevelopment or rooftop, is that 50 percent of a change of a project that would constitute --

MR. MONTEVIDEO: If it's a hypothetical that he doesn't understand, I'd be more than glad to fill in any details.

Q. Dr. Horner, again I have a 25-year-old home. I live in Los Angeles County. This is a hypothetical. I want to put in a new roof. I live in an area that's classified as an environmentally sensitive area and I need to get a permit to put on my new roof.

Do I have to comply with the .75 numerical design standard?

A. I have to take your word, first of all, that you would be subject to a control. I don't know that. I told you I don't know that.

Q. So in terms of the breadth of the application of the Los Angeles SUSMP program, you don't technically have an opinion in general or you don't have an opinion with respect to this particular hypo?

A. Technically do I have an opinion or do -- I say -- I'm just unwilling to answer a hypothetical question that I'm not sure is based on a provision you actually have to comply with. It may be. It may not be.

Q. I'm asking you that question. You don't know one way or another.

A. I don't know one way or the other.

Q. Very good. Let me give you another hypothetical.

MR. FLEISCHLI: Obviously it's a legal determination.

CHAIRMAN BAGGETT: Sustained. Continue.

Q. BY MR. MONTEVIDEO: If I remodel the interior of my home, let's assume for the sake of discussion that I have a 2,000 square foot home on a 5,000 square foot lot. I'm remodeling the interior of my home, and let's assume for the sake of discussion, for the purposes of my hypothetical, that that constitutes redevelopment if I affect a thousand square feet or more of the interior of my home.

Now, the question is I have a 5,000 square foot lot. I have a 2,000 square foot home. Most of it is frankly hardscape and flows to the street. How would one go about trying to comply with the numerical design standard of .75 inches of rain?

MR. FLEISCHLI: From a technical standpoint --

R0073686

if I might object, is that a technical question or a legal question?

MR. MONTEVIDEO: I asked him how would one go about complying with the .75 standard.

THE WITNESS: I'll refer you to --

MR. HELPERIN: I'll have to object on relevance grounds. The case that a home meeting the characteristics Mr. Montevideo has just described would not indeed constitute redevelopment. The changes he's talking about would not constitute redevelopment under the SUSMP. How one would go about determining how the SUSMP would apply is completely irrelevant and creates a situation in which we're trying to define how we comply with --

MR. MONTEVIDEO: Mr. Chair, I asked him to assume all that. I'm just trying to find out --

CHAIRMAN BAGGETT: I'm asking if you're asking his technical opinion or his legal opinion.

MR. MONTEVIDEO: Technical opinion.

Q. How would one comply with the SUSMP?

A. I'll refer you to three people -- it's one of your local groups. They outfitted a house in south central L.A. with a very similar situation as you describe. Relatively small house, relatively small yard.

Q. Is this the article you were talking about?

A. I saw it in a conference presentation. I didn't see the article. It does look like the house.

Q. Please proceed.

R0073687

A. I said I would refer you to the creative techniques that they used in that particular situation which includes cisterns, a roof redesign, yard storage of run-off, reduction of impervious area, quite a comprehensive small scale application, very impressive.
Q. But a set of creative techniques nonetheless; correct?
A. Well, nothing that's beyond technical realm. People have used cisterns for thousands of years.
Q. Let's talk about cisterns.
A. We've just forgotten how to talk about them.
Q. This article shows us --
MR. LEON: Mr. Chairman, sort of a point of order. In all fairness, I have some questions that I would like to ask Dr. Horner. I see that the hour is getting late. I don't know how far Mr. Montevideo is going to go.
CHAIRMAN BAGGETT: One more minute. One more minute and let the other parties.
MR. MONTEVIDEO: Yes.
Q. Cisterns have been in place for a long time. This article talks about the cost of that cistern. If we can just move it down to the bottom of the page a little more, cost if it were being mass produced by a manufacturer, the cost of that cistern being $10,000 for this home. Is that 3,600 gallons about right?
A. I have no idea.
Q. Do you have any idea --

A. It sounds awfully high but --
Q. Pardon me?
A. It sounds awfully high.
Q. This is a study that was done in Los Angeles by the Tree People, in quotes, and this is again in the administrative record. It quotes the cost of that cistern being $10,000 assuming it were mass produced. So you don't have an opinion --
A. I don't have an opinion. I can read it where it says that, but I don't have an opinion on that.
CHAIRMAN BAGGETT: You have 25 seconds.
Q. BY MR. MONTEVIDEO: Dr. Horner, have you looked at the impacts of the L.A. SUSMP program on affordable housing at all?
A. No.
Q. You're familiar with San Gabriel Valley?
A. Oh, driving through the freeway.
Q. Have you looked at the impacts of this program on the water quality throughout the San Gabriel Valley?
A. No.
MR. MONTEVIDEO: Very good. Thank you.
CHAIRMAN BAGGETT: Thank you. You've got just a couple minutes.
The petitioner first and then have the respondent. The other petitioner first and then the respondent. You can keep your questions brief and we'll forego redirect.

CROSS-EXAMINATION

BY MR. WELCH:

Q. Dr. Horner, I'm Lyman Welch on behalf of the Western States Petroleum Association. I'll keep my questions brief and direct you to the testimony you gave about the gas stations and potential treatment mechanisms.

You mentioned sand filters and compost filters --

A. Yes.

Q. -- as a potential treatment mechanism that could be used for gas stations.

A. Yes.

Q. That would require the construction of a fairly large underground vault; is that correct?

A. It would require an underground vault. Fairly large is a relative term. Its size is dependent on the drainage area that discharges to it.

Q. The use of both a sand filter and compost filter would require an underground vault?

A. That's correct.

Q. And if gasoline or other petroleum products happened to be spilled at a gas station and you had a sand filter or compost filter in place, that would result in the product flowing into this underground vault and contaminating the sand or compost material?

A. But both of these filters have a presedimentation chamber in which there would be considerable ability to catch a spill, and it may or may not depending on the medium, depending on whether it does so by being pushed along by a high flow, run-off, stormwater run-off flow at the same time.

Q. You would agree, though, that the product would enter the underground vault?

A. Yes. I think that would be one of the eminent uses. It would be a line of defense against an accidental spill.

Q. Wouldn't you also agree it would be a risk of explosive gases building up in the underground vault?

A. I think that's always a risk at a gas station.

Q. This would be an additional risk in the underground vault?

A. One presumes that it would not be allowed to remain there any time, that it would be gotten out. We presume maintenance. People are not going to ignore these occurrences.

Q. You mentioned Mr. Stenstrom's work on insert filters --

A. Yes.

Q. -- at UCLA.

A. Yes.

Q. And these are testing of insert filters that Mr. Stenstrom is doing in the laboratory at UCLA?

A. Yes.

Q. He hasn't done any testing of the practicability of using one of these insert filters at a gas station, has he?

A. I don't think he's out on the street, so to speak, yet. These are relatively recent inventions and getting their first tests. In fact, their first tests were last year and I don't know what his plans are, but like with any other product development it's in an early stage but moving along. Certainly he would go there.

Q. So it's fair to say that the usability of these insert filters is still in the testing stage.

A. These particular ones. There have been insert filters around for a number of years and there are proved versions, and I characterize them as soon to come along on the market with improved performance capability.

Q. It would be fair to say the older version of the insert filters didn't work well because of the clogging problems?

A. There are certainly instances of that and those instances could be cut way down with regular maintenance attention such as could come at a place with a regular attendant. A lot of the applications were not in those places.

Q. Are you familiar with the November 1999 study that the City of Sacramento did on insert filters?

A. No, I haven't seen that one.

MR. WELCH: Thank you.

I have nothing further at this time.

FURTHER EXAMINATION

BY BOARD MEMBER BROWN:

Q. On your BMPs that you're suggesting here, knowing that engineers like to do economic analysis, have you had economic analysis on alternatives to address this issue either on a regional basis or individual or both?

A. I have not done economic studies myself. I'm aware of the economic analyses that have been put together, watershed protections work, that I'm on their editorial board, but I have not done economic studies myself.

BOARD MEMBER BROWN: Thank you.

CHAIRMAN BAGGETT: We're running very tight on time.

MR. LEON: Thank you, Chairman Baggett.

CROSS-EXAMINATION

BY MR. LEON:

Q. Mr. Horner, thank you for your patience. My name is Jorge Leon. I'm the Regional Board's attorney. Just a couple of questions.

Were you involved in the development of the SUSMP program with the Regional Board?

A. I was not directly involved with it. I was involved with the settlement with Los Angeles County.

Q. That was the county program?

A. Yes.

Q. Thank you. Are you familiar with the Florida stormwater control program?

A. To some degree.

Q. Do you have an opinion as to whether their program is effective, working or not?

A. Florida has a reputation of being one of the top programs in the country, certainly probably in the top three without much argument.

Q. There was an article on the slide a few moments ago, if we could have that up real quickly. We don't need it.

You recall the slide that was up there about the article and the program that was developed?

A. Yes.

Q. Sort of an innovative program. Do you know what kind of a storm that was set for, the number of years? Was it 133 years?

A. I'm sorry. I couldn't confirm that. I wish I could.

MR. LEON: Thank you. That's all the questions I have. Thank you.

CHAIRMAN BAGGETT: I understand there's a time issue here, so we will forego the redirect or recross unless you want to stay longer.

THE WITNESS: No, I'm afraid I can't. Thank you very much.

CHAIRMAN BAGGETT: With that, we have one other witness, Margaret Clark.

MARGARET CLARK,

having been previously sworn, testified as follows:

STATEMENT OF MARGARET CLARK

MS. CLARK: My name is Margaret Clark and I'm the Mayor of Rosemead. I appreciate your taking my testimony. I have a memorial service this afternoon.

I am also on, and have been for eight years, the San Gabriel Basin Water Quality Authority which is overseeing the groundwater cleanup of (inaudible) in the San Gabriel basin, and as such I'm very concerned about this issue. I'm also a board member of the Los Angeles San Gabriel River Water Shed Council, and as such I do share the goals of the SUSMP program in the sense of reducing contaminants to the surface waters. I'm interested in conserving the water for the San Gabriel basin for which 80 percent of the needs are provided from local sources and I'm also interested in possibly reducing the size of future storm drain needs, but I do have some very serious concerns about this program from an environmental standpoint.

I am testifying today on behalf of the petitioners to address the problems created by the Regional Board's failure to comply with either the letter or the spirit of the California Environmental Quality Act.

Our lawyers will provide you with the legal arguments as to why the Regional Board should have complied with CEQA, but I want to give you factual reasons why the Regional Board and all the environmental groups here should respect potential significant adverse impacts on the environment that may be created by the Regional Board's SUSMP.

In addition to the requirements of CEQA, the permit itself gives the discretion to the permittees to consider other environmental mandates. As you see the first paragraph, consideration shall be given to the type of development and the potential for stormwater pollution when determining the applicability of BMPs. Cost-effectiveness, ease of maintenance and consistency with other environmental mandates may also be considered.

These permittees must be permitted to exercise that discretion and to consider other environmental mandates and specifically to consider the full potential of adverse impacts from what the Regional Board is trying to mandate.

In addition, consistent with CEQA, other available alternatives to address these issues must be considered at the beginning of the process other than the option that has been forced on everyone by the Regional Board. Other alternatives must be considered before we create another environmental disaster such as what occurred with the use of MTBE to preserve our air at the expense of our water quality. Please let us learn from this and other failed environmental policies.

First, the evidence that is in the record before you shows that the Regional Board has not considered the potential of vector control problems, including specifically mosquito and rat problems and other infestation problems that may arise from having standing water with sludge and sediment existing for extended periods of time. We have a letter from the greater Los Angeles vector control district that has already expressed reservations about the path that the Regional Board is requesting that we embark on.

This is in regard to the study they're doing with Caltrans on the pilot project for the best management practices.

This letter says, "We are finding that most of the studies reinforced man-made water retention BMP devices produce mosquitoes. Left unmanaged, we believe the natural 'infiltration devices' will also contribute to mosquito problems. Unquestionably there is a potentially serious mosquito nuisance and public health consequence associated with broad establishment and implementation of these devices, and that deeply concerns the mosquito abatement district. Therefore, the abatement district is willing to participate and support any manner or action that seeks to prevent local and regional development and installation of such devices that contribute to the production of mosquitoes and/or other public health vectors."

We need to look at the environmental impact before we move forward with this or any other similar project. We also need to consider the groundwater impacts from the accumulation of pesticides in the concentrated area.

Next we need to consider what we're doing to our communities, particularly to our economically disadvantaged communities and how this program may disparitly impact smaller, higher density developments. You will hear how we will lose affordable housing if this program is implemented and the Regional Board's failure to consider this impact.

What we haven't heard and the Regional Board hasn't analyzed is the potential adverse health effects to these communities from creating large retention basins in the midst of a multi-unit project. Where is the environmental justice in all this? We need to look at our communities who are bearing the brunt. Aren't we asking these lower income communities to bear the larger brunt of the solution in comparison to others? Please let's consider this impact before we move forward.

And the other aspect of this problem, of the development, is what are we doing to our ability to redevelop the areas in our inner cities? Many of our cities represented here today are built-out, and yet we are being asked to provide affordable housing within our inner cities. Doesn't this really lead to urban sprawl? If we cannot afford to develop in the inner cities, it will lead to development in the green areas, and that is exactly what we as environmentally concerned citizens are trying to prevent. And it would certainly inhibit the new wave of smart growth. So we need to look at that issue.

Third is the issue of our groundwater quality. I know that there are certain exemptions or waivers in what the Regional Board is proposing, but how closely has the Regional Board analyzed this problem and particularly how long will it take before there is such a concentration of pollutants in a particular infiltration basin before these pollutants reach our groundwater? In effect, are we making the same mistakes we made with MTBE where we traded off water quality for air quality? Are we trading our groundwater quality for surface water quality?

I was very involved in the MTBE issue about four years ago when we were on the various city and environmental committees that I was on, and I remember asking the Air Resources Board coming to our committee and providing testimony that this was -- we had to clean up the air and it would not get into the groundwater because all they had to do was make sure that all the underground storage tanks were double lined and all the pipelines. I asked the question at the time, even if could you ensure that, which is very unlikely, I said what about a natural disaster such as an earthquake? And of course, they didn't listen and now we have a very, very serious ground water contamination problem. As you know, all the wells in Santa Monica City were shut down because of MTBE and that's extremely expensive to clean it up once it gets in there.

So I'm very passionate about this issue being on the San Gabriel Basin Water Quality Authority. Millions of dollars go to the cleanup, and let's look at it before it happens. I don't want to come here four years from now and say "I told you so." That doesn't help. Let's look at it before it happens, please.

Finally, has there been any consideration of available alternatives such as a regional approach to addressing these issues rather than addressing these issues on a site-by-site or project-by-project basis? And as Mr. Brown pointed out, he asked the question, a very good question. Are there more effective ways to do it on a regional basis?

We as cities are not opposed to spending the money to solve this problem. We acknowledge there's a problem, but if there's a better way to do it on a regional basis, more efficient, please let's spend the money that way.

As we have over time with our other environmental policies and statutes such as CEQA and the endangered species or even simply our own experience with sewage systems versus our septic tanks, in many cases it makes sense to solve these problems on a regional basis rather than on a site-by-site or project-by-project basis. This is one of those occasions.

We ask the State Board to consider all

appropriate alternatives to avoid the potential significant adverse impacts that have not been fully considered by the Regional Board before we embark upon a potentially disastrous environmental path. If we are truly concerned about our environment, we won't and we can't just do something; rather we must do something that is right for our environment.

Thank you very much.

CHAIRMAN BAGGETT: Petitioner, do you have any questions for your witness?

MR. MONTEVIDEO: No, not at this time.

CHAIRMAN BAGGETT: Is there any cross-examination?

EXAMINATION

BY BOARD MEMBER BROWN:

Q. Ms. Clark, has there been efforts with the water control districts in counties to address this problem on a local basis that you have been satisfied with, at least pointed in the right direction or should be?

A. I really don't know. I do know that at our SCAG environment committee we've had testimony from the Orange County District that is implementing a regional -- diverting the stormwater into the sewer treatment system. And if that's feasible, in my opinion that's much more cost-effective to know that the water is going to be treated before it's discharged.

Q. It might be worth your while, I'm sure you're familiar with it or others are, with what Fresno is doing in this issue.

A. That sounded very interesting, what you said. I was very interested in that.

Q. I forget the director's name. Doug Harrison. He has done just an outstanding job addressing this issue on a regional basis and it might be worth your time and others to visit.

A. I would love to study that. Maybe the SCAG people here could get that information for us. Appreciate that.

CHAIRMAN BAGGETT: Any questions from Board Members or staff?

CROSS-EXAMINATION

BY MR. HELPERIN:

Q. Good morning, Ms. Clark. You testified a lot today about the risks posed by the incorporation of these best management practices into various types of development.

Do you have a background in engineering?

A. No, I don't. My husband is an engineer and I have two daughters. You see, this is --

Q. One of my best friends is an engineer.

A. Can I make this point, though, that that's the very reason when the MTBE issue came up. All the engineers had it all right. We're going to put this oxygenate in and methyl tertiary butyl ether won't hurt anything and this is going to be wonderful. They didn't listen to the practical questions from people like me in the public. What's it going to do to the groundwater?

Q. You've also testified about the biological concerns with respect to mosquito breeding. Do you have a degree in biology?

A. No, I don't.

Q. Are you aware there have been studies done all over the country on mosquito breeding best management practices?

A. I would assume there were.

Q. Are you aware of the results of those studies?

A. And I hope the vector control district, I would assume they know these studies and they're not going to go off on a limb.

Q. Are you aware that there has been no problem with adult biting mosquitoes in any place in the country where these types of best management practices have been adopted?

A. I'm not aware of that but I know encephalitis is a very serious disease and I have a lot of grandchildren I'm concerned about.

Q. I would not argue that point. Are you aware that despite all the studies that have shown some breeding within the BMPs in the Los Angeles area there has been no evidence of adult biting mosquitoes in the areas of the BMPs?

A. I am not. Was it done in the summertime?

Q. Yes, it was.

MR. MONTEVIDEO: If I could please. May I raise an objection? Her last question raises a good point. We need some foundation for these questions. You're making statements where there's no foundation anywhere in the record. If you say we have records or documentation to show her that supports what you're saying, but beyond that there's no foundation for the questions.

CHAIRMAN BAGGETT: I'll sustain the objection. Lay some foundation.

MR. HELPERIN: I have been and will be testifying as a fact witness throughout this testimony. I have been working on BMP-related matters for the last two years, and I don't have with me today the studies on mosquito breeding, but I am personally aware of some of those studies and am personally aware of the results of some of those studies. But I will limit my questions to only those things of which I am personally aware.

MR. MONTEVIDEO: Mr. Chair, again, I think the issue here is whether there's a foundation in the record. It's not a question of his personal knowledge.

MR. HELPERIN: Personal testimony is an admissible form of evidence, Mr. Chair.

MR. MONTEVIDEO: But I thought this was Ms. Clark's testimony.

CHAIRMAN BAGGETT: He is a witness. Counsel, the challenge we have here is we've taken two witnesses out of order. In retrospect, it was not the best thing to do. We've done it to accommodate both parties in this case, and it is very challenging considering there have been no statements, none of the rest of the case-in-chief. We're throwing on both sides and it's a challenge.

If you could, I think it's things we're going to get to later when you get to the full case-in-chief. You don't have to make that --

MR. HELPERIN: Certainly. I wanted to address the mosquito issue because Ms. Clark focused on it and I wanted to at least bring up some of the --

CHAIRMAN BAGGETT: You'll have that opportunity later.

MR. HELPERIN: Just one final question on that issue, and if it's not acceptable, that's fine.

Q. Are you aware of mosquito-eating fish? Do you know there is such a thing?

A. Oh, yes.

Q. Do you know those are regularly put into retention ponds that have standing water in order to prevent the breeding of mosquitoes?

A. I would assume so, but I don't know if you can do that who's going to be monitoring that on each retention pond.

Q. You are aware that's a regular component of the program to prevent mosquito breeding.

A. Yes. Sure.

Q. Another question. You had testified earlier with respect to the permit and the language of the permit and that it makes provision for review of other environmental issues; is that correct? This is a direct copy of a section of the permit, and I believe the section you quoted is the second underlined section where it says the cost-effectiveness, ease of maintenance and consistency with other environmental mandates may also be considered; is that correct? Do you see that's under Section B?

A. Yes.

Q. Which is the list of recommended BMPs which is separate from Section C, which is the one that contains the text about the SUSMP?

A. Say that again.

Q. The permit mandates a lot of programs, and within the development planning program the permit mandates multiple programs be developed by the permittees of the Regional Board. One of the programs that the permittees and the Regional Board have to develop is the development planning program. Subsequently to that they have to develop a list of BMPs, recommended BMPs, which the Regional Board then approves. Subsequently to that they adopt a SUSMP.

The text that you quoted is in the second program. It's relevant to the development of the list of BMPs and it should have been and was taken into consideration at that time. It's not relevant to the --

CHAIRMAN BAGGETT: What is the question?

MR. HELPERIN: I just wanted to know if she was aware of this distinction in the permit.

CHAIRMAN BAGGETT: Okay.

MR. HELPERIN: Thank you.

Q. You're from the City of Rosemead; is that right?

A. Yes.

Q. Has the City of Rosemead implemented continuous deflection systems? It's a BMP for the control of stormwater pollution.

A. I don't know.

Q. Do you know if the City of Rosemead has implemented any retention basins?

A. We are considering it on one of our projects that is coming in.

Q. Has the City of Rosemead implemented any of the structural BMPs that are at issue here today on a regular basis throughout the city?

A. We are doing the porous pavement on our senior housing project at my request.

Q. So you actually have no personal experience with the implementation of any of the BMPs.

A. Well, they haven't been required and we have done some, but not the ones that we want to make sure they're helpful to the environment.

Q. So your concerns here are speculative, essentially.

MR. MONTEVIDEO: Objection. Misstates her prior testimony. Misstates her answers.

CHAIRMAN BAGGETT: Sustained. Rephrase.

Q. BY MR. HELPERIN: So you have no personal experience with any of the problematic, potentially problematic issues that you've raised here today.

A. Oh, yes. Let me tell you about a treatment plant that the San Gabriel Basin Water Quality Authority is implementing in the La Puente County Valley project.

Q. What kind of treatment plant?

A. It's (inaudible) chlorite. It's the first in the nation.

Q. Is this a structural stormwater control?

A. It is not structural stormwater control. What I'm going to tell you is what the Department of Health Services is requiring of the water producers.

Q. I appreciate that, Ms. Clark. We're actually here to talk about structural stormwater controls.

A. And that's exactly what they did with MTBE, sir. They were concerned with air quality and they weren't with groundwater.

CHAIRMAN BAGGETT: Please continue.

THE WITNESS: On my example? They're requiring the water producer to identify all potential chemical compounds that might be found in the groundwater that might contaminate -- that might reach the wells in the future. And what we are asking is why isn't the Regional Board not even identifying the fate of reasonably expected pollutants? That should be required to be performed before you implement these things, and I'm very concerned about this.

Even the table, if I might, I didn't understand all of it from your other witness, had 80 percent, 70 percent, 60 percent. What about the 20 percent? What about the 40 percent?

Q. BY MR. HELPERIN: Those percentages would potentially get into the water as the hundred percent.

A. That concerns me. If you accumulate that, you've got a problem.

Q. Right now it's at 100 percent.

CHAIRMAN BAGGETT: Could we --

THE WITNESS: It's going to the surface waters. It's not going to the groundwater.

CHAIRMAN BAGGETT: Any more questions?

MR. HELPERIN: A couple more questions. I apologize.

Q. The Orange County program that you mentioned, are you aware that that program deals only with dry weather run-off?

A. Yes. Bob Jorrell gave us a --

Q. And just one last question. Has there been any administrative civil liability issued against the City of Rosemead by the Regional Water Board?

A. No.

MR. MONTEVIDEO: I object. I'm not sure she understands the question, Counsel. She doesn't have a law degree.

Q. BY MR. HELPERIN: Do you know if there have been any fines issued or draft fines issued against the City of Rosemead by the Regional Water Quality Board?

A. Not to my knowledge.

MR. HELPERIN: Thank you.

CHAIRMAN BAGGETT: Any other parties wish cross-examination?

If not, then I'll ask my colleagues if we want to take a break now. So we will break one hour for lunch, come back at 1:00 and begin the policy statements. We will be in recess.

(Lunch recess taken)

CHAIRMAN BAGGETT: Let's go back into session.

When we recessed was the public policy comments. Again under public policy there's no cross-examination of public policy commentaries. They are not sworn witnesses.

We have a number of blue cards. We will limit to three minutes unless there's questions from the Board Members themselves. With that, we'll just go down in the order.

We have Gilbert Canizales. When you come up, if you could please state your name for the record and if you have a business card you want to give the court reporter.

MR. CANIZALES: I actually had some information I wanted, letters, copies.

CHAIRMAN BAGGETT: That's fine.

MR. CANIZALES: My name is Gilbert Canizales, and I'm here on behalf of the State Senator, Betty Karnette. In the interest of time, I'll just read a portion of the letter to convey the Senator's view.

"Dear Chairman, I am writing to respectfully urge the State Water Resource Control Board to grant the petition appealing the Los Angeles County Standard Urban Stormwater Mitigation Plan at your meeting today and to order that the Regional Water Control Board develop a comprehensive plan in cooperation with the affected cities, businesses and builders. I make this request on behalf of 33 cities in Los Angeles County and the affected businesses and industries that are appealing the Regional Board plan.

"Let me say up front that I am not opposed to stormwater run-off treatment solutions that are targeted, cost-effective and have some demonstrated assurance of results. Unfortunately, the current SUSMP proposal does not meet those requirements," and as was mentioned earlier by, I believe, the Mayor of Rosemead and others who have testified here today, there's a list here on page 1 and 2 of the number of ways that this proposal can be improved.

And finally again, on behalf of Senator Karnette, I strongly urge the State Water Resources Control Board to remand the SUSMP to the Regional Board and to order hearings and workshops on the development of equitable, scientifically based plans to control stormwater run-off.

Thank you.

CHAIRMAN BAGGETT: Thank you. Any questions? Thank you for your comments. Thank you.

Next we have Alexis Strauss, United States Environmental Protection Agency. Is she back? I know she was here. We can go to Mark Pisano and Colin Lennard.

MR. PISANO: My name is Mark Pisano. I'm the Executive Director of the Southern California Association of Governments, and I have with me general counsel who would be available for questions should there be any. I also have copies of my testimony for the Board Members.

SCAG recognizes that water is a fundamental element of this region's future prosperity. As such, water quality is a key focus of SCAG's current planning efforts. We are working with the non-profit organization Tree People to incorporate stormwater best management practices into our livable community's program guidance. We're also participating with Caltrans statewide, but also within our regional effort to identify cost-effective solutions that policy members can support.

We're supporting the Malibu Creek Watershed effort and augmenting our regional database and stand ready to lend expertise to watershed planning efforts. And finally, we're committed to reviving our areawide best management policy, 208. The Clean Water Act provides for 208 as the areawide stormwater planning process, and a recent law article pointed out that 208 was intended as the main tool to deal with non-point source problems and also with stormwater, and as such it would address many of the key issues now being addressed in this hearing and in the debate on TMDLs.

SCAG is the agency designated to run this process in southern California. In 1979, we produced an areawide waste water treatment plan with the participation of numerous elected officials and advisory panels, and even though this plan is now out-of-date, a new plan is in the process of being developed. We're in the stages of working with other -- with many of the agencies within our region to update our plan.

Furthermore, Section 208 can provide more enforcement certainty to the Regional Board since there's a requirement in federal statute that all permits issued in our region must be consistent with this plan.

Please understand that SCAG's member jurisdictions recognize the value of clean water to the region, its economic benefits and environmental benefits, and we stand ready to achieve those goals and to protect those resources, but the means of achieving it are fraught with uncertainty and the Regional Board's approach asks jurisdictions with limited funds to take financial and political risks.

The problem as far-reaching and serious as water quality should not be addressed in a veritable vacuum of knowledge or (inaudible) effectiveness of solutions. The best management practices called for in the stormwater --

in the Urban Stormwater Mitigation Plan are of unknown effectiveness for many pollutants. The Regional Board's proposal is fraught by a lack of knowledge and resources and even the nature of pollutants in our region's non-point source run-off.

The Section 208 process will provide the scientific data among participants that will allow them to identify those BMPs that are effective in controlling pollutants. As a key participant, the Regional Board can share much needed analysis of waste loads and targets that need to be achieved in order to improve water quality.

I'm not going to go through all the issues on cost because I see my time is coming to a close, but I want to note that we're not going to solve this problem unless we look at it inter-jurisdictionally and unless we look at it within watersheds, unless we look at it among governmental institutions and pull together a coordinated and cost-effectiveness program.

There's too many issues unknown, there's too many debates and just too much differences in order for us to be successful. I'm free to address any questions in my testimony.

BOARD MEMBER BROWN: Do you have any ideas of how enforcement occurred in the working with SCAG 208?

MR. PISANO: Yes. Board Member Brown, there's a provision in the statute that says that permits be consistent with 208. 208 is designed -- and let me note that I was in EPA, worked on the legislation and administered that program nationally before I came to my position. It was designed to provide the kind of input, the kinds of analysis and to resolve the differences so that permit conditions can, in fact, be explicitly written and so that enforcement can pursue and there's both permit enforcement and Porter-Cologne enforcement.

If we follow the provisions that are laid out in statute, we can put together, I am convinced, a cost-effective and enforceable program, and one in fact we can get achieved consensus and make all the various trade-offs that we have to make.

MR. LENNARD: If I may just add to that as well. Under the 208, obviously you've got a bottoms-up approach. What we're dealing with here is top-down, and if you look at the very reasons for the 208, it was designed being a bottoms-up approach to water quality. In addition, 208 is very specific with respect to economics and environmental consequences.

CHAIRMAN BAGGETT: State your name.

MR. LENNARD: My name is Colin Lennard. I'm General Counsel.

BOARD MEMBER FORSTER: I'm curious. When L.A. had their hearing on their permit in January, there was a proposed permit on the street and then the permit was modified during the hearing. Were you supportive of the original proposal before it was modified at the January meeting?

MR. PISANO: We did not take a formal position in favor of or opposed to the permit. What we testified at that hearing was the approach that was being taken, it did not have the necessary consultation nor did it follow the kinds of processes that would lead to enforceable permit actions.

We're neither opposed to nor are we supportive of across-the-board numerical limitations. In some areas they may work. In other areas they may not. What we want and what we testified at that hearing to the effect of is let's carry out what was intended under federal statute. Let's carry out a mutually coordinated program so that we can be effective and our elected officials can go back to their community and say they achieved necessary environmental goals but at the same time attained the community objective.

BOARD MEMBER BROWN: What are you now proposing the State Board do?

MR. PISANO: What we did in our initial hearing and what we're doing today is that -- is that the State Board be a co-participant with us in revision to the 208 plan revision. We are working with the POTWs and working with our members and working with Caltrans to develop an intergovernmental funding program and implementation program. And I outlined the rudimentary elements in my testimony today.

Specifically I am proposing that this Board direct as policy for this state that its Regional

R0073716

Boards within our region -- we have five Regional Boards within our region -- that those Boards work with us in a coordinated effort to develop a 208 plan. We can live with the schedules that you're laying out in your permit processes, but what we're asking for is that the intended intergovernmental decision making framework that is in statute be able to follow in our region.

CHAIRMAN BAGGETT: Thank you. Next we have Manuel Acamazon, Irwindale, followed by Councilmember Bruce Barnes from the City of Cerritos.

MR. ACAMAZON: Good afternoon. My name is Manuel Acamazon. I'm the Mayor Pro Tem for the City of Irwindale. Thank you for the opportunity.

We do have some concerns. As a representative of many people, I'm not the only councilperson that will speak to you this afternoon. I normally don't like to read what I like to say, but for purposes of accuracy I would like to read my statement. Irwindale opposes the SUSMP by saying that it is an unreasonable cost, costly and its benefits of improving water quality is questionable. The City of Irwindale is a developing community and like other cities it is very, very interested in commercial development and housing development. The City is planning to reclaim its defunct mines for commercial use and build low to moderate income housing for its growing population.

The SUSMP proposed by the Regional Board frustrates these plans. The City of Irwindale is not like other cities like Santa Monica. As a city they don't have problems to get businesses. Nevertheless, Irwindale has to work hard to attract builders to develop in the city by offering incentives.

The SUSMPs offered by the Regional Board would be a de-incentive. Of course City of Irwindale is also concerned about environmental issues, and I think nobody argues that. We do have environmental concerns. Nevertheless, our residents like going to the beach. We enjoy fishing and the surf. Our citizens also like to fish in clean waters. We certainly don't want to aid in any practice over which we cannot control -- that we can't control the threats to those beneficial things.

What bothers us, however, is the Regional Board's reason for requiring certain developers to put infiltration devices in every parking lot with 25 or more spaces. We understand these devices basically reduce oils, grease and metals from parking lots, but the Regional Board has not explained to us how oil, grease and metal from run-off sources (inaudible). We would like the Board to explain this to us in writing, and instead of generalization we would like specifics.

We know some things about urban run-off. We know that bacteria is mostly from sewage released and causes beach closures and causes illness to swimmers. We also know that decaying vegetation can contribute to high levels of bacteria, but this is something we in Irwindale can help fix.

For example, we are expanding (inaudible) of our catch basins. During dry periods the flat gates stay closed keeping out trash, pet droppings, leaves and grass clippings and other sources of bacteria and viruses. When it rains, the gates open up to a lot of run-off to enter the storm drains so it doesn't flood. We have already installed four of these devices in our city. We believe that these devices are more effective than the controls proposed by the Regional Board for new developments. Our devices reduce bacteria and viruses throughout the river and also keeping out other sources, but we have a hard time seeing what benefits would result from controls that reduce oil, grease and metals.

Also we understand that if these expensive devices are not properly used, they won't work. If Irwindale has spent its resources to follow the state and federal mandate, we at least deserve to know in specific terms, not generalizations, what we are getting ourself into.

That concludes my statement I would like to go on public record, but one other thing. Many of our cities, we're looking for funding in different areas. We have a project we want to work for some funding. This is going to put a damper on not only the people we're trying to help, we need more details from you, better results of what you're trying to accomplish so we as a people directly, the residents of our country, of our state, can make better decisions not based on one thing that you've come up with.

I know that a lot of things have become controversial. Nevertheless, we're not fighting environmental rights, which is good, but we also need to be balanced in the things we do and I think you need to consider that.

I thank you for your time and I hope that you come to a good conclusion that's best for the people. Thank you.

CHAIRMAN BAGGETT: Thank you. Councilmember Barra followed by Councilmember Shaw. Bruce Barra. If he's not here, you're next.

MS. SHAW: Good afternoon. I'm Marlene Shaw, Councilperson for the City of Compton, California, and the reason I was a little concerned some of the people just coming in, but basically you've heard all the technology, the details, the issues. You had expert witnesses this morning, Dr. Horner, his position and research.

I have to tell you that first I have not done that type of research, so I can only deal with what I know as a fact that affects my city and other cities across this nation, especially the State of California and Los Angeles County.

The City of Compton background is 112 years old, chartered in 1888. The population consists of about 51 percent black, 47 percent Latinos and I would say the 3 percent of others. Basically we are 10 square miles and we have over 100,000 people, so that would give us about 10,000 people per square mile. Being a city made up of black we are, naturally we have financial constraints. We do everything we can to try to make the lives of our citizens livable.

We are one of the highest taxed cities in Los Angeles County, if not the state of California. I often listen to my constituents who say that we pay more taxes than Beverly Hills. Given all this, to say the mandates you are requiring of us, we really cannot afford to pay for that as a city. We cannot raise our taxes. We cannot depend on the actual developers to do it because if it costs them too much to develop, they will not come into our city, and we do have a problem trying to bring developers to come into the city.

The plans that we have, like the performing arts center, we have plans that this will affect all of the development and businesses that we're planning for our city. Also, although we have over 10,000 people per square mile, our arena assessment requires us to have over 721 more housing. We have areas that we're trying to develop. We have brown fields we need to work with. They all need a corridor going right through our city at this particular time forcing a lot of different construction to look different places while we're going through these changes.

So I'm saying from the City of Compton, and I do not know if anyone has researched a city like the City of

Compton where you have the overcrowdedness, where if a person has an older house and has to put a roof on, if they're to meet the requirements that you have, then they won't be able to put the roof on because they won't be able to afford the catch basin or drain, whatever you're going to require in order for them to do that. They can't afford to paint the house because if they paint the house and the water goes into the storm drain, then we have to prepare to do different things.

Your gas stations, we have a lot of gas stations, a lot of fast foods in our city. We have a lot of those types of businesses that really and truly as a city, if we are to try to meet all your requirements, we cannot do that. If we don't do that you can fine us up to $25,000 a day. If you do that, then you can have the city because we can't afford that.

(Laughter)

MS. SHAW: It's almost time, so basically what I'm trying to talk about with the catch basins, somebody mentioned the fact well, do you understand that if you have a pool and the water is in there you can put this in and put that in, I don't know what they put in. Mosquito abatement, I understand that. A mosquito bit me last night.

(Laughter)

MS. SHAW: But basically what I'm asking for is an understanding. If you would just for a minute put yourselves as a policy person in the city like the City of Compton, facing those types of restrictions, trying to figure out how you're going to be able to even survive as a city, not being able to tax your people anymore, not having the revenues because there are no monies to go along with these mandates, not wanting to run our development out by the high cost.

I'm asking for consideration, even that the cities would have some type of control understanding and being able to make the determinations as to where we can do these different things and also an understanding as to what cities like the City of Compton where you have more cities like the City of Compton in this state will be able to work with you and try to meet your requirements.

I thank you very much for listening to me and actually for your understanding and consideration.

Thank you very much.

BOARD MEMBER BROWN: Has your council addressed the issue of how your city might in itself be concerned with the problems that we're facing here and how you control the run-off?

MS. SHAW: First thing, we've always wanted to make sure our storm drains are clean because when it rains and water comes up, we don't want it flooded, but also I was an environmentalist. I believe in clean air. I believe in drinking clean water. I'm a official person. I believe in OSHA. I believe in all these things.

I have with me today my person from -- our public director, Mr. Dante, and Mr. Ferrington, another Councilperson, is on the way, but because -- this morning I stayed because it's so important to us for this, our council. Some other things either Mr. Dante could answer. As a councilperson I say yes, we need this. I do know that things need to be put in place. I can't say oh, we've got the filters for every storm drain. I'm not going to tell you that because I really don't know, but I do know that we have approved projects that try to meet the mandates, but we also have to ask that you have some understanding and see that cities like the City of Compton to be able to work with you to try to meet the mandates and still be able to thrive as a city.

BOARD MEMBER FORSTER: I want you to know I taught school in Compton in 1965.

MS. SHAW: Oh, you did? Which school?

(Laughter)

BOARD MEMBER FORSTER: I can't remember.

(Laughter)

MS. SHAW: I'm very glad because we are very proud of our city, our school district and our college. Compton College used to be at the Compton High School (inaudible) facility. My mom moved into Compton in 1951 and we're still in the same place. It needs a new roof, too.

(Laughter)

CHAIRMAN BAGGETT: We've got Charles Sihler, City of Pomona, then Alexis Strauss.

MR. SIHLER: Good afternoon, Members of the Board. My name is Charles Sihler. I'm an engineer associated with the City of Pomona. I'm a former member of the L.A. County Executive Advisory Committee. I spent over 30 years in the water industry.

The SUSMP as issued would create an enormous financial burden for the City of Pomona. The City of Pomona, while one of the five largest communities in the Los Angeles County area, has less than half the general fund tax base of the other communities of its size. Over 60 percent of the population is minority and we have over half of our area that's been designated for low-moderate income.

While we subsequently have been built out, the development requirements would stifle homeowner, developer and redevelopment efforts within the city to try and build it up and bring it back to the (inaudible) of the past. While some may say that the communities are all being treated the same, in the eastern part of L.A. County we are the easternmost city. The adjacent communities of Chino, Chino Hills, Ontario and Montclair have no such restrictions as the SUSMP. This renders us as far as local development dollars way behind the power curve if we have to enforce it as posted.

While studies in other areas may have shown severe detriment to receiving waters from run-off, a seven-year study of the Los Angeles Long Beach Harbor area with regard to a non-NTBS issue showed the only contaminant noted to be fecal coliform. That was coming -- that level was the same as was coming out of the mountains, which meant animal waste.

We have over 800 catch basins within the city. If we were to make the modifications to meet the goals that are stated, you would subsequently kill all of the social-related programs, the senior, the youth, library services and park maintenance. The City and the citizens have done an outstanding part to clean the environment through common sense BMPs, enforcing and working with them. The SUSMP, as issued, reflects an extreme example of a government mandate, unfunded government mandate, on our community.

Based upon the data and testimony that I have heard and seen, over 60 percent of the county that does not drain into the Santa Monica Bay, the L.A. and San Gabriel River basin areas, is being colored by Santa Monica Bay data. I would ask you to review this and overturn the SUSMP as issued in favor of a consensus-based, CEQA-compliant plan.

Thank you for your consideration.

CHAIRMAN BAGGETT: Thank you.

Alexis Strauss followed by Jack Hazelrigg, Greater Los Angeles County UCD. Apologize.

MS. STRAUSS: Thank you. Thank you, Board Members. I'm Alexis Strauss, Environmental Protection Agency.

We believe the Board has a strong legal and factual basis as well as a compelling responsibility to adopt these requirements to control stormwater pollution which should come as no surprise. The petitioners, as well as the other municipalities subject to the permit, have been engaged with the Regional Board, EPA and others since 1990 regarding the L.A. County MSW permit. Ten years later I feel we have yet to realize the intent of the implementation of this very permit.

At issue here is but one of several reasonable and necessary implementation measures that the Regional Board believes, and we at EPA agree, is needed to reduce pollution from stormwater. We know the impacts of stormwater pollution in southern California have been very well documented, both public health impact and the economic impact of beaches polluted due to stormwater flows.

This hearing and the actions that we have been forging together is about toxics in toxic amounts, not about mosquitoes. This is about fish that are too contaminated to eat and beaches that are closed because they are too polluted for swimming, and the challenges for us all professionally regardless of the comments at the hearing is what we can best do to fix these problems.

These problems will continue to plague us unless the Regional Board can fulfill its appropriate regulatory and leadership role. The Standard Urban Stormwater Mitigation Plans provide a consistent and common-sense approach for the development of planning at the point in the process when pollution prevention requirements can most efficiently and cost-effectively be incorporated into a project. If this Regional Board requirement, which you have seen is already operational in several other states and municipalities, is not upheld, I believe it will cause worsening conditions, costly retrofits, and worst of all the piecemeal approach to stormwater (inaudible) of our municipalities.

The overall scheme for controlling stormwater pollution is best achieved through matching municipalities' land use authorities with the Regional Board's regulatory authorities so the cities will take increased responsibility to work with and not against the Regional Board in controlling the key sources of stormwater pollution.

We have a very long way to go to achieve our mutually held clean and safe water goals and the MS-4 permit is a vital tool. We are seeing high levels of non-compliance with the state's general construction stormwater permit, and we can ill afford to postpone the full implementation of this permit.

The Regional Board sponsored an exceptional level of outreach through workshops, meetings and solicitations of comments, and throughout the past year the staff and the Board Members have revised in response to those very comments. The Regional Board has emphasized that we must achieve efficient BMPs and giving flexibility in meeting the design standard.

Let's give this permit our full support and hope that we can realize its promise, less we have to turn instead to more restrictive and less flexible approaches. I think you may realize that we have to reissue this permit in a year and a half. (Inaudible) implementing the permit. This is no time to digress into alternative planning processes of 20 years past and no longer useful in our current implementation of the Clean Water Act. We have made hundreds of voluntary watersheds succeed in southern California, but we cannot succeed in our overall efforts if we cannot make major gains in stormwater pollution.

We've done what we need to do with the point sources. We have to make major gains with the non-point sources. So I would urge you that we have to (inaudible) to achieve compliance. I ask to you support our efforts at last to implement this vitally important plan.

Thank you.

CHAIRMAN BAGGETT: Any questions? I have a couple of you. You have a nationwide perspective, I assume, of what Maryland and Florida and other states have done. Is this out-of-step or more restrictive?

MS. STRAUSS: It doesn't appear to be more restrictive. It's a unique situation where we have 86 participating municipalities, and I think what we're missing in the discussion thus far is -- the majority of what we need to do is agreed upon and there are a few things that are points of tension. One of them is the

.75 precipitation. (Inaudible) trigger that, go further than that, and the Regional Board have been actually comparing that.

I think the overall package is a difficult one to compare elsewhere with other land use authorities. We have a highly urbanized area here that's highly built-out. There probably are places that Fresno -- the optimal situation that Fresno has devised. We don't necessarily have the same flexibility in land use in the urbanized land use basin. I think the mechanics here is typical of what we're seeing in other cities, and I personally, through the efforts of the California Stormwater Task Force, believe that the collective intention of the municipalities, the state agencies, and the other participants here to a level comparable to anywhere in the country. We just haven't gone as far as we need to to do it. We just haven't gotten that consistent commitment and partly because we have not implemented this permit yet and we're ten years down that road and about to reissue.

CHAIRMAN BAGGETT: In your written comments you talked about cost-effectiveness studies and analysis and cost analysis you've done on the MS-4. Is there anything -- have any of these proposed BMPs been analyzed?

MS. STRAUSS: I think that the Regional Board has gone through all of that in developing the last year's worth of submittals in the meetings that we participated in. I think where EPA took that a step further into something not relevant to today's discussion, which is the phase 2 stormwater program which is upon us as well and is referenced, we have a long way to go with phase 2. We have got to get phase 1 under our belt and running. I'm worried that we're not doing that. (Inaudible) Clean Water Act requirements under 403 in this situation and I would like us to succeed. I think we have most of the stuff and there's a little bit with some of the cities that we need to work past.

BOARD MEMBER BROWN: Ms. Strauss, you're right. The City of Fresno in that area did lend itself quite well to that overall broad-based solution. Of course we could always be hopeful that other areas would have some similar opportunities; maybe not the same, but opportunities for a regional approach as opposed to an individual approach.

My question is, you see that there might be opportunity for some compromise -- not compromise but maybe like a variance in the .75 as areas differ here. The importance for BMPs of types that are suitable, economically feasible and suitable, vary also with the problem in the areas you just mentioned with Fresno. The .75 seemed to be a contention with some of the cities in that's a lot of water to contain. I recognize some of the other cities across the country are .25 and greater.

Is there some way in your mind that we can leave some of that discretion for variances with the locals as opposed to state mandate?

MS. STRAUSS: I think that the documents I have read in preparation for the last year's worth of work on this permit, there was room that the Regional Board was offering in how those could be met. I don't have the expertise of the first speaker in knowing the proper design standard. I have no engineering expertise whatsoever, and I dare say given the enormity of the task before us and given that the cities had proposed .6, that we're rather close in where we're headed and perhaps whether it's .6 or .75 or 1.0 or .8, that this is what we're trying to define is the bare minimum of what we're doing to turn the corner on stormwater.

So in terms of a regional solution, the difficulty is not necessarily whether it's .75 or something else. The basic threshold of our governments is that land use planning authority that exists at the city level. It does not exist on a regional level, although maybe a hundred years from now it might. The basic authority for when I want to develop a multi-unit dwelling exists at the city level. They do not exist at the regional level and we have to match up what the cities do in their land use authority, regardless of where you choose to actually set that number or return it for comment.

BOARD MEMBER BROWN: The .6, since the cities did seem not to object to that as strenuously as the .75, what if the State Board set a .6 to say .75 and have some discretion to the local communities as to what that should be? I guess that's the question, if you think there's room for that consideration.

MS. STRAUSS: I think legally (inaudible) answer to the flexibility, but I think practically it would be fascinating to turn that question into an answer. If you have heavy rainfall here, here, a dry rainfall here, here and calculated what the differences including water traveling through storm drains to the beach, I don't know what that would mean in terms of mass loadings and terms of likelihood for pathogen and other impacts to beaches.

If we were sitting in the middle of what was happening in Huntington Beach, some of the cities wouldn't be making this argument. There was a phenomenal impact from that to a very small source. Once you know the answer to that, the volumes of the loadings themselves turn the corner on solving the problem. And even though individual cities can comment on them, their own development needs, we all share the desire, I even share it now that I live up north, a desire to be here in winter because it's so much warmer.

The beaches are the identity of southern California, and regardless of where we live in this basin, a lot of people go to the beach. More people go to the southern California beaches than the rest of the country combined. And if they're closed, we have a completely different set of problems and we know what it is to have those closed, and those restrictions are going to be with us for a long time.

CHAIRMAN BAGGETT: Thank you very much.

MR. HAZELRIGG: Yes. My name is Jack Hazelrigg. I'm the General Manager with the Greater Los Angeles Vector Control District. I have with me one of my colleagues, staff members, (inaudible). He's our scientific technical services director to answer any questions that you may have.

You've already seen presented to you earlier today testimony and evidence, a letter especially written by Mayor Clark that addressed some of our concerns regarding the SUSMP. Basically what we are requesting is that the Board simply consider the negative impact on public health as a consequence of SUSMP.

And what do I mean specifically? We're really concerned about the mosquitoes that could occur from an extensive application of the devices that are proposed in SUSMP. For example, we know that if these devices are indeed implemented, they will produce mosquitoes and produce quite a bit of mosquitoes. We know that because we're involved in the Caltrans pilot project right now in District 7 that has similar devices installed along the freeways. There's 14 of these devices now installed and several are being constructed, and each one of these devices except for one there is notable and abundant mosquito breeding occurring in each of these devices.

So what we're asking here is indeed on one hand you may be providing the benefit, but you also have to understand that there may be a detriment or consequence to the benefit and that will indeed be implementing throughout the County of Los Angeles a tremendous production of mosquitoes, possibly other vectors that we have not really involved studying at this point in time.

My district represents 34 cities and a partial area of the County of Los Angeles. Many of these cities are parties today at this hearing, some are not, but our perspective is one of public health.

CHAIRMAN BAGGETT: Questions?

BOARD MEMBER FORSTER: The devices that you're using for Caltrans, are they the -- what are they?

MR. HAZELRIGG: Every one of the devices that the expert witness was here and had on the overhead are being implemented in the Caltrans pilot project study right now.

BOARD MEMBER FORSTER: All?

MR. HAZELRIGG: Each and every one of those devices, yes.

BOARD MEMBER FORSTER: Are some less apt to be a mosquito breeding place than others?

MR. HAZELRIGG: The infiltration device is the one that has not proven to produce any mosquitoes at this point in time, but we did not have a lot of rainfall in the season to be able to assess some of the consequences of the filtration devices because normally what happens in those devices is the water will percolate and the water won't be present after three to five days. We need water standing for three to five days before we have any mosquito breeding.

It's not actually the devices. The devices in themselves are probably technically poorly designed in producing mosquitoes, but it's a consequence of not managing the devices that we're concerned with.

My experience in 25 years in mosquito control, environmental groups, we've dealt with a lot of environmental projects. On paper, they look fine. Unfortunately, there isn't generally money that's provided afterwards to support and manage the program in these projects and that's when we're faced with the really horrendous mosquito problems.

CHAIRMAN BAGGETT: Thank you. Andrea Harrington, City of Claremont, followed by Leanne Hamilton, City of Arcadia.

MS. HARRINGTON: My name is Andrea Harrington with the City of Claremont. We just wanted to show our support of the original system. We think the money would be better spent.

CHAIRMAN BAGGETT: Leanne Hamilton. Charles Redden from City of Covina.

MS. HAMILTON: I'm Leanne Hamilton with the City of Arcadia. While the City didn't prepare a separate statement, we support the efforts of the presenters for the petitioners in the cities that you're going to be hearing from and yourselves to find more reasonable solution to this problem.

I'd like to thank you, distinguished Board Members, for holding this hearing in such a timely fashion and coming to listen to our concerns about this problem and hopefully find a more workable solution.

Thank you.

MR. REDDEN: My name is Charles Redden. I'm with the City of Covina. On March 7th, 2000, the City Council of the City of Covina passed a resolution publicly supporting the petition to the State Water Board in contesting the action taken by the Regional Water Board regarding the reduction of the Standard Urban Stormwater Mitigation Plan.

There were two areas of concern that sparked this resolution. One, that there was no scientific proof that the retention treatment program works to reduce pollutants which impact streams, rivers and oceans. These new unverified standards will affect new and existing development with substantial initial and ongoing costs to the cities. Number two, that the established agreed-upon method to create the SUSMP was unilaterally done by the Regional Board in violation of the terms of the current NPDS permit.

These procedures were established for fair, effective ways to prevent stormwater pollution. The procedures were turned on their ear in a closed session of the Regional Board. The new SUSMP requirements should be reversed. It is not effective and it was not created properly.

Thank you.

CHAIRMAN BAGGETT: Ray Tahir, City of Montebello, followed by Heather Hoecherl.

MR. TAHIR: Good afternoon, ladies and gentlemen. My name is Ray Tahir and I represent cities of Montebello, Commerce and the City of Whittier. I'd like to kick things off by responding to Alexis Strauss's comments relative to the pathogen material.

I should point out these controls have done absolutely nothing to reduce the amount of bacteria or viruses that go into the storm drain system. (Inaudible) parking lots, more specifically to capture oil, grease and some unspecified metals. The problem is that no studies have been done. Local studies have been done documenting that oil, grease and certain metals have an impairing effect on (inaudible).

The other issue I would like to address is that of the .75 design standard. Cities don't have a problem with that, whether it's .75 or one inch or a half inch. The SUSMP adopted by the Regional Board compelled mandatory BMPs that infiltrate or treat run-off. That is the issue. More specifically, it's for any new development designed to have 25 or more parking spaces. With that in mind, I would like to read the statement prepared by -- actually, that I prepared on behalf of the cities that I represent. The cities see the SUSMP as (inaudible) economic development. The cities, however, do not understand how our rivers will benefit by requiring developers to put in these expensive devices. In other words, what is the justification? Is it because they have parking lots? Okay. Please tell us how parking lots are polluting rivers and oceans in Los Angeles County.

Also, tell us which metals are polluting these. Zinc? Lead? Copper? Particulate form of solid? Please tell us. Don't tell us about how these problems exist elsewhere in the United States. Tell us why they are a problem here in Los Angeles County, why are they a problem in the basin (inaudible) water, and please explain to us how much an increase will be reduced by these devices on thousands of miles of roads and highways that also receive oil, grease and metals from vehicles.

Are the cities going to have to put these expensive devices in storm drains too? If so, who is going to pay for these devices? Also, what about parking lots in existing developments? Are cities going to be required to implement these expensive devices as well?

The cities want to do their part in minimizing the amount of chemicals that go into the storm drains, but it cannot spend a lot of money to do so. Cities are not in the business of cleaning up the environment. For example, the South Coast Air Quality Management District, (inaudible) in Los Angeles County, not cities. We are not in that business.

As a local government, cities take care of local issues. We provide fire and police protection. Cities also provide seniors with various services including affordable housing. What cities want right now (inaudible) is affordable housing and job opportunities. That's the business cities are in.

If the state and federal government wants to help cities enforce mandates regarding environmental regulations, then it should provide the necessary financial wherewithal to do so. With that in mind, (inaudible) SUSMPs adopted in January and revert back to the SUSMPs the cities submitted back in July of 1999.

Thank you very much.

BOARD MEMBER FORSTER: Is it Mr. Tahir? What do you do with the City of Montebello? Are you a Councilperson?

MR. TAHIR: I'm a consultant.

BOARD MEMBER FORSTER: You're a consultant.

MR. TAHIR: They could not be in attendance today, so they authorized me to make this statement to you.

BOARD MEMBER FORSTER: Do you recognize that the L.A. area has a lot of impaired water bodies? You didn't seem to think that there were any.

MR. TAHIR: Yes, indeed, I'm aware of that. I should also tell you that the (inaudible) restoration project plan states with respect to oil and grease, it says that oil and grease mostly dissipates rapidly and are not considered problematic in Santa Monica Bay. I also took a look at the Los Angeles County 1998-99 stormwater report, and I couldn't see anything in this report that said that grease from new developments were problematic or had an impairing effect on receiving waters.

I also looked at the 303-D list for the Los Angeles basin. I couldn't see if grease was specified as being problematic. In some places, you're absolutely right, ma'am. What we need to do, though, is we need to do a receiving water study that identifies exactly what the pollution problems are for every reach of every receiving water of the basin. Once you do that, we'll be able to target these pollutants and then allocate or assign appropriate BMPs, structural or not structural, and deal with it. We've got to have a baseline first. We can't rely on studies elsewhere.

BOARD MEMBER BROWN: You just answered my question. The question is, what do you think should be done.

MR. TAHIR: The first thing that ought to be done is to assess the problem. How can you prescribe a solution without knowing exactly what the problem is? You can't, once again, rely on problems based on study data elsewhere. Florida, you have some very aggressive stormwater management program requirements relative to new developments. I believe there is an 80 percent solids reduction requirement. They need to do that because they're protecting a specific impaired (inaudible) beneficial uses, (inaudible) blue crabs. For

Florida, it's the Everglades. But those studies have to be done.

BOARD MEMBER BROWN: I got that from your statement. That's fine. I just want to make sure that I understood you that you feel the cities don't have any responsibility in water cleanup.

MR. TAHIR: Oh, no. Quite to the contrary, but cities -- and all of you know this. Cities have limited resources. The Councilman from the City of Irwindale mentioned earlier that Irwindale is putting in (inaudible) catch basins to catch trash and fecal matter. Well, fecal matter definitely is a source of pathogenic material; right? Pathogens responsible for beach closure. That's what cities want. That's something they can see, they can understand. They can't understand these problems that have not been defined yet, or grease has not been defined. And you can't talk about mitigating certain metals without specifying copper in particulate form or copper in solid form. That has to be done first. That's real critical.

If you don't do that, what this becomes really is a lot of cities have the impression this is really a political scene.

CHAIRMAN BAGGETT: Heather Hoecherl followed by Lynn Jacobs.

MS. HOECHERL: Good afternoon. My name is Heather Hoecherl and I would just like to read a prepared statement for Ellen Mackey who was unable to attend due to unexpected conflict.

I am a senior in college with the Ecological Society of America. Today I am strongly requesting consideration for rejection of the SUSMP standards adopted by the Regional Board. It has become the tendency to marginalize the opinion of scientists who supply the technical information and becomes (inaudible) people who would twist information or the lack thereof for their own agenda.

The technical information presented to the Regional and State Boards assisted them in holding the line against backroom politicking that (inaudible) and endangers the future quality of the L.A. River. Technical information must drive the decision making process, not political considerations.

The last most egregious time in L.A. we saw political considerations take priority over technical information and recommendations, the L.A. taxpayers lost $273 million to the Belmont High School project. Technical information from scientists and engineers described the potential variables involved in selecting the Belmont site, but the information recommendations were inconvenient, therefore, overridden.

It has been said that the implementation of these SUSMPs will increase housing costs substantially. Housing cost increases are not enough to make a substantial difference in homeowners (inaudible) in exchange for helping to ensure lush, clean riparian zones and high water quality for their children and grandchildren.

Southern California is usually the trendsetter for the rest of the nation, including Texas. Now is the time for everyone within the sound of my voice, the respective boards and development community, to step forward and to do the right thing, finally.

Thank you.

CHAIRMAN BAGGETT: Lynn Jacobs and then Sarina Morales-Choate from the City of Santa Fe Springs.

MS. JACOBS: Good afternoon, Chair and Members of the Board. My name is Lynn Jacobs. I'm President of a company called Ventura Affordable Homes that endeavors to build affordable housing in southern California.

While the previous speaker's letter was very concerned about technical data, I don't acknowledge the previous speaker as an expert on affordable housing and saying that this will not affect housing costs substantially.

The concerns that I have as someone trying to provide affordable housing, and also as a Planning Commissioner of the City of Ventura, we're looking statewide at a policy which started, I think, both from the ground up and also from the national level called smart growth, and smart growth may be interpreted as sustainability, livability. It's a very popular concept which, among other things, embraces choice and smart environmental decisions.

To be able to do this, we have to both provide housing for people and provide a safe environment and control effective use of limited resources, and one of our most limited resources in southern California in general is land. The cost of land and the cost of development has increased dramatically, almost as dramatically as our population increase and our lack of housing production.

We need to use some real creative thinking in developing appropriate standards here. I'm not speaking as a scientist, I'm not speaking as a technician, but there are two areas that concern me as someone trying to provide housing for people in California.

One is the requirement that post-development run-off shall not exceed the predevelopment run-off on property, and the other is the requirement on housing of ten units or more, whether they're multi-family or not. This makes it very difficult to do in-fill housing, which is what's mandated by most of our comprehensive plans and smart growth concepts to reuse brown fields to provide in-fill housing and to increase density within cities. It makes it very difficult to take a one-acre parcel that's in a downtown area and put ten units on it. It's almost impossible to reach that prerun-off stage from a technical point of view as a builder.

I would be happy to answer any questions you might have, and thank you for allowing us the opportunity to speak. I do want to make one more personal comment as a Planning Commissioner. We had a hearing in Ventura last night until 11:30, applause and boos, and I want to compliment both the Board and the audience for such a certain behavior today.

BOARD MEMBER FORSTER: I have a quick question. You're from Ventura. Doesn't the County of Ventura have a stormwater permit in effect that you all agreed to that's similar to this?

MS. JACOBS: I knew you would ask me this question. The Ventura permit is currently under consideration by the Regional Water Quality Control Board and they deferred the hearing on that, continued it pending the outcome of this because they were trying to make it comply with the new L.A. permit, and in Ventura we had a lot of concerns about that as well. I know that's not the subject of this particular hearing.

BOARD MEMBER FORSTER: I'm sorry, L.A. Regional Board. I just wanted to share something with you. One of my biggest concerns is your issue, not impacting affordable housing. So we're going to look at that very seriously, but there are simple techniques, and probably you haven't even gotten that far to look at them yet, but simple techniques to use in depressing playgrounds or there's books out there with ideas that I don't think they're insurmountable, that you could do double duty.

You would use your green spaces to be more capable of holding some water before it goes off on the street. So you have to be creative and we're going to try to be creative because we do not want to hurt affordable housing.

MS. JACOBS: I appreciate that tremendously. I think the difficulty that I'm having and my fellow affordable housing builders are having is that I can only speak with knowledge from Ventura County. The requirements that we see, given our limited land with our new save our agricultural resources initiatives, which has put a lot of the developable land that was previously zoned for development into permanent open space, is that we don't have the number of acres available to provide our housing needs, even if we take our SCAG regional numbers and the units that are available and built them out at maximum density.

We're trying to combine higher density with appropriate green space. Ventura County has some unique challenges in that our drinking water is in aquifers that are very close to the surface, and this retention basin approach, from the examples I have from my engineers and landscape architects that work on my projects, is not functional. I believe that there are some additional -- let me state it differently. If we have environmental regulations, it should be accompanied by more solutions and ways to implement than I'm seeing at this stage.

CHAIRMAN BAGGETT: Sarina Morales-Choate followed by Bill Pope.

MS. MORALES-CHOATE: My name is Sarina Morales-Choate and I represent City of Santa Fe Springs and I just wanted to read a letter from Assemblyman Calderon basically urging you to consider the appeal, that he states a couple of the flaws in the SUSMP as approved and some potential adverse impacts.

And then just one brief thing I'm going to read from it, he's not opposed to solutions that are targeted, cost-effective and have some demonstrated assurance of results. Unfortunately, the current SUSMP proposal does not achieve these tests and we just wanted you to consider his remarks.

Thank you.

CHAIRMAN BAGGETT: Thank you. Bill Pope followed by Heather Kuiper.

MR. POPE: Thank you. I am Bill Pope and I'm here to praise Caesar, not to bury him today.

I applaud what you're doing. I have a very personal interest in this. I recently said in my car that I was here to represent my son. It's probably too late to save my son but maybe to save his kids. My son is a 26-year-old musician and song writer. He released his first album last year called Orange, which is love songs here about his experiences growing up in and around Santa Monica Bay. He produced a second album this year, Spinning Top, dealing with the frustration of many things, one of which is losing his hearing at the age of 26 from repeated ear infections as a teenager. Both his doctors, Dr. Adair in Santa Monica and (inaudible) in Beverly Hills, believe that his ear infections, repeated

R0073748

ear infections were the result of him spending too much time in Santa Monica Bay in the area around the Pico and Ashland storm drains. The infections he got they think they have traced in that area, at least there's a direct correlation between that.

After several thousands of dollars and two operations, he is still losing his hearing, which may jeopardize his career. So I applaud what you're doing for his kids and those to come in the future.

A lot of the arguments that I've heard here today to me seem terribly insignificant compared to what you're trying to do. I've read the proposal, and to me it's just basic common sense. It's the thing anybody should do that is going to take benefit from using something like the land. They should then become responsible for doing what the land itself should have done and could do on its own.

Whenever we take something from somebody, we are responsible for making up for their loss. Anybody who gets hurt in an accident has the right to sue and the person responsible then thus make amends and support that person in some way to make up for the loss of their ability to do something themselves.

And this proposal seems to do just that. It doesn't need a lot of scientific evidence around it. Scientific evidence could be seen easily to anyone who had stuck their head under the water and been scuba diving in Santa Monica Bay back in the '40s and '50s.

Compared to what it looks like today, it's obvious we have done irreparable damage. Maybe not irreparable, maybe nature can heal itself if we stop. So I applaud what you're doing.

Thank you.

CHAIRMAN BAGGETT: Thank you. Heather Kuiper followed by Joan Greenwood.

MS. KUIPER: Good afternoon. I'm Heather Kuiper. I'm trained as a public health epidemiologist, and so usually when I speak in public I'm talking about data and statistics, but today I'm hear as a community member. Bill and I may be some of the few people who are not here as part of our jobs. (Inaudible) unfortunately, but they say that when a letter is received by a public official it often represents maybe even a thousand people's opinions. So if it takes 15 minutes to write a letter, we've been here several hours. It's possible that I represent several thousand people and without diluting myself with images of grandeur, I want to represent the idea that Bill and I are trying to represent a large group of people who care about the environment and the people in Los Angeles.

So what I would like to do is tell but a few of the ways that I have personally felt the impact of Los Angeles's urban run-off problem. First, when I worked for the County Health Department, some coworkers and I formed an ocean swimming club. We would meet at my house before work, get on our wetsuits, run down the beach, jump in the ocean and swim the mile back up the coast. We then car pooled to work and would feel great, and I just thought that L.A. was great. I loved the ability to do that.

But then I started to feel chronically sick and realized that in order to feel healthy and be healthy, I would have to give up regular swimming in the ocean. I felt angry and scared that I was so vulnerable to public policy, especially when it led to the end of a wonderful activity that should be a part of the fabric of a healthy community.

Second, I'm dismayed at the amount of trash on the beach, especially after storms. On several occasions I've gone to pick up trash on the beach and been overwhelmed. Additionally, I take all of my out-of-town guests to the beach and to (inaudible) lagoon. I want these activities to be a source of pride and to be able to show to them that Los Angeles is not as bad as everyone thinks it is. When I reach the beach and see an overflow of trash, I do not feel pride and my guests' opinions of Los Angeles go unchanged.

Finally, my intention of speaking today is to bring home that these standards under consideration and protecting the beaches and broader environment also protect people and so build the foundations of an integrated society.

I'm here trying to represent the people of Los Angeles who make up that society. I cannot do an adequate job because my face is only one color, I come from only one country, and in my home I speak only one language. But if you go to the beaches, you will see they are a magnet for all the different races and cultures of Los Angeles. The beaches are a beautiful and peaceful point of convergence for the people. We need this place to be healthy and safe and to be a place that people can feel proud of.

A safe beach and ocean is a vivid reminder that our public officials are watching out for us. So in your deliberations, please keep in mind these broader implications. Los Angeles's problems are grave and I urge you to uphold SUSMP's rigorous mitigation of the urban stormwater without loopholes and mitigations. The community awaits your decision.

Thank you very much.

CHAIRMAN BAGGETT: Joan Greenwood followed by Arturo Cervantes.

MS. GREENWOOD: Hello, Members of the Board. I first would like to express my concern over -- despite the fact that I had participated in the public hearings on the SUSMPs, I was not sent a notice about this meeting and I feel that I was denied my opportunity to present formal testimony and to be cross-examined by the petitioners' attorneys. So I hope you will bear with me because I did not learn of this meeting until yesterday.

I'm here today to speak on behalf of the Wrigley Association, which is a neighborhood association representing 20,000 residents in the City of Long Beach. We support the actions taken by the Los Angeles Regional Water Quality Control Board with respect to the issuance of the municipal stormwater urban run-off discharge within Los Angeles County.

In the city of Long Beach, I also sat on the environmental task force, and the environmental task force began meeting in September of '98 as part of the city's strategic planning process. We met twice a month until June of '99, in which case we made our recommendations which essentially would support the SUSMPs and the best management practices under the umbrella policy of sustainability and green architectural principals.

There were two public citywide meetings. At the conclusion of the second meeting, the chair of the environmental task force then persuaded the chairs of the other four task forces that our environmental roles and the sustainability and green architectural principles are viable for our city.

We have looked at the cost-effectiveness. We have looked at the issue of affordable housing. In fact, the mayor appointed to the environmental task force a person with the Olsen Company who is charged specifically with looking into affordable housing in the city of Long Beach. The gentleman did not object to any of the recommendations made by the environmental task force.

The city council has held several workshops.

The recommendations have gone to the various city departments, and the environmental task force has the distinction of being the only task force whose none of their recommendations were thrown out. So this now will go through one more workshop and we expect next now the city council will adopt the goals that have been set forth by this environmental task force, which leads me to believe that the people who live in Long Beach want these SUSMPs.

We believe they are reasonable, they are well-grounded in science and technology, they are cost-effective, especially when you look at flood control and flood management practices and the cost of infrastructure if we don't do it on affordable housing. We do have a recent development in the Wrigley District where the developer put 18 homes on two acres. He ended up getting a premium from those homes because people liked them and he complied voluntarily essentially with the SUSMPs.

If we compare this to another single-family affordable housing project where the homes were much cheaper but highly subsidized by the Cities of Signal Hill and Long Beach, we see it as the cost of the land, not the cost of complying with the SUSMPs. And as a society, we would be far better off subsidizing SUSMP BMPs than the cost of the land.

In closing, I would like to urge you to deny the petitioners' request and carry out your responsibility to the people of Long Beach as mandated by the public trust doctrine. By the laws of nature, these things are common to all mankind: The air, running water, the sea, and consequently the shores of the sea. This is according to the Institutes of Justinian (phonetic) that goes back to 533 AD. This doctrine also applies to the creatures that inhabit the oceans, estuaries and rivers and shores.

The people of Long Beach are relying on you as the public trustees of this standard to defend our right to enjoy the benefits of clean, healthy rivers and beaches. I am an analytical chemist. I am the former director of an environmental lab. I have studied extensively the data on San Pedro Bay, the beaches and rivers of Long Beach, and I do not agree with the fact that we have not gotten good baseline data. We have it. We have the indicators. We know what the right thing is to do.

Thank you.

CHAIRMAN BAGGETT: Thank you.

MS. JENNINGS: I have to apologize for that one person's name, hopefully, out of the 350 or so on the list. That was the only one that got left off. I don't know if it was the Regional Board or us. I apologize.

CHAIRMAN BAGGETT: Bruce Barnes, City of Cerritos.

MR. CERVANTES: Good afternoon, Members of the Board. My name is Arturo Cervantes. I'm a civil engineer with the City of Vernon. I manage the sewer and stormwater programs there. I would like to basically just explain a practical problem that we would be having with the numerical design standard here at the city. We are exclusively industrial, so let me read a little bit of what I have in some of my notes.

Incorporating a numerical design standard into the SUSMPs will create a problem for the City of Vernon. The City of Vernon is five square miles. The city's zoning plan identifies (inaudible) to the SUSMPs. Industrial, heavy industrial and commercial, 95 percent of the city is composed of either industrial or heavy industrial, of heavy industrial land use, and we're fully built-out. Because of the typical land area that industrial facilities require, 90 percent of the new developments and redevelopments will be required to comply with the parking lot requirements in the SUSMP. These facilities will be required to build structural BMPs.

However, page 15, number 12 of the SUSMP recommends against filtration BMPs for these types of facilities and industrial land use. For industrial areas that leaves only the option of constructing BMPs which are directly connected to storm drain lines. Storm drain lines, however, haven't been built in about 30 percent of our city streets. To meet the numerical design standard, the city would then have to build a 1000-foot main to comply with or develop these BMPs.

Basically the version of the SUSMPs proposed by the Regional Board would encourage developers out of the city. Additionally, this numerical design standard may discourage current facilities from retrofitting or structurally buildings that don't meet code in the city of Vernon.

The City of Vernon acknowledges there is a problem with pollution statewide. However, the numerical design standard has not, through appropriate studies, been determined to be a solution. I would like to compare this to another project that I'm taking care of for the City of Vernon.

Gateway Cities performed a study on the truck traffic impacted intersections in southern California and determined that one of the intersections in our city, (inaudible) determined that intersection to be the worst impacted intersection in southern California. That interchange ties directly to that. We decided to fund 35 percent of construction related to that project, but we were also seeking state money to do so, the remaining 65, but before we can seek state money for a project, the state requires one to perform a project study report. Once we do that, we go through the application process of MTA to prove that that, in fact, is a problem and that we need state money to solve that problem.

Second, before we get to money one more time, we have to prepare a project report. Again, we've got to prove we have a problem and this is, in fact, a solution. There is a problem because it's already been proposed.

Before we spend state money, we're required to perform studies, then a design and then construct it.

We're asking that the state do the same for us, prepare studies. Just one study will be sufficient and the City will foot the money.

Thank you.

CHAIRMAN BAGGETT: Thank you. City of Cerritos, anyone? We have one final card, if anybody else wants to speak. Bruce Reznik.

MR. REZNIK: Good afternoon and thank you for letting me speak today. I'm Bruce Reznik from San Diego BayKeeper. We've heard a lot today, and frankly to touch off as far as stormwater goes, essentially we've been doing nothing and it's not enough and that's clear, but I'm here, like I said, on behalf of San Diego BayKeeper, but also on behalf of the entire environmental community in San Diego, most of whom could not join us because the City of San Diego Natural Resource Committee is having a hearing on SUSMPs down there as we speak now because of our municipal stormwater problem coming up.

So I think it's very clear to say that everyone in San Diego, I think everybody in California, is looking to leadership from this Board. We are looking for you to step forward and approve the SUSMP requirements or SUSMP standards as adopted by the Regional Board.

In a lot of what we've heard today, it's very easy to lose sight of what we're talking about. Getting lost in the host of acronyms and legalese and frankly red herrings that range all over the board from MTBE to issues -- I don't want to get into mosquitoes. We lose sight of the issue that's here and that's clean water and how essential that is, how essential it is to our environment, how essential it is to public health, how essential it is to our economy that's so tourist dependent. I can't tell you how essential it is to issues like environmental justice.

You heard on one side housing and you don't hear on the other side of commercial fisherman who lose their jobs, lose their livelihoods, and possibly even water. Communities of color and disadvantaged communities that fish in San Diego and fish in Santa Monica, they lose that fishing and lose that opportunity because of our polluted bays. There are unattendant consequences of inaction as well as action and we need to consider that.

We know our waters are woefully polluted. There are 500 water bodies that basically don't meet Clean Water Act standards, 1700 total impairments which need TMDLs. TMDLs are a very expensive last measure when you don't do preventive maintenance. We know that (inaudible) should be ratcheted up and refocused on that. Our non-point source pollution is a growing source of our problems, and you hear figures from 40 to 70 percent of our pollution problems are non-point. We know the greatest indicator of non-point, what causes that, is loss of pervious open spaces in favor of impervious surfaces.

As soon as we develop, as soon as we lose our open spaces, as soon as that's replaced with concrete, more of our pollutants flow. It's the single greatest indicator. As we develop, we continue to degrade our already polluted waters.

What else do we know? We know that we failed. Everybody in this room has failed. We have failed the people of California. We have failed to protect our precious natural resources in California and we cannot continue to fail. SUSMPs are a necessary first step and it is a first step that is not sufficient. We know that. As our municipal stormwater permit is coming up in San Diego, we're going to be demanding a lot more SUSMPs. We're going to be demanding numeric effluents on impervious cover, and while it's appropriate, building moratoriums or pesticide controls, whatever is needed to restore our waters. But in the battle of clean water, every single battle, every step we take is imperative, and SUSMPs are one of those imperative steps to address the impacts of future growth, to add specificity to a permit and make it enforceable and to shift the burden of stewardship to those entities that profit. They profit and they need to clean up after themselves.

The last thing -- I see the red light -- I think it's so imperative to remember is to remind every here that those most impacted by the decision here today, most impacted, are not yet born. Every day we delay, every development that goes in without these kinds of requirements is a lost opportunity to protect our resources. And we have a decision to make today, whether we are going to take a proactive stance in preventing future harm or whether we're just continuing to shift the burden to our children and our children's children to clean up the mess we continue to make.

Thank you very much. Questions? Thank you.

CHAIRMAN BAGGETT: Thank you. Councilman Joe Cvetko, City of Bellflower.

MR. CVETKO: Good afternoon, everybody. My name is Councilman Joe Cvetko with the City of Bellflower. My city also opposes the SUSMP adopted by the Regional Board in January. Bellflower sees the SUSMP adopted by the Regional Board as a proposition that holds little promise in improving water quality and would cost the city much in terms of deterring development.

Bellflower needs and wants development. We need to expand our retail commercial sector to widen our tax base. As you must know, Bellflower and other cities are largely dependent on sales tax revenues to support critical municipal services. We have focused a great deal of effort on trying to revitalize our commercial sector, but we have a long way to go.

Our city continues to grow in population and along with growth comes an increase in demand for city services. Costly new requirements would be devastating to our community development efforts while we perceive limited return in water quality improvement. An increase in development costs could place affordable housing out of reach for our senior citizen community, plus even first-time home buyers, a community in which a few years is going to be the largest population bubble group in society because of baby boomers.

Housing for low and moderate income families is also likely to slow down because of increased development costs resulting from costly SUSMPs. Developers are likely -- not likely to develop in areas that have very costly development requirements. Our fear is that developers will go to neighboring counties where the SUSMPs are not as stringent as they are in L.A. County.

Please overturn the Regional Board SUSMP and allow the cities to implement the version they submitted last summer. I would like these statements to be entered into the public record. I would like to thank you. And my personal opinion, it seems to me the environmentalists are trying to over-regulate mother nature, and you know what they said about regulating mother nature. You don't want to fool around with mother nature, i.e. floods, hurricanes and stuff like that.

Thank you.

CHAIRMAN BAGGETT: Thank you. We have two other ones, Larry Forester and Jayme Laber.

MR. FORESTER: Larry Forester, Mayor Pro Tem, City of Signal Hill. I apologize for the confusion to the Board and the Council because Margaret Clark did have a funeral to go to. I hadn't filled out a card. So I apologize.

I'm here as Mayor Pro Tem of a very small, two-and-a-half-square-mile city representing about 160,000 residents. I also have an M.S. in ocean engineering, so I'm extremely environmentally conscious. I look at the SUSMP as currently structured and say to myself is there accountability? Is there accessibility? Is it in the public's best interest? My answer to that is one size does not fit all.

I look at my affordable housing program in the City of Signal Hill where we have 144 homes going in. We're creative. We've done it with redevelopment money in conjunction with a shopping center. I look at my own condo association where we just put a new 8,000 square foot roof on our building.

We are land-locked on a hill. There is nowhere we could put a collection basin. Absolutely none. I think that's what a lot of this program does not deal with. I do not think it's an effective program.

Let me add one step further. I had done some research that I know a bunch of public work engineers with various cities have worked with the Regional Board. I have been told, and maybe somebody correct me if I'm wrong, the Regional Board basically threw out all of that information and did a shotgun on their own.

I would like to conclude with a statement that I had made to the press, and I'll read it exact, and that is, "The potential environmental benefits of this rule are speculative at best. Worst yet, economic impacts these rules place on the taxpayers and consumers have not been considered." And again, I have to say that I'm in very mixed emotion because being an ocean engineer I am very environmentally sensitive, but I want a more effective, better enforceable type system that cities can live with. I'll answer any questions you have.

BOARD MEMBER BROWN: What do you think should be done?

MR. FORESTER: I think they should go back to what the public works directors presented to them, go through that report and reevaluate it. My knowledge, which is information or hearsay, is that it was thrown out cart blanche. I don't agree with that.

I look at what we do in Signal Hill right now. I look at the best management programs used. I look at a program where we literally covered an entire hill with plastic where we're building a water reservoir and shut down a project for almost three months to prevent water run-off. So I think we are doing things, and I do think the Regional Board can work better with the local communities and cities.

I thank you for your time.

CHAIRMAN BAGGETT: Thank you. Now, last call here. Public comment?

MR. LABER: Jayme Laber with Ventura County Flood Control District. I'm an engineer with them. My comments are not so much on the appropriateness of the

L.A. County document and the design standards but how it has a direct impact and bears on the Ventura County permit that is going to be including a similar SUSMP document that L.A. is having.

Our concern in Ventura County is that the SUSMP document will be perceived as an end-all document for all jurisdictions in the state and will lead to no flexibility to allow for consideration of other local hydrology such as we have in Ventura County. The Ventura County Stormwater Quality Management Program has been very proactive in using land development guidelines to get criteria. The L.A. County SUSMP is contrary to the treatment of .75 inches of rainfall. In Ventura County we're using two different values. 70 percent annual capture rate is what we're using for volume-based BMPs, and flow-based 10 percent, and we feel that these have worked in Ventura County.

In Ventura County you can see detention basins, grassy swales, constructed wetlands and numerous other BMPs in Ventura County. With the ability to keep the flexibility currently built into the current program by being able to apply conditions based on engineering judgment and taking into account like the type of project, the location of the project, pollutants of concern and connection to channels, we feel that the 70 percent annual capture rate that we're using in Ventura County is very appropriate. It was developed based on unit basin storage volume developed for Ventura County

R0073765

using Ventura County hydrology and we -- an increase of going from 70 percent annual capture rate to an 80 percent capture rate is a 10 percent increase and increases a detention basin requirement 20 to 40 percent larger than what it would be for 70 percent. By increasing that 10 percent, that 20 to 40 percent larger basin only will be removing an additional 26 percent of total sediment, so we feel that's flexibility for Ventura County and we don't feel we should be locked in with L.A. County based on their hydrology and there's -- we would like to see some flexibility built into that.

CHAIRMAN BAGGETT: Thank you. Questions?

BOARD MEMBER FORSTER: Are you going to give your comments to the staff? Some people have handed out comments.

MR. LABER: I don't have them typed up in a format.

BOARD MEMBER FORSTER: They can be written.

MR. LABER: I can give them. I'll hand them in.

CHAIRMAN BAGGETT: Thank you very much for all of you who have taken the time to come and give your thoughts to the Board from the policy standpoint. We do appreciate very much that you take time out from other lives to do that. We feel it's important.

With that, before we take a break, we have theoretically, if the four cases-in-chief, if you will, can keep to the times remaining we could be out in time, as I understand, to return to an annual event, a cultural event in Los Angeles.

BOARD MEMBER FORSTER: The Laker game.

(Laughter)

CHAIRMAN BAGGETT: At least I understand that. And then we'll do the cross-examination and closing statements tomorrow morning. I just don't think -- unless people want to stay. We can see how it goes, but I think we'll be pushing it myself. I would like to get at least the four cases-in-chief done today.

So let's take a ten-minute recess. When we come back, the testimony of the cities will be up and they have 53 minutes remaining. And NRDC, you have 39 minutes of your allotted time.

(Recess taken)

CHAIRMAN BAGGETT: We're back.

After much discussion, I think we'll continue with the four cases-in-chief. There are four witnesses from three parties that cannot make it tomorrow morning, so we will try to do those recrosses after we're done with the three different parties, David Nahai, Ray Pearl Ms. Zinke and Dr. Gold. Those are the four that have a challenge tomorrow morning, so we'll try to get through those today also.

Continue.

RICHARD MONTEVIDEO,

having been previously sworn, testified as follows:

STATEMENT OF RICHARD MONTEVIDEO

MR. MONTEVIDEO: Yes. Good afternoon, I guess it is, Members of the Board and Mr. Chair. Thank you for the opportunity today. My name is Richard Montevideo. I am counsel for Bellflower, et al. petitioners as well as the City of Arcadia today.

We are here challenging the appropriateness and properness of the action taken by the Regional Board on January 26th, 2000, as well as the action taken by their Executive Officer as a follow-up to that action.

We've heard a lot today about water quality and we've heard a lot today about the need to improve our water quality, and frankly that is an important issue for us but it's not an issue for us today. Mr. Pope's son had a problem, has a problem he's dealing with. We've heard other testimony today dealing with trash on the beach. There is a problem in Los Angeles with water quality and water quality in Los Angeles needs to be improved.

The discussion today kind of reminds me of a talk that I gave at the Constitutional Rights Foundation on behalf of the Constitutional Rights Foundation a couple of years ago to a group of high school students, the Surf Rider Foundation, on the environment and cleaning up the environment. I asked the question, "Who here is in favor of a clean environment," and of course all the hands went up. The next question I asked, "Who here is a polluter," and you look around and no one put their hand up. By the end of the discussion almost everyone had their hand up.

The point here is that if I ask a question today who here is in favor of water quality, I'm sure all hands would go up, including all hands on behalf of the petitioners. The issue that we're dealing with today is not a question of whether or not we have a water quality problem, whether the water needs to be improved, the quality needs to be improved.

The issue really is the best approach given what we know today about water quality, consistent with the process laid down by Congress in our state legislature. That's what we're striving to do today, what's the best approach consistent with the process that's been laid down by Congress in our state legislature.

Now, I am here representing some 33 cities, and on top of that we have other cities who have submitted letters of support. In total we have 40 cities out of 85 cities in the county, along with representatives of the BIA, who have expressed great reservations and concerns about the action taken by the Regional Board. We also have additional entities, public entities who are concerned with the action taken by the Regional Board.

Let me first say that in spite of the Regional Board's and NRDC's comment that this is a small subset, obviously it's a very significant number of cities that are in the county that have concerns with what the Regional Board did. Why do so many cities and the BIA and even WSPA have concerns with what the Regional Board did? There are several issues that need to be addressed.

First is the flagrant violations of the permit that we believe the Regional Board in the action they took and the potential disastrous environmental consequences that could result if we go down that path without fully looking at where we're going and striving the best approach to look at water quality.

Second is the significant financial impact on virtually every sector of our community that will result if we go down a path that isn't well thought through.

Third is frankly the failure of the Regional Board to follow the deliberations -- the deliberate and collaborative process required by law, and a process that if we accept their approach is in effect, from our perspective, an arbitrary process and takes us down a path of not knowing where we're going, a directionalist path. At the same time we lose the time and we lose the financial resources to really put into addressing the problems that we have and putting together a plan that will hopefully work the particulars of Los Angeles County.

This in sum and substance is why we are here today. The question then arises, the Regional Board is an agency charged with the responsibility of addressing water quality. Why, Mr. Montevideo, would you contend that they haven't acted appropriately to address water quality? The answer lies in the record that's before you and in the testimony that's been provided and in the staff reports that have been provided by the Regional Board. The answer they have for not following the process they should have followed is frankly they are number one, under staffed; number two, admittedly under-funded; number three, admittedly they no longer have the time to deal with the issue because they have delayed in their review of other programs; and frankly number four, they are faced with lawsuits from the environmental organizations.

This particular document is a January 19th, 2000 memo from Mr. Dickerson. He states at the bottom of page 1, and this is in volume 2 of the administrative record, "Additionally, the inadequate staff available to this program results in our inability to move more quickly. For example, I've had to expend a great deal of my time on technical staff related to the municipal permit to close the gap between what we must do with the limited staffing we have. Only one staff person is assigned to this project, and total funding from the permit is $10,000 annually."

You add that to the concerns that they have expressed because of potential suits from other organizations. If you look at paragraph 3, the full paragraph 3, third paragraph on the page, I quote, "The unfortunate effect of adopting EAC's argument," which is a procedural argument, basically here's what you're supposed to do under the permit. "The unfortunate effect of adopting the EAC's argument to adhere at this time to the scheme laid out in Order 96-054 would be to further seriously delay implementation of the SUSMP without providing any real additional procedural protections to the co-permittees." One, obviously we don't agree with the statement, but secondly it only address procedural.

How about substantive issues? He goes on to state in the staff report, this is dated January 18, 2000, "It would also expose the Regional Board to court action for failure to timely move toward program implementation." So the result is we have a program that's affecting 8, 9 million people that's in effect been developed by a single staff person with the funding of $10,000 who frankly admittedly was out of time, and was in effect provided a number by the NRDC and the other environmental organizations to use that they pulled out of the settlement agreement between the county and the NRDC.

He didn't have time to do his own research and do his own work and didn't have the funding. He's one person, yet at the same time he's attempting to develop a program that applies across the board throughout the county that ultimately would be applied, as we heard today, to Ventura County and potentially even San Diego County.

Now, in his testimony before the Regional Board, Dennis Dickerson states, "The staff issue -- I hope you recognize that everything we've done is on the basis of one individual working full-time, already overburdened, already spending -- diverting resources away from the things that we should be doing, just to focus on this issue." So in effect he's saying that the person has other things to do on top of what he's doing here and the other issues are presumably just as important.

"We truly need more staff. I'm looking for yes, more staff, more money in order to get this job done." This was a plea by Mr. Dickerson to his Board to say "I need help." The consequences of him not having the help and not having sufficient funding was that we ended up with a program where 40-some cities plus a number of entities throughout the county have expressed strong reservations with and objection to. The consequences is that we're going to be spending tens of millions of dollars, if not more, to implement a program that frankly has not been thought through.

Now, one of the concerns that we have is that this program that's before you today was not adopted in accordance with the terms of the permit, and I want to take a step back and talk about the permit for a second.

Why is the permit so important? Why do we keep talking about the permit? Well, as you heard from the representative from the United States Environmental Protection Agency, they want to move forward on the permit. That's what their concern is. This permit was initially issued back in 1990 and reissued in 1996. It is this permit that provides the basis and the authority to proceed with the SUSMP program. It is this permit, frankly, that includes or that fully encompasses the authority and the jurisdiction of the Regional Board. Without this permit, the Regional Board has no authority to regulate. With the issuance of this permit, they have authority, presumably, if it's been provided by the State Board, but their authority is limited then to this permit.

This permit was issued under the Clean Water Act and it was issued under the Porter-Cologne Act. Once the Regional Board issued the permit, it fully exercised its discretion. Just as the permittees have to live with the terms of the permit, frankly so does the Regional Board.

Now, the NRDC and Regional Board has made comments and made arguments in their briefs as to why our position is not well-founded. One of the things, however, that you won't see in their briefs and in their arguments is the position that the Regional Board can move forward and adopt a SUSMP program that is in direct violation of the terms of their permit.

They argue the Regional Board otherwise has authority under the Porter-Cologne Act or Clean Water Act to take these types of actions. That may or may not have been true if we didn't have a permit that was in place. The County of Ventura and San Diego County are in the process of looking at a revised permit. They're in a completely different situation than these permittees before you here today.

Today we have a permit in place. That permit provides for specific terms that have to be followed in developing a SUSMP program. Let's talk about that.

There's two basic areas of the permit that we believe the Regional Board effectively violated. One area deals with the preparation of the SUSMP program and what needs to go into the SUSMP program and the purposes of it. The second area deals with the procedural review and approval of the SUSMP program.

Looking at page 33 of the permit -- by the way, I do want to comment that when I went back to look for the permit in the administrative record, I didn't find the entire permit. I actually had to submit it as Exhibit 1 to our submittal. It's indicative of the fact that the Regional Board doesn't consider they're bound by the permit. If they don't have the permit in place, they don't have any authority to govern these cities with respect to the SUSMP we're talking about. But we do have as Exhibit 1 the permit that's before this Board as a part of the administrative record.

When you look at page 33 of the permit, these are the operative provisions, pages 33 and 34 that deal with the preparation and development of the SUSMP program. The first point I want to make and the first issue that jumps out at you is who is the principal permittee, which is the county? In effect, who are the parties that are to develop the SUSMP program? It tells us right in the language of the permit. The principal permittee in consultation with the permittees shall develop a development planning guide as materials for use during planning and permitting of all development projects requiring discretionary approval.

Now, there are three things that are supposed to be developed by the principal permittees along with the other permittees. One is a model documented system. Second is a list of BMPs. That's A is the model documented system, B is the list of BMPs, and then C is the Standard Urban Stormwater Mitigation Plan which is to incorporate the BMPs that were developed as part of subsection B.

Nowhere in the permit does it say that the Regional Board is to prepare the SUSMP program. Nowhere in the permit does that say if the permittees don't do it by X date, the Regional Board will take over that process and submit it. Nowhere in the permit does it give the discretion to the Regional Board in any way to simply mandate their own devised SUSMP program on the permittees.

The language of the permit itself, which this SUSMP program is developed under, says it's the permittees that are to develop the SUSMP program. So the Regional Board's action, unilateral action is outside the terms of the permit and is in express violation of the terms of the permit.

The next violation is the question of whether they can apply the SUSMP program to non-discretionary projects. When you look at the terms of the permit itself, it says in very clear terms permitting of all development projects requiring what? Discretionary approval. There's nothing in here about non-discretionary projects. To continue, Item A-1, priority projects are development and redevelopment projects requiring what? Discretionary approval.

Moving down to page 34 -- page 35. I'm sorry. So there's two instances where we see the word discretionary projects and projects requiring discretionary approval. Item 3 says in order to integrate stormwater -- I'm sorry. Item 4, next page. Item 4, developer information program.

The principal permittee, in consultation with the permittees, shall develop a model program not later than January 30, 1998, to inform developers seeking discretionary approvals. Thereafter, at the bottom of page 35, in order to integrate stormwater management considerations into discretionary development projects, you see the word discretionary throughout this permit. You don't see the word non-discretionary throughout the permit.

The Regional Board's in effect last-minute inclusion of non-discretionary projects is in direct violation of the expressed terms of the permit.

What's the next violation of the expressed terms of the permit? Well, if you look at page 34 of the permit, it talks about SUSMP programs in particular and says Standard Urban Stormwater Mitigation Plans and guidelines preparation not later than six months after the Regional Board's approval of the BMPs. That time frame was met.

It then goes on to say the SUSMPs shall incorporate the appropriate elements of the recommended BMP list, so you have to look at the BMPs that have been incorporated into the SUSMP itself. And finally at the minimum, SUSMPs and guidelines shall be prepared for the following development categories. The categories that are supposed to be affected by the SUSMP program are development categories, not locations.

What the Regional Board has done is include a new category outside of development categories called environmentally sensitive areas. Unfortunately, the permit doesn't allow for the expansion of the SUSMP program to anything other than development categories. At the time the permit was adopted, the Regional Board actually thought about environmentally sensitive areas, and in their course of their consideration of environmentally sensitive areas, they actually address the issue of environmentally sensitive areas.

But they didn't do it under item C, the SUSMP program. They did it under a model documented system. They said the documented system shall consider location of the project with respect to designated environmentally sensitive areas and the slope and erosion potential of the site and surrounding areas. So yes, they thought about environmentally sensitive areas. Yes, it was an issue, but it was an issue to be addressed as part of the documented system, not as a part of the SUSMP program itself.

The SUSMP program was supposed to apply to development categories, not areas or locations of the county. The inclusion of environmentally sensitive areas into the permit, into the SUSMP program, is outside the terms of the permit and is a violation of the permit.

What are the other violations of the permit? The substantive violations committed by the Regional Board in adopting the SUSMP program are actually evidenced at the top of page 34, again of the permit. Consideration shall be given to the type of development and the potential for stormwater pollution when determining the applicability of BMPs.

The issue there is consideration shall be given to the type of development and the potential for stormwater pollution. Did they consider the type of development and the potential for stormwater pollution? First, keep in mind this consideration is supposed to be given to the -- it's at the discretion of the permittees for developing -- who are developing the SUSMP program.

Secondly, they are supposed to at least give some consideration to type of development. We have here a one-size-fits-all standard. That's one of our primary concerns with it. We talked earlier about programs that are existing throughout the country. Dr. Horner wasn't able to say what aspects of those programs applied in terms of redevelopment projects.

Here we have a program that, in effect, applies to new development of 100 or more homes, but at the same time it applies to somebody who is in need of a discretionary permit if they are in an environmentally sensitive area or if they simply have a hillside home; if they have to change their roof, which doesn't increase any impervious surface. Just merely changing the roof would require that they comply with requirements of the SUSMP program. There are a whole slough of other examples that would arise.

The issue here is did they consider the type of development for potential of stormwater pollution. The answer is no, they developed a one-size-fits-all program that doesn't allow the flexibility to address the nuances of the individual developments.

The next sentence says cost-effectiveness, ease of maintenance and consistency with other environmental mandates may also be considered. Cost-effectiveness is something permittees are saying has to be considered. How can the Regional Board possibly take a position that they should not consider cost-effectiveness, yet they are. Their position is we've looked at cost but we don't have to consider cost-effectiveness of the program, simply whether or not it's economically feasible. That's different than cost-effectiveness of the program.

Also, other environmental mandates. One of our primary concerns is that the Regional Board does not provide an opportunity for these permittees to look at other alternatives such as a regional approach. A regional approach only makes sense. It needs to be reviewed. Maybe it's not the best approach, but it should be considered and the Regional Board hasn't given us the opportunity.

Finally is the issue of post-development run-off. The permit says that post-development run-off can increase over predevelopment run-off at levels, but they're supposed to maintain the predevelopment levels to the maximum extent feasible. So post-development run-off, there's a specific standard that's included in the permit, levels to the maximum extent feasible. What did the Regional Board do with their SUSMP program? If you look at the Regional Board's SUSMP program, they don't have the standard of maximum extent feasible. They simply prohibit increased levels of run-off in post-development.

So in short, we have a series of violations of the expressed terms of the permit by the Regional Board. One, they have unilaterally adopted the SUSMP program even though the permit says the permittees are supposed to develop the program. Two, they've applied it to all non-discretionary projects. Three, they've applied it to something other than development categories by applying it to environmentally sensitive areas. Four, they failed to consider the type of development and the potential for stormwater pollution from these developments. They've developed a one-size-fits-all program. Five, they failed to consider the cost-effectiveness of their program, not whether it's feasible economically but the effectiveness, the cost-effectiveness of the program. Six, they failed to consider consistency with other environmental mandates and CEQA. Seven, they've included an outright prohibition on post-development run-off in violation of the standards set forth in the permit itself to the maximum extent practicable.

Now, those are the substantive violations of the permit. Let me very briefly cover with you the procedural violations of the permit because there is a separate section that deals with submittals to the Regional Board and how the Regional Board is supposed to address those submittals.

If you turn to page 21 of the permit, there is an expressed provision called the environmental review process that is supposed to be followed by the Regional Board in considering submittals from the various permittees. It states -- this is under subsection G. "In addition, it provides a method to resolve any differences in compliance expectations between the Regional Board and permittees prior to initiating enforcement action," any differences in compliance expectations.

So the way this process is to work is the permittees submit their program, which they in fact did in July and then resubmitted in August of 1999. At that point, you move to Section 1-A of Subsection G, and the Executive Officer then has 120 days to review and approve or disapprove the program. Did that occur? No. They simply ignored it and proceeded with their own program.

After that point in time, the Executive Officer, if he's notified that the permittees simply want to implement their own program, which just happened here -- I'll get to it in a minute -- he then has 10 days to respond and provide his comments. That process was followed by the permittees but was not followed by the Executive Officer. If the Executive Officer believes there was a problem with the SUSMP program as has been submitted by the permittees, he is supposed to provide the permittees an opportunity to correct the concerns that he has raised. He specifically, under Subsection G-2, is supposed to provide the permittees a notice of intent to meet and confer; in effect, to get the parties together at a table to address the issues, to see if they can address the issues that the Regional Board has with the permittees' SUSMP program, not a program developed by somebody else. Did that process occur? No. No meet and confer was sent out by the Executive Officer, no action was taken by the Regional Board on the permittees' SUSMP program.

After that point in time, if after the meet and confer the parties can't work things out, the Executive Officer will send out a notice of program deficiency. If they can't work things out, he then suggests an amendment to be sent out by the permittees. The permittees then have an opportunity to send out the amendment, and after an additional 120 days, the Executive Officer has to review the amendment to look at the issues and whether or not the amendment is acceptable.

The permit actually gives the Executive Officer 120 days. If they were concerned about the timing with the submittal, they could have responded in a matter of days. Unfortunately they didn't respond at all to the permittees' program. They simply proceeded to implement and approve and seek to implement their own SUSMP program in direct violation of each of these provisions in the administrative review process.

What are the consequences if this review process is not followed? The consequences are that the Executive Officer shall not take enforcement action against the permittee until the Executive Officer has notified the permittees in writing that the administrative review process has been exhausted and that the Executive Officer has determined that a violation exists warranting enforcement.

The Regional Board's position is well, we only have to comply with this if we want to take enforcement action. If we don't want to take enforcement action, we don't think we necessarily have to comply with this. I'm not sure how that would work. If they want to pursue to enforce their own SUSMP program, they still have to come back to this administrative review process. When they do that and come back to this process, they come back and sit down at the table and presumably bring all the parties that are affected by the program and figure out a way to make this thing work in Los Angeles County.

The reason the Executive Officer did not proceed and take the time to comply with the administrative review process is what he tells you right here. "It would also expose the Regional Board to court action for failure to timely move forward toward program implementation."

So why in short did the Regional Board simply short-circuit the process? Number one, it's a threat of litigation, frankly, and who does that threat come from? Undoubtedly it comes from the environmental organizations. Just this last week even the State Board was served, from what I understand, with a lawsuit from the environmental organizations. The NRDC has sued the county. The number that we're talking about today came out of the county settlement. NRDC has sued the City of L.A. The NRDC has sued a number of cities within Los Angeles County.

We heard some cross-examination of Mayor Clark today about whether they were complying with the SUSMP program, and in effect it's environmental McCarthyism. There is a fear that if you stand up to follow the process, if you poke your head up and take a chance of saying well should we, they're going to one, point out your inadequacies, and two, they're going to sue you. You combine that with understaffing, underfunding, and the Regional Board was already behind the eight ball.

The result is we have a program that's been taken out of the county settlement with the NRDC and effectively jammed down the throats of the permittees in this case. Frankly, that's not a way to be conducting public policy. What we need to do is to work through the process under the permit. Look at the terms of the permit and adopt a program that works for Los Angeles County considering the types of developments and the particulars in Los Angeles County, not simply look at programs across the nation. Sure, consider the data, but look at the particulars. Don't apply the same standards to somebody putting on a new roof that you would to a gasoline service station.

What do we ask this Board do today or tomorrow? We ask that you look at the evidence before you and not to decide, frankly, whether Party A or Party B is in favor of water quality or whether we have a water quality problem. We know we're all in favor of water quality and we know we have a water quality problem. What we ask that you do today is follow the path laid down by Congress and laid down by our state legislature.

Second, we ask the Board consider all the evidence and determine whether or not the Regional Board complied with the substantive and procedural terms of the permit.

Finally, we would ask that the Regional Board consider bringing all of the parties that are involved in this issue to the table, not just the environmental organizations. Let's have the plaintiffs sit down at the table with the Regional Board. Let's have councilmembers. Let's have developers. Let's have the builders. Let's have the restaurant association. Lets have WSPA. Let's look at the issues and pool our collective thoughts and mind set together and come up with a program that works for Los Angeles County, not simply a program that Dennis Dickerson, in effect, had to adopt because he just had to do something. Let's adopt the program that works for our particular problems and addresses our particular concerns.

The evidence that's going to be presented to you and has been presented to you shows that the Regional Board did not act appropriately or properly when it ignored the expressed terms of the permit. We ask this Board issue an order in accordance with the terms of the permit, in accordance with the finding that the Regional Board did not act appropriately, and that this State Board take action beyond just doing something, that this Board take action doing something that's right for Los Angeles County.

At this point I would like to have Richard Watson come forward and provide information for you on technical issues.

BOARD MEMBER BROWN: I have a question for you, Richard.

MR. MONTEVIDEO: Yes.

EXAMINATION

BY BOARD MEMBER BROWN:

Q. What do you mean when you say follow the path laid down by federal and state?

A. The Clean Water Act sets forth a procedure to be followed in terms of adopting the permit to reduce the discharge of pollutants to the maximum extent practicable. The regulations that have been adopted to carry out that provision talk about what goes into adopting a permit.

The Regional Board presumably followed those regulations to adopt a permit. After they've adopted the permit, the permit then sets forth what is supposed to be included in the SUSMP program. In effect, they're saying within the authority given to you by Congress. Don't attempt to act outside of your authority and outside of the permit.

Q. Working together to develop a program, do you have any idea or suggestion with all of these cities who would be on point with the go-ahead and end up as the responsible party that could provide some assurance that these things are going to happen that we would include?

A. There's a number of things we can do. This State Board has the authority to actually, if it wants, to impose a mediation or arbitration, but mediation approach solution before it makes its final decision. It has the authority to bring the parties that are involved in the issues to the table. If you're asking who those parties are, the County already has the Executive Advisory Committee who has worked very closely with the Regional Board and the environmental organizations throughout the course of the various other programs on the permit. I would continue to use that agency or that entity, so to speak.

I also would bring in the Southern California Association of Governments, who I do think has authority here and who I do think could add a lot to this process to look at a more regional approach. I think representatives of the building industry should be involved, potentially the restaurant association, at least extending opportunities to the affected parties to get involved.

Let's roll up our sleeves and see if we can work out a process that makes sense for L.A. County, but a process that requires individual homeowners -- if you look at the example from the Tree People, to spend $10,000 if they have a hillside lot to put on a new roof doesn't make any sense. I'm not saying it doesn't make sense for certain types of developments or maybe certain new developments, but the standard needs to be addressed and we need to take a look at the types of pollutants and recognize we have a problem. We clearly have a problem, but let's figure out what the problem is and where it's coming from and put together a team.

Q. Has there been discussion with the organizations about doing something like this before today?

A. Mr. Watson can probably address the issue better than I can. The Regional Board has been in a very difficult position, frankly. This is hearsay because I'm giving it to you third-hand, but I'm understanding they were told the environmental organizations did not want to sit down at the same table with us at the same time and discuss. They wanted to talk directly to the Regional Board and the Regional Board was basically conducting shuttle diplomacy.

The offer was made before. We're willing to do it now. In fact, we think it makes sense, but let's get everybody, not just the environmental organizations.

BOARD MEMBER BROWN: Thank you.

BOARD MEMBER FORSTER: In your opinion what's the difference between the discretionary and non-discretionary?

MR. MONTEVIDEO: It's a significant issue because it effectively will probably double or more than double the application of this program. If somebody is trying to put up -- if it's a hillside residence, for example, they want to put up a retaining wall that's greater than six feet, in most cities they're going to need a non-discretionary permit. If it's a hillside, all of a sudden they have to comply with SUSMP requirements.

So if you're in Rancho Palos Verdes, the entire city basically is in an environmentally sensitive area or drains into an environmentally sensitive area. So any non-discretionary permit that applies, all of a sudden they have to take their existing layout of their home and try to figure out a way to collect three quarters of an inch of water and address or treat three quarters of an inch of water.

The hypothetical in the article that the Tree People -- that was on the Tree People's example actually is a real concern to us. The hypothetical that I posed to Dr. Horner, we didn't necessarily get through it all, but it's a realtime situation. You're talking about a 2,000 square foot home on a 5,000 square foot lot. It's very common in Los Angeles County. If that lot is already landscaped and it's done, existing homes are going to fall into that, and if it's in an environmentally sensitive area or if it's like Mr. Forester's apartment or condominium that's on a hillside, any discretionary approval that you need, if you go in and need some plumbing permits and need electrical permits, in certain situations all of a sudden you have to go back and really landscape the whole house. How do you accommodate three quarters of an inch of rain? In many cases they don't have enough room, putting aside the dollars.

MS. JENNINGS: I have one question.

EXAMINATION

BY MS. JENNINGS:

Q. When the gentleman from Ventura County spoke, he seemed to be talking about what the number was that they could accept. From reading the transcripts, it appeared that at some point the counties and cities were proposing a number of .6 and then .75 was adopted, but it appeared to me that that number was actually never officially proposed by the cities and the county.

Is there a number which the cities and the county would accept or are they only willing to essentially say it has to be totally within the discretion of each city what that would be?

A. The short answer is yes, I think there is a number they would accept but it's not just a number. I can't emphasize enough that this program applies across the board.

Q. I'm not talking about exceptions, but if there's a number, what number is that?

A. I think that number has to be -- first you have to look at the development. The number may change from development to development or to redevelopment projects.

Q. I think I'm asking because the Board Members would like to know. Is there a number that the cities and the county would support like they supposedly at some point were looking at .6, or are they basically saying there's so much flexibility that's necessary that there should be no number?

A. I don't believe they're saying the latter. The reason I'm struggling, Ms. Jennings, is I can't tell you the number and apply it across the board. I think yes. Are they willing to live with a number? Of course they are, but the number has to be taken in context in terms of where the project is and whether it's the in-fill project versus out in open space, and it also has to take into consideration the differences in pollutants, the run-off.

I think there is a number and I think that number is going to be a number for one project and potentially a different number for another project. Is the .6 acceptable? I think in some cases it would be but undoubtedly not in all cases.

Q. I suggest, if I might, I think you might have a better answer. I think the difficulty for the Board is everybody is saying we don't like what the Regional Board did and we're going to do a good job ourselves, and the Board Members may want to know what's the bottom line. And you don't have to answer that now, but you may --

A. I would like to make a comment on that. You've put your finger on the problem. The reason I can't give you a specific number is because it hasn't gone through the process of development. The reason we haven't gone through the process of development of numbers is because the Regional Board took the number out of the county settlement --

Q. I don't want to get into an argument with you, but you did have the process and the County made two proposals and I'm asking is there a number that they would live with.

A. I think the answer is yes, but I can't tell you what the number is.

MR. SMITH: If I could just respond to that. My name is David Smith. I'm the general counsel for the BIA. We are making a presentation collaboratively with the cities.

I think the BIA position, to address your point again without belaboring it, we would stress substantially that particularly when you're talking affordable housing components and in-fill projects, an across-the-board number, a one-size-fits-all approach is potentially problematic for a lot of reasons. And while a standard, the general standard may be appropriate, looking at it from the builders' side -- you heard from Ms. Jacobs today -- particularly those builders who are focused on accomplishing the affordable housing need and increasing mandates for affordable housing, the constraints are very different when you're talking about pushing into the suburbs and open space and you have a little more flexibility or whether you're just talking about how much green space are you going to have, can you use it for filtration or not.

When you're talking about these parcels, any across-the-board number for that presents potential problems and we would ask that some level of flexibility -- and this is where the consultation process -- we want it to come back to the consultation process to address these individual concerns.

MR. MONTEVIDEO: Mr. Chairman, may I ask how much time we have remaining?

BOARD MEMBER BROWN: Question.

FURTHER EXAMINATION

BY BOARD MEMBER BROWN:

Q. If my math is right, I suspect you've already figured this out, but three quarters of an inch containment on a quarter acre lot is 4500 gallons.

A. I've seen calculations of over an acre at 27,000 gallons, so that's probably a little low.

Q. An acre I have at 18,000 gallons.

A. I've seen notes from the Regional Board and other numbers have been in the 20,000 gallon range. So I think --

Q. Basically 20,000 gallons, so a quarter acre lot would be in the neighborhood of 4,000 to 5,000 gallons.

A. Sounds about right.

BOARD MEMBER BROWN: That's pretty hard.

CHAIRMAN BAGGETT: 22 minutes remaining and the light will go off at five.

RICHARD WATSON,

having been previously sworn, testified as follows:

STATEMENT OF RICHARD WATSON

MR. WATSON: Richard Watson. I will give you a little bit of my resume in preparation. I have attended Stanford University. I have degrees, bachelors and masters, from UCLA, completed all the requirements for a Ph.D. except for the dissertation from the University of Alberta. I'm a planning consultant. I spent 15 years with a Mission Viejo company and an engineering company that was purchased by it. I've been working in stormwater since the fall of 1990. I'm currently a member of the Executive Committee of California Stormwater Quality Task Force. I chair the TMDL Watershed (inaudible) Committee and I'm part of a consulting team working with Caltrans. In fact, I sited the various structural BMPs that Dr. Horner discussed earlier.

What I would like to do is graphically demonstrate something we've said already, and that is that we don't deny there is a problem. And really going back to (inaudible) and the ultimate BMP is us. By that I don't mean just builders and the cities, I mean all of us.

I would like to take that in saying we're not opposed to the SUSMPs as they were presented by the municipalities, but we do have problems with the numbers. We're not really here to argue the numbers today. We want the opportunity to work together to determine appropriate numbers in response to the question from

Betsy earlier.

There are differences of opinion, and if you apply some formulas that are from the water quality capture, applying numbers from the Denver drainage menu which was just revised in September, you get amounts that are considerably lower than here, and I did a little few calculations and come up with a number. If you use .5 imperviousness and use a 24-hour drain time, you might have something like a quarter of an inch. If you take .9 imperviousness in a 40-hour drain time, then you have something like -- and I forgot to write it down. I think it's .47. So you get a range of numbers depending on what you use.

What is our position? Our interests in the building industry are a little different than those of the cities because we're the ultimate target. The industry has supported the municipal BMP because we share an interest in a workable program. We support the joint development of numerical design criteria. Our engineers, just like the engineers in the cities, like to design to numbers but we want to be part of the game. And so we want to work with the various players so we have numbers that work in the two permits.

We're concerned also that the Clean Water Act is being refashioned into a tool to stop building and development. We're concerned that our builder members may spend time investing in structural BMPs right now and then as soon as the TMDLs are adopted, it's going to be determined those particular BMPs don't meet TMDLs so they're going to have to do something all over again.

We're also concerned about the impacts on housing costs and availability, and you'll hear much more about that later, but one thing that we do know is that affordable housing will become much more difficult to supply. One thing we haven't discussed so far is that homeowners associations may be burdened with some very long-term operation and maintenance costs.

The Regional Board is admittedly handicapped by staff and budget limitations. We talked about that a little bit already, but they should be providing good leadership based on sound science, and the fact that they're limited doesn't mean that they have an excuse for outgrading their own permit as was discussed earlier. The attempt was laudable, the process was not. From a planner's point of view, good intent does not equal good regulations. Doing something to do something to placate others might placate some critics but it doesn't generate respect for the regulations or the regulators. I think for the regulations to be successful, the regulated community should respect the regulators and the regulations.

We want our representatives of the major parties -- and this is a little repetitious. We want to sit down together. The regulated, the regulators, the environmental interests, sit down together and work through some numerical design criteria. One example,

R0073798

Florida had about 29 drafts or something and 100 TAC meetings before they adopted some regulations and they worked together to do it.

Another example is Denver. This one I find interesting was left off of Dr. Horner's list but was in the original presentations that we saw at the Regional Board. I'm not quite sure why it was left off the list. They've come out with a new manual and it could be the numbers I mentioned before that didn't match exactly, but this revision -- and it's a revision, not a new document. It took over a year with an advisory committee, had lots of input, and it's basically a design manual with policies set by each jurisdiction.

A term that someone used already, one size does not fit all. There are a lot of problems in an urban area and trying to make one particular size fit. This says -- this particular quote talks about watershed loading. We have that coming. They're called TMDLs. So this whole idea of one size fitting all is a real problem and we actually talked about watershed configurations. The permit talks about that too, but we didn't get into that in this process.

One of our concerns is that the Regional Board -- neither the Regional Board nor the Executive Committee focused on the nexus between water quality standards, in other words beneficial uses, and water quality objectives and these criteria.

We requested several times that the Executive

Officer or staff convene meetings with interested parties at the same table, and it appears that because the environmental group said they didn't want to meet with us -- I can only talk about from a personal perspective -- because I was told directly by one of the attorneys present in the room that they didn't feel they had a need to meet about it.

One of the things that we're concerned about with this process is we think it's doomed if you don't bring the knowledgeable participants together. That means engineers -- and I'm not one, I'm a planner so I don't fit into that category -- the developers and the builders. If they're left out, it's just plain not going to work.

We're also concerned that the Executive Officer -- neither the Executive Officer nor the Board itself paid any attention to our basic premise that it was really appropriate to take this process, follow the process that was in the permit and work together to put numbers in the next permit cycle, which I think was what Alexis said is only 18 months away, and the report of waste discharge is next February. So it wouldn't delay us very much in the process that the Regional Board, or the Executive Officer, has said may take us a century because we're dealing at the margins and in redevelopment and new development. So there is time. You're not losing much to do the process right.

Another concern of ours is that when the

Southern California Association of Governments offered to use its good graces to pull the people together, it didn't work. The municipalities came. One of the staff members for the Regional Board came at least once. The building industry was there. WSPA was there. Other industries were there, people who were invited. The environmental community chose not to participate. So the SCAG folks were trying to explore could they help us in some way with this regional question that Mr. Brown has asked about earlier.

We were sitting down to try to figure out how to do something, to have a mix of regional and on-site perhaps. Basically the Regional Board had an ad hoc process instead of following the process laid down in the permit. I must say that Dennis Dickerson was very gracious, made himself available, but he did not establish that process to bring us all together, and that was quite frustrating. And I think he understands how frustrated we were about that.

One of our other process concerns, and this is from a planning process, is that during that January 26th meeting it became readily apparent that the staff and Board Members had a different document than we had in the audience. That was really disconcerting. There had been a revision the night before that the audience members did not have and that was a problem.

There was also a bit of incomplete staff work and that's because of the time limitations. I think in the written document I included several examples and I'd just like to mention one. That's that environmentally sensitive issue. Early in the process various of us drew attention to it. It was a three-prong definition. At first we didn't have the maps, we didn't have the lists, and what we were envisioning is this sort of vice business of coming from this side and this side and some other direction, and conceptually everything could be incorporated. It turns out it's not quite that bad.

We didn't see what came out when Dennis approved it. That was not before us before the January 6th hearing where he was asking the Regional Board to direct him to approve the SUSMPs that he had done, not the ones the cities had done.

Also we were really concerned about what constituents of concern he was really addressing or they wanted to address because different BMPs address different pollutants of concern and we're sitting here waiting, just watching the TMDLs come down at us.

So we were proposing that maybe we look together to put together a program in this SUSMP framework that would get us towards addressing the 303-D list because we have some 700 segment pollutant combinations here in 90 group TMDLs in 13 years. So we know we're going to be doing more. The problem is could we use this process to work towards that one. They didn't want to.

One of the things that also bothered us was numeric design criteria that were developed thoughtfully in other parts of the country were taken, brought out here. We didn't do piloting, we didn't peer review them and they were put in by the staff in the SUSMPs. In those other areas there was testimony that's in the record by Bob Collacott who personally called the various entities and it was from two to six years spent developing those programs involving the regulated community, and that was the problem.

Also one of the things that was surprising to us is that as we were going through this process and we reached that critical date on January 26th, the County has not yet determined how to implement its settlement with the NRDC. They now have. I understand there's a manual. There's a workshop day after tomorrow, so we'll get to see the manual. So they have an idea how to implement it, but it was very complicated on how to figure out how to do the types of projects and it will be interesting to find out what they determined they can do, but it had not been done and the Regional Board was giving its directive to the Executive Officer to adopt the SUSMPs.

The Regional Board and the Executive Officer really appear to be more interested in doing something rather than in following an orderly, technical, scientifically sound process, and that from a planning point of view was really disheartening because there had been other things like the urban development TAC of about four years ago that Mr. Gold and I were both on. I think we spent about a year working through that. This wouldn't necessarily take a year, but the process was not followed.

One of the things that came up earlier in some discussion was the state general permits, and I have perceived that the State Board-issued general construction permit is being confused with the Regional Board-issued municipal permits in part because as you know, your own permit, the general construction permit in section ten has BMPs in it and those do have to be -- it's strengthened with the latest revision and the Regional Board has responsibility to enforce those permits and it seems like it's being used to shift responsibility from the Regional Board to the cities, that is the SUSMP.

What would constitute regulation based on sound science? One of the things that we think needs to be done is look at the beneficial uses in the receiving waters. That was mentioned earlier by Ray Tahir, and even if you only want to go that far, at least look at the identified water quality impairments and get at those.

One very practical thing that could be done -- it was a question I think Mr. Brown has asked earlier. What would you do -- one of the things I would like to see you do is advise the Regional Board or involve yourself to convene an advisory committee similar to the public advisory committee that you have for AB 982. That one is a little contentious but it has 24 members, environmental communities, and I know there have been some problems but it does get people to the table. And that could be set up differently, but we need that sort of mutual working together.

I think we need to review what's been done elsewhere in the country and review it together, not just have Rich Horner's survey and documents I have and other people have, but to really sit down and go through them maybe one at a time and say what's applicable here, what's not applicable here. I think we could view the staff proposal, that is the numeric part, as sort of an interim guideline and conduct pilot projects. I don't mean adopt it and say you're going to come back and change it. Adopt the SUSMPs as they were submitted by the municipalities and there could be this guideline that says you think it should perhaps be .75. I gave you numbers earlier that said it could be less than that. Do some pilot projects and you've got six watersheds in this permit and do it by watershed.

Require the L.A. co-permittees to follow a process similar to the one that's in the current permit. In other words, have them implement what they were not allowed to do, and that is in the report of waste discharge they tell what you performance standards are needed. In the next permit cycle they work those out. That's what the current permit says.

Basically permit cycles should come first. This quote from the Florida plan or from the document conveying it, you do performance standards before you establish design criteria. We haven't followed that and we're doing it kind of backwards.

Design criteria obviously include many factors that have to be considered. Cost and effectiveness are important and we don't have the answers. I'll give you a couple numbers in a minute, but we've had various cost estimates. We really haven't sat down at the table and worked them through together. It's almost like apples and oranges sometimes.

There was one particular one that was almost a joke, and I think the staff may have got it from the city. I'm not sure, but $33 to maintain retention basins. Most maintenance crews can't even get out to a basin for $33, so there was some slight problems we had with those numbers.

Numbers from elsewhere, Texas is estimating at about 3 to 5 percent of the basin construction cost in constructing BMPs are needed for maintenance, and Florida has estimated it takes about 5 or 10 percent of the land area to comply with their rules. Granted, that's partially flood control, but if you get into the control of the peak discharge, that's about the same thing.

Some generalized numbers, these came from a newsletter that was, I think, referenced earlier. What the costs will be, we don't know exactly because we don't know what BMP would be in there, but if you take something like a media filter, which is turning out to be very costly to construct in California because of our earthquake standards, something like $27,000 an acre served. So you can figure that out for whatever size project and whatever density. Infiltration basins, about $20,000. Filter strips, in other words grassy strips where you have to worry about level grade so the water can flow in evenly, about $17,000. Swales are cheaper, about $10,000 per acre served. Detention basin, about $10,000, and then you get down to the inlets or inserts that were mentioned earlier.

What do we recommend? We recommend that the Regional Board convene that Technical Advisory Committee I mentioned, have equal numbers of environmental, regulated, industry folks to advise the Regional Board and the Los Angeles co-permittees on performance standards, et cetera.

We further recommend this TAC should include representatives of SCAG and perhaps the State Board because as mentioned earlier, this could be a precedent. It's obviously going to be because San Diego is considering it and the L.A. Board is considering it for Ventura. And grant the petition. Order the L.A. Regional Board to order the July or August one and then proceed working towards the next permit.

Any questions?

MR. MONTEVIDEO: Mr. Chairman, I'm curious that the questions that occurred in the last were -- do we have any leeway on the two and a half minutes?

BOARD MEMBER SILVA: Just a real quick question. Relatively how long would it take to form this committee and come up with a recommendation?

MR. WATSON: I don't think it would take very long to form the committee. You just have to say who you want to have on it and delegate some names of representatives.

BOARD MEMBER SILVA: Given the (inaudible).

MR. WATSON: You have the Executive Advisory Committee and they could name -- you come up with a number, they could name people, industry representatives could name some people, and we would want to be there.

The question is how long would it take to come up with an agreement and that if you've got a whole bunch of standards to review, if you review them properly, it will take a little bit of time, but the framework for the process is there.

The existing permit says that the permittees should assess what performance standards are needed, include that with the report of waste discharge in February, and then in the next permit cycle work through all the details. So you have a process, it just wasn't followed.

CHAIRMAN BAGGETT: Thank you. Two minutes and 46 seconds.

DEE ZINKE,

having been previously sworn, testified as follows:

STATEMENT OF DEE ZINKE

MS. ZINKE: Hi. My name is Dee Zinke and I'll endeavor to be as brief as I can.

MR. HELPERIN: I'm going to have to object. We were not informed of this witness. The only witnesses that Mr. Montevideo designated were himself, Ms. Clark, and Mr. Watson.

MR. MONTEVIDEO: Actually, Mr. Chair, I didn't even designate myself but if I could be heard on the issue. The notice that went out by the State Board did not require that the individual witnesses be identified. The regulations allow for that but do not require it.

Because the notice did not ask that we provide the names of all the witnesses, we did not do so for fear that nobody else, everybody else would do the same thing and not provide the names of the witnesses. According to the notice that was sent out by the Board itself --

CHAIRMAN BAGGETT: I'll overrule the objection but you are limited to what testimony was submitted as evidence. The witnesses cannot speak beyond what was submitted. You are down to two minutes and 46 seconds.

MR. MONTEVIDEO: If we -- Mr. Chair, if we have -- unless -- if we can get some stipulation on additional time, I would be more than willing to grant additional time.

CHAIRMAN BAGGETT: If the other petitioner wants to use its time, do you plan --

MR. WELCH: We would be happy to yield some time.

MR. MONTEVIDEO: 20 minutes?

MR. WELCH: We'll give you 20 minutes of time.

MR. LEON: One point. We had asked at the beginning of the proceeding to have Alexis Strauss named as one of our witnesses and that was not allowed.

CHAIRMAN BAGGETT: That was not allowed because her testimony, there was no evidence or testimony submitted in your brief and submitted to the Board. I think petitioner has produced significant information, evidence which I assume the witnesses are speaking to information.

MR. MONTEVIDEO: Correct.

CHAIRMAN BAGGETT: On the record, and I think that's the difference.

MR. HELPERIN: Mr. Chairman, if I may. For the record I do find this objectionable and on the basis of basic equity, on the basis of unclean hands, on the basis of waiver, on the basis of estoppel. Mr. Montevideo was able to preclude a representative from the Environmental Protection Agency from speaking to this Board on information which there was no reason to believe was outside the scope of the submitted testimony that was submitted by the Regional Board, solely because she was not named.

These witnesses were not named. Mr. Montevideo in fact stated that part of the reason why Ms. Strauss should not be allowed to testify was because he was not aware she would be testifying and, therefore, he could not appropriately prepare for cross-examination, to examine her with respect to her credentials or her experience. That is certainly true with respect to these witnesses --

CHAIRMAN BAGGETT: You'll be allowed an opportunity to cross-examine. I'll still overrule the objection.

MR. HELPERIN: For the record, I would also like to object to the transfer of time from the Western States Petroleum Association to the cities. I don't believe that it's appropriate for one party to be able to speak longer simply because another party has less time.

CHAIRMAN BAGGETT: If you would like 20 minutes, we can talk about it.

MS. ZINKE: Thank you. I hope it does help that you do have my outline identifying my name and my position for the Association.

I'm Dee Zinke. I'm the Executive Officer for the Building Industry Association for the greater Los Angeles and Ventura Counties, and I come before you today to talk about the issue of affordability in housing and to clearly identify the unintended consequences for this (inaudible).

Less than one half of the Los Angeles families earning a medium income can afford a medium priced home today. This is 20 percent below national levels. For every $1,000 added to the price of a home, 25 families are priced out of home ownership in the state of California. At any given night here in the southland, 100,000 people do not have a place to sleep at night that they call home. 50 percent of those are children and 50 percent of those are children under the age of five.

As population increases, this housing crisis continues to worsen. Last year Los Angeles again posted the highest population gain of any county. Housing this population is a very real challenge. The regulations that were proposed and adopted by the L.A. Board do not take into account any variation in housing type. Ten units of single-family detached housing are treated the same as ten units of multi-family condominiums. This is a one-size-fits-all eat-it which shows no sensitivity to affordable and (inaudible) housing.

43 percent of all California families rent rather than own their own homes and renters face the greatest affordability challenge right now. In Los Angeles and Long Beach area, 51 percent of renters are paying over 30 percent of their income for housing which is the standard that we look to. In addition to that, our renters -- and when you look at who we're talking about, 59 percent of African-Americans are renters; Latino population, it's about 57 percent, and this is significantly different than the Caucasian population

that is an issue of significance to the minority communities.

Worse, the proposed regulation hits in-fill hardest where land is scarce and expensive. Most in-fill projects are site-constrained. Site-specific volumetric controls could become a major expense for these projects. According to the Department of Housing and Redevelopment's recently issued report, Raising the Roof, most of the state has enough land capacity to accommodate housing needs, except Los Angeles. Let me repeat that. Except Los Angeles County.

We hear a lot lately about environmental justice that was said earlier this morning and assuring that our poor and minority communities are getting a disproportionate share of pollution. In this case it's the redevelopment projects, the areas which are most in need of urban renewal that are disproportionately penalized by the cost of imposing this proposed rule. Once more, the inventory of in-fill land contains many contaminated sites and there is absolutely no recognition of the environmental benefit of cleaning up of these sites for the health of the watershed.

We'll all be interested in encouraging job centers, i.e., smart growth. This rule makes it easier for land-rich to comply but extremely difficult for urbanized areas. The result is low income or moving out, causing other environmental problems. According to the California budget project report, "Locked Out:

California's Affordable Housing Crisis," families seeking affordable housing are being forced to move out of metropolitan core areas creating longer commute times, greater air pollution and loss of open space; or the alternative is that they're moving in together, burdening our already overstressed infrastructure.

New York Times in February reported in an article about the San Gabriel Valley that low incomes and high housing costs have led to widespread overcrowding and used an example of ten people paying $100 each to live in a single trailer. In another recent article about the crisis in housing Councilman Mike Oferra (phonetic) was interviewed. He stated that hundreds of thousands, maybe as many as a million people, in our city live in substandard housing conditions. Most of these people are kids. One in seven people lives in overcrowded housing conditions.

Studies indicate that children who live in overcrowded or substandard housing are more likely than adequately housed children to suffer a variety of health problems, and that was in the "Locked Out" report as well.

There isn't a builder in this room that advocates we should be exempt from water quality standards where at a minimum affect (inaudible) long-term best management practices, which I think it continues to be ignored in the testimony. We're interested in practices to improve the quality of water run-off in addition to our construction management practices.

What is absent in this permit is flexibility to address the broad variation in development from rural to highly urban dense areas, from high and luxury housing to affordable low income housing, to allow regional solutions versus site-specific solutions.

You have several options before you today. We would urge you to work within the appropriate permit process and move forward with a program that encourages the most effective BMPs that actually serve to clean the water. If you wish to pursue, or in this case support, the Regional Board's numerical standard, what we would like to do is again reiterate using the next 15 months or year to actually develop the evidence and accepted engineering standards that demonstrate and improve water quality.

Right now we are engaged in and support water management efforts and as a result have an affinity for regional solutions to protect the health of the watersheds including habitats and estuaries and bays.

California is now in its eighth year of providing less than half of the homes needed to shelter its population. That is 125,000 units a year we're short or up to a million up to this point for the existing population. Los Angeles population is expected to grow from 9.8 million to 11.2 million by the year 2010. It is a fallacy to assume that we will address the impact of this population through constraints on new housing.

If we increase the cost of housing and price people out of the market, there will be greater environmental degradation as our sewage, water, waste treatment infrastucture is overtaxed beyond its intended capacity. We believe this is a very real unintended consequence, adding cost to the housing in the urban and affordable housing markets.

The job of the Regional Board is obviously to improve and protect water quality yet fail to fully understand the impact on housing in that process. As stated in the last hearing, shelter is considered one of the most important basic needs, but clean water is no less precious. If more children are priced out of a home because we are guaranteeing them clean water to drink, I will sleep better at night. Right now I don't believe that those merits stand to achieve that goal.

We still maintain that the clean water initiative, which is a program that was proposed as a coalition at the last Regional Board hearing where all stakeholders work together, goes much further to addressing our water quality needs as a more appropriate process to address appropriate changes to standards readopted in July of 2001.

Thank you.

CHAIRMAN BAGGETT: Thank you.

MR. HELPERIN: Mr. Chair, I would like to lodge the same objection with respect to any witnesses the Cities of Bellflower, et al. proffer.

CHAIRMAN BAGGETT: Overruled also.

ILENE ANSARI,

having been previously sworn, testified as follows:

STATEMENT OF ILENE ANSARI

MS. ANSARI: First of all, I'm Ilene Ansari, Mayor Pro Tem for the City of Diamond Bar. I have six pages of testimony, but on the basis of making it short, I'll try to explain the issues that are of concern to cities.

CHAIRMAN BAGGETT: We have your testimony in the record already?

MS. ANSARI: You have my testimony in the record. I am Mayor Pro Tem for the City of Diamond Bar. I am also on the biodiversity council because this is of importance to me. I'm vice chairman of the Energy Environment (inaudible) for SCAG and I was the chairman of the NPDS committee. Before I ever became an elected official, I was an environmental activist and I'm also by profession a registered nurse and a former associate professor of nursing. So let me get those on the record.

The concerns that we have as elected officials is first, the unfunded mandate. And the concerns that we have as elected officials, my City of Diamond Bar has 58,350 people. We are a contracted city. We are a very mean, lean city and this is concerns that we have.

We're concerned about the Clean Water Act and we're concerned about the comments that were raised at the meeting that was held on January 26th. When the staff of the Regional Board recognized the significant expenditure of the MS-4 program and mentioned the fact that the financing of the program offers a considerable challenge for municipalities, a proven successful mechanism is the establishment of stormwater utility fees which are assessed on the property owner based on stormwater run-off generated from the site. And I will not go into detail on this.

The problem that we have is we are extremely limited by law with Proposition 13, Proposition 62 and Proposition 218. We would have to run a utility user tax in order for us to reach the mandate of this requirement of the NPDS. Right now, as it stands now in the state of California, 60 percent of the cities have been able to pass utility user fees. But in L.A. County, only 40 percent have been able to pass those utility fees. So that is very difficult for us to be able to do in our city.

We as cities do not have the discretionary funds or monies for this. My city of 58,000 has a budget of $10.2 million. As it was stated at one of the meetings, and when I questioned them two years ago at a seminar that was held at USC, I was told the fee would be anywhere from $4 per person to $11 per person. If you go by the amount of people that we have in my city, that's over $650,000 a year on a budget of about $10 million.

So we are concerned about how we are going to reach the stormwater run-off.

The other issue that we have is the lack of scientific basis for this, and we have concerns with this. This is going to be environmentally sensitive for our city or is going to have other problems similar to what MTBE had, and we'll find out afterwards.

What we want to do is work with the entities so we can come up with a permit that deals with all of us. So what I'm asking you to do is please mandate -- if you mandate the SUSMP, I wish that you use verifiable scientific data and that such a plan be funded by the state of California as required by the California Constitution. Under the Porter-Cologne Act, you're required to do a cost analysis of how much it's going to cost the cities. We in the cities want to work together for clean water. That's what we want for our children. I as a nurse want that. I don't want health issues, so let's work together.

Thank you.

MR. MONTEVIDEO: For the record here's a copy of her testimony.

MS. JENNINGS: Now I have a problem. I know the Chairman said we had a copy, but I couldn't find that. Are you saying you're trying to submit testimony today right here? You know that was not allowed. She can make the remarks she made, but my recommendation is testimony clearly can't be admitted right now.

CHAIRMAN BAGGETT: I assume from representation of counsel --

MS. JENNINGS: We did not have that?

MR. MONTEVIDEO: You did not have that. I was curious because she shortened her comments.

MS. JENNINGS: He just assumed that you had --

CHAIRMAN BAGGETT: That was the representation of counsel earlier. If that's not the case --

MR. MONTEVIDEO: You had it at some time, but that's --

RAY PEARL,

having been previously sworn, testified as follows:

STATEMENT OF RAY PEARL

MR. PEARL: Good afternoon, Members of the Board. My name is Ray Pearl, Deputy Director of Government Affairs for the Greater Los Angeles Building Industry Association. I'm going to cut my comments down significantly but start off by saying we in the building industry continue to be frustrated and dumfounded by the Regional Board staff, that they took us down the numerical standard path. They have put the cart before the horse by saying let's solve some unnamed problem with some kind of solution and we'll figure the rest out later. That doesn't make sense. That's not only bad science, it's also bad policy.

How about defining the problem? Which

pollutants do you seek to reduce? What are the non-point sources that generate these pollutants? Why not develop policies that will actually reduce pollution from these identified sources? No one, including Regional Board staff, has yet to cite a single study that shows how this proposal will be effected in Los Angeles County.

From the very beginning we have had one simple, basic question. How will we measure if we abide by this new requirement if we have successfully achieved water quality? We asked Dennis Dickerson that very question. His answer was there was absolutely no way to know. In a meeting we held with him, his exact words, and you've heard them alluded to before, these were Dennis's words, were that we, quote, "Just have to do something." That statement from a public official is unbelievable and sad. That is absolutely no way to conduct sound policy. It does, however, illustrate one of our main concerns.

This policy is a shot in the dark and has no chance of achieving water quality. This policy attacks the home building industry. And if you are to believe Heal the Bay and others, that alone will solve our water quality problem. The Regional Board sought to address one minuscule, microscopic portion of the stormwater run-off issue. What good is it to clean water only from new development if nothing has been done to address the millions of people already living here?

I want to stress we've been here before and where we were with the Air Quality Management District.

In the early 1990s, they pinpointed development as a major source for dust contributing to air pollution in the southern California area and they sought to heavily regulate our industry. After extensive studies, however, the determination was made that development's impact on air quality was much less than originally assumed. The original assumption was that development was two-thirds of the problem. After conducting extensive local studies, it was determined that new development was roughly 9 to 11 percent of the problem. Quite a difference.

The AQMD therefore focused its efforts elsewhere because of real world evidence in the southern California area. That is all we're asking for in this situation. Why are we afraid to be more thorough?

You are also under a serious misconception if you believe the environmental rhetoric that this proposal will keep beaches open and drinking water safe. It will not clean the bay, it will not keep beaches open and make water safer for aquatic life. As long as I've lived in southern California, I've only heard of beaches being closed because of oil spills, sewage and medical waste. Beaches are not closed because new homes are built.

My final question is this: Based on sound science, what specific contaminants does the Regional Board attribute to new housing? Unfortunately the answer is still unknown and not addressed in the proposal.

Lastly in my presentation, I have asked a number of serious and basic questions. You may believe them to be rhetorical, but they are not. We met with Dennis Dickerson and Xavier Swamikannu on three different occasions. On October 25th, 1999, we met with Dennis and Xavier. On November 12th, 1999, we met with Dennis by himself, and again with Dennis on January 24th, 2000.

I want to stress once again that every single one of the questions I've asked in this presentation were asked of Regional Board staff. They have never to this day been able to provide us an answer to a single one of those questions. I hope you will ask them why. Maybe they will answer your questions.

Thank you.

MR. MONTEVIDEO: We have Mr. Desi Alvarez to provide some testimony.

DESI ALVAREZ,

having been previously sworn, testified as follows:

STATEMENT OF DESI ALVAREZ

MR. ALVAREZ: Good afternoon, Mr. Chairman and Members of the Board. I'm Desi Alvarez, Director of the Public Works for the City of Downey, also Chair of the L.A. County Stormwater Permit (inaudible) Executive Advisory Committee.

The permit has various provisions and requirements aimed at improving overall run-off of water (inaudible) process (inaudible) which requires the preparation of SUSMP. The permittees submitted a SUSMP to the Regional Board that met all the requirements of the permit and it was a result of much effort and anticipation of many constituents. This SUSMP was, in fact, an economical approach to reducing the amount of pollution generated from urban areas.

However, the SUSMP was not considered by the Regional Board and no formal action was taken on it. Instead, it was replaced by one which was and does not have broad support, and most importantly is neither practical nor economical and unfortunately did not result in improvements in water quality.

The SUSMP adopted by the Regional Board fails to take into consideration the diversity of land uses and development activities in Los Angeles County. It is a treatment driven approach with little scientific basis. Any plan that will require the application of (inaudible) technology should be based on adequate study to demonstrate effective removal of pollutants that are typical, that is local conditions. The technology should be based on clearly defined parameters representative of that found in local run-off and sets amounts of pollutant removals that is expected. This was clearly not done. None of the testimony that was presented to date, presented here, will provide this information.

The SUSMPs adopted by the Regional Board require the use of (inaudible) technology. They're not specific about what technology to use. In effect, we do not know if any of the technologies that will be used will do anything to remove any significant amount of pollutants. One thing is certain. They will place a financial burden on every sector of our communities and lead to a whole series of unintended consequences that we have yet begun to figure out.

The SUSMP submitted by the permittees not only met all of the L.A. County municipal stormwater requirements, but actually took advantage of a proven approach to reduce the amount of pollutants in stormwater. The Plan would implement the use of best management practices that could be tailored to specific needs of individual communities and would result in reducing pollutants (inaudible) consistent with the requirements of the Clean Water Act.

It is a plan that makes sense and a plan of which we are supportive. We are asking that you basically request the Regional Board to implement the SUSMP as was submitted by the cities and would be happy to work with them on additional modification with the support of a broad-based community, not just a small group of organizations.

Thank you.

EXAMINATION

BY BOARD MEMBER BROWN:

Q. Has L.A. County performed any studies, investigations to determine why the beaches were closed?

A. Why the beaches were closed? Generally the beaches were closed because of high pathogen counts.
Q. Have they done any study to try to determine the cause?
A. It's generally sewage spills, or one of the things that you do see in stormwater is high bacteria count and that comes from many sources. A lot of those sources --
Q. My question is have you done any technical studies to determine what the problem is or what's causing it. My understanding of what you're estimating, your estimation probably is true. I don't know. Have you done any scientific analysis or study?
A. I'm not familiar with any specific studies.
Q. The next question is would the County do such a study now that the problem has been brought to light. More specifically would the County, in your opinion, be a good, responsible party to try to determine why your beaches were being closed?
A. The County may be a good party to do that. I would agree. They would be one party. There are other organizations that may assist in that effort.
Q. I understand, but somebody's got to go on point here if this state doesn't. It would seem like the County would be an alternative for consideration to go on point and be a responsible party to try to determine what the cause is and to prevent it.
A. I would hope that they would, but not being

R0073826

part of the county organization, I can't speak for them.

Q. Has it been discussed?

A. To answer your question directly --

Q. That's fair, but has it been discussed within your group, within your own --

A. I think that the County has taken a leadership role in this permit. They have funded a lot of the monitoring requirements and I think they would probably be available to assist in the study. That's the best I can do for an answer.

Q. Can you get an answer, do you think?

MR. MONTEVIDEO: Maybe by tomorrow.

BOARD MEMBER BROWN: Thanks.

MR. MONTEVIDEO: Barbara Ferraro.

BARBARA FERRARO,

having been previously sworn, testified as follows:

STATEMENT OF BARBARA FERRARO

MS. FERRARO: Hello. I'm Barbara Ferraro. I'm a Councilmember in the City of Rancho Palos Verdes and I'm here to express some of our concerns about the SUSMPs that the Regional Board adopted in January. I'm going to make this very brief.

One of the aspects of the new regulations that will have a great impact on our city is how they have designated areas as environmentally sensitive. This is important to the City of Rancho Palos Verdes because nearly the entire City of Rancho Palos Verdes is within an area designated as environmentally sensitive. That's right, the entire city.

Our staff has read and reread these regulations and asked the Regional Board whether virtually the entire city is within this environmentally sensitive area and have been told that it is. The problems come when we have a person -- we have mostly in-fill left. How can a person simply installing a new roof have to include a detention basin as part of their project? We feel like this is quite unreasonable. My colleague John McTackert (phonetic), who is also a Councilman in our city, and our Public Works Director are also here. And if you have any questions, they would be happy to come up and answer them.

I want to point out that we believe it is to everyone's benefit to improve the quality of water. No one is more conscious than we are, having seven miles of coastline. We understand very well the importance of these regulations. However, the way they've been proposed they're not really workable. They're too far reaching for our residents.

I urge you to request your staff to work more closely with members of our staff, with the cities, to prepare regulations that can be reasonable and attainable.

Thank you.

CHAIRMAN BAGGETT: Thank you.

MR. MONTEVIDEO: Mr. Chair, that concludes my presentation. Thank you and thank you to counsel for WSPA.

CHAIRMAN BAGGETT: Let's take five.

(Recess taken)

CHAIRMAN BAGGETT: Let's reconvene.

I have a question for counsel here. Since we just finished the first case-in-chief, maybe this will help simplify it a little bit for some of the witnesses. Which witnesses do the other parties intend to cross-examine? If there aren't any you're planning on cross-examining, we can dismiss them now and they can go on their way. Maybe you can contemplate that.

Do you have any of the petitioners' witnesses you will cross-examine? There's seven of them. We've already done Mayor Clark.

MR. WELCH: I don't think we have any cross-examination of the co-petitioners' witnesses.

CHAIRMAN BAGGETT: Think about it. I'm sorry. I'm trying to help move the process along here. I'm not proposing we do this cross-examination now.

We'll go back in recess.

(Recess taken)

CHAIRMAN BAGGETT: We'll reconvene.

MR. FLEISCHLI: I was just going to point out that we have discussed this and have no cross-examination questions for Ms. Ansari, Mayor of Diamond Bar, but we would like to have an opportunity to cross-examine all the other witnesses.

CHAIRMAN BAGGETT: Okay. So I guess you're excused. With that, let's reconvene and get on with the next case.

LYMAN WELCH,

having been previously sworn, testified as follows:

STATEMENT OF LYMAN WELCH

MR. WELCH: Good afternoon, Mr. Chairman and Board Members. My name is Lyman Welch appearing on behalf of the Western States Petroleum Association. We are here for a specific reason that's different than much of what you've heard this morning and this afternoon.

The Western States Petroleum Association, or WSPA, is here because the SUSMP requirements implemented by the Los Angeles Regional Board will have a considerable impact on new and redeveloped retail gasoline outlets in the Los Angeles region and potentially in other regions of California as this program is implemented elsewhere.

Retail gasoline stations have a special circumstance that's different from any of the other developments that are covered by the SUSMP regulations. Gasoline stations are typically found in urbanized areas. They are located on small parcels of land, and the nature of their operations requires that they have gasoline and motor oil present to dispense to cars and vehicles that come through.

When running a gasoline station, it's important to prevent any contamination of the subsoil or groundwater from spilled gasoline or motor oil that happens, and gasoline stations take extensive precautions to try and prevent any groundwater contamination. For example, gasoline stations typically have an impervious surface, concrete, throughout the area of the gasoline station just to prevent infiltration of gasoline or spilled product into the subsurface or groundwater. This is just one of the steps that gasoline stations take to prevent groundwater and the soil from being impacted.

Now, the SUSMP, one of the -- in fact, the major concern that WSPA and gasoline stations have with the proposal is that the proposal requires gasoline stations to either infiltrate their run-off or to treat their stormwater run-off. And as I've noted, infiltration of run-off simply is not practicable for the retail gasoline stations.

To prevent groundwater contamination, they need to have solid concrete surface and there's no potential for infiltration of stormwater into the ground as a potential remedy for any stormwater pollution.

Keep in mind that the Clean Water Act under which the SUSMP was implemented requires that the BMPs are developed -- were to the maximum extent practicable. When you're looking at that requirement, that doesn't mean that you have to put on every single kind of possible treatment device that is known to man. You have to look at the cost-effectiveness of particular BMPs and you need to look at whether they're effective at all, and you need to look at health and safety concerns that are relevant to different types of management practices.

The Western States Petroleum Association has taken a very proactive approach to stormwater contamination in gasoline stations. Back in 1995, you'll hear that WSPA ordered a study to specifically look at all of the different types of best management practices that could be used by retail gasoline stations to prevent or reduce stormwater run-off containing pollutants.

The different types of best management practices -- and you've heard some of this today. They are -- management practices or operational procedures are one type of BMP that can be applied. And those types of operational procedures have to do with things like sweeping the ground, posting signs at your gas station, tell people not to top off their tanks when they're filling gasoline, and other types of management procedures that can be implemented day-to-day by people who are working at the gasoline station to prevent spills which could run off in the storm event. Now, those types of source controls can be very effective at preventing stormwater run-off pollution.

You'll also hear there's a second type of control, a structural control that you can implement where you design your site so that the stormwater runs off in a particular way to prevent pollution, and in particular gasoline stations you'll hear one method of structural control is to design your fueling station so that any spills won't easily run off of the fueling area and that stormwater can be directed away from the fueling island area so that stormwater which comes onto the site from nearby locations won't interfere with any or won't pick up any contaminants from the fueling island.

There's a third type of best management practice which I'll call treatment controls. Those are using devices such as you've heard, sand filters or inlet filters, which actually instead of reducing the pollution at the outset try and treat it if you have a spill and something gets into the stormwater.

Now, WSPA looked at all of these types of best management practices or BMPs, and as a result of the study in 1995 and 1996, you'll hear they found there were a number of operational procedures and source controls that were effective at controlling stormwater pollution. You'll hear there are a number of structural controls that can be implemented such as using Portland impervious cement to prevent stormwater pollution. They found that those can be very effective in preventing pollution from gasoline stations. In fact, in studies that were conducted, the data show that when a retail gasoline station uses those types of operational procedures and structural controls that virtually all of the contaminants found in stormwater are below levels that would be of concern. So by using those two types of controls you effectively eliminate the pollutants from going into the stormwater levels that are of concern.

Now, the third type of treatment system was also looked at by WSPA, and you'll hear that the different types of treatment systems that are available that can practically be used in a small area of a retail gasoline station where you have these requirements for an impervious surface, those types of treatment systems, the data show -- there's really no data to show that these treatment systems actually work.

After WSPA concluded its study, later it became involved with the California Stormwater Quality Task Force. As you know, the California Stormwater Quality Task Force is a regional group of regulators and other interested parties that got together and took an independent look at the requirements that can be used at retail gasoline stations to prevent stormwater pollution.

In 1996, a working group got together -- and you'll hear more about this from some of the people that were involved in this working group -- and together with representatives from the Regional Board staff and from the State Board staff they came up with what's Exhibit A to our attachments, a best management practice guide for retail gasoline outlets.

This best management practice guide was designed to offer guidance throughout the state, not just particularly limited to one area like the Los Angeles region but throughout the state, to all retail gasoline stations, and not only new gasoline stations or modified gas stations, but even existing facilities. This best management practice guide contains recommendations for procedures that can be applied across the board.

You'll see that the best management practice guide incorporates the operational procedures as well as the structural controls that I mentioned earlier, and that you'll also find the stormwater task force that looked at treatment devices found that there wasn't enough data and they weren't justified by peer review to support using treatment devices in retail gasoline stations since the operational procedures and the structural controls, if applied properly, would prevent any significant stormwater run-off problem.

So we have this guidance that was developed by an independent party that took an objective look at the requirements that should be used as BMPs for retail gasoline stations. In the process when the Los Angeles region was developing the SUSMP proposal, representatives from WSPA appeared before the Regional Board and submitted writing in August of 1999 that referred to the work they had done, including the best management practice guide, and also appeared at the hearings in September and January before the Board and again expressed WSPA's support for application of the best management practices the stormwater quality task force had developed.

WSPA supports the best management practices in the stormwater practice guide, both the operational procedures and the structural controls, and urged that the Regional Board consider that. Well, surprisingly, although just a year ago when SUSMPs were considered, the Regional Board in that proceeding referenced the best management practice guide from the stormwater quality task force. In this case just recently, a few months ago, you'll find that when the final SUSMP proposal was proposed by the Los Angeles Board, you'll see in Section 14, Table 1, pages 16, 17 and 18, the Los Angeles Board has a list of a number of resources and references that people can look at for best management practices. And although the SUSMPs apply to retail gasoline stations, you can look all day through these suggested resources and you won't see the stormwater quality task force best management practice guide.

Why is that, especially when WSPA was present at the meetings and suggested inclusion of these best management practices? It's unclear why they weren't included when they were developed just to address this problem. They should have been included, and it's true that the SUSMPs proposal does include a few of the operational procedures that are in the best management practices guide but certainly not all.

The main concern that WSPA has with the SUSMPs proposal is that the SUSMPs proposal requires treatment mechanisms to be included for retail gasoline outlets, but the data just isn't there to show that they are effective. There's no data to show they're effective in controlling stormwater pollution from gasoline stations. There's no evidence to show that they're necessary because the stormwater quality task force best management practices when applied properly are sufficient to control pollution in stormwater run-off.

The other concern that WSPA has is there was really not significant study to demonstrate the cost-effectiveness of the treatment BMPs that were proposed by the SUSMPs, and we know that basically what the Los Angeles region did is apply this one requirement that applies across the board. Whether you're a parking lot, a gasoline station, or a single-family home, you have to comply with the same requirement, but it doesn't look at the special circumstances that are faced by a retail gas station.

You've heard today and you'll hear from our witnesses that sand filters and compost filters require construction of an underground vault that presents risk of explosive gases and concerns of the workers that have to go in there. If you have a leak of product that goes into an underground vault, there is potential for contamination of media and a potential safety hazard. If you had a leak that gets in there and a car drives up, you could have an explosion.

By implementing the SUSMPs in the Los Angeles region and mandate that these underground vaults be installed at gasoline stations, from WSPA's perspective it's simply not a very well thought out idea to be putting underground structures in at a gas station which could promote gas and oil getting into the subsurface. We have had a lot of problems with underground storage tanks leaking and contaminating problems. Do we really want to have more underground structures that can lead to similar problems? We don't think that's the best idea. It is not a sound scientific approach, either. So that's what you'll be hearing from our witnesses here today, about the special circumstances that apply to gasoline stations.

Now, you may be also wondering what is it that we're asking you to do. You've heard today that there have been a number of procedural concerns and we certainly echo the concerns that the permit was not followed here. I think there's really no disagreement that the provisions of the permit were not followed, and we've also identified a number of other procedures that weren't properly followed that could have corrected some of these deficiencies. For example, the provisions of CEQA were not applied properly, the Administrative Procedures Act requirements were not followed, and the unfunded mandate procedures. If this is a discretionary act, there's no funding here for the cities to implement any of these provisions. There are a number of deficiencies that we've identified in our pleadings that are before you. I won't belabor them now.

So bottom line, what are we asking the Board to do? You have before you the California Stormwater Task Force guide containing best management practices for retail gasoline outlets. What we would ask you to do is to remand this matter to the Regional Board with directions that as for retail gasoline outlets, that they apply the procedures here in the best management practice guide as the BMPs that should be applied for the retail gasoline outlets in the Los Angeles region.

And as you've heard today, these same best management practices were developed by a statewide committee and can be applied throughout the state, so the direction that the Board gives today can be used in Ventura County, in San Diego and throughout the state of California. WSPA will fully support the application of these best management practices that have been developed for that purpose.

CHAIRMAN BAGGETT: Thank you.

MR. WELCH: Thank you.

BOARD MEMBER BROWN: Question.

EXAMINATION

BY BOARD MEMBER BROWN:

Q. You made two assumptions, Mr. Welch. First assumption is that if procedures are properly implemented that you had in place, there should be no spills of gasoline.

A. That's not exactly true. I think it's inevitable that at a gasoline station you're going to have some spills in the normal course of operation. What we are saying is that if the best management practices that are implemented in this guide which require a quick, prompt response to any spills that occur so that absorbent material is put down and then swept up and spills are managed when they occur, by implementing those types of procedures as well as having the structural controls that are included in here, those in combination prevent any significant quantities of pollutants from entering the stormwater from gasoline stations.

Q. The second assumption is that if there is a spill and it does go into a containment area of some sort, the concern is the explosion that could occur or other harmful reactions. Assuming that there is gasoline or product available to enter those containment facilities and that's not a good idea, what would you suggest be done for the product?

A. As I mentioned before, one of the procedures in the best management practice guide would be to put absorbent material down to absorb the gasoline. Keep in mind that this is taking place on an impervious Portland cement surface which would prevent the spill from getting in the ground.

Q. I understand and I concur with that. The assumption you made was that there was gasoline in the vessel and that's dangerous. So if you make an assumption that there's gasoline in the vessel and that's not a good idea and it got there somehow, some way, what would you recommend that would be done with that containment and how would you handle it?

A. Okay. Well, my assumption is that if the SUSMP treatment requirements are imposed and a particular system is designed which requires an underground vault such as a sand filter or compost filter we discussed earlier, you would have this underground structure. It's designed so that gasoline product would run into it. So as a result of the design of that system, you will inevitably end up with contaminated material.

If you -- if that were to occur, then you would have a number of concerns. First, with an underground structure there are particular health and safety requirements that would apply.

Q. That's not the question. The question is, if that's not a good alternative because of those reasons that you're mentioning -- and I'm not disagreeing with that at all. If that's not a good alternative and there is product that becomes available, what would you do with it? How would you handle it? What's your suggestion?

A. Perhaps I'm not in the thrust of your question. Our response would be to have a quick response to absorb the spill, contain it and clean it up on-site and not -- and by not requiring a treatment device that has an underground structure, you don't have this problem.

BOARD MEMBER BROWN: Thank you.

CHAIRMAN BAGGETT: You've got two witnesses still? Let me throw out the Chair's ongoing attempt to keep a harmonious atmosphere while deliberating. The last two respondents, you might want to consider doing your opening statements and your one witness each that cannot come back tomorrow and finish your case-in-chief tomorrow morning, if that's possible.

If the two counsel want to think about that, it might be one way to solve Dr. Gold's problem and not keep us here to where we aren't functioning as alertly as we should be. With that --

MR. WELCH: If there are no further questions.

CHAIRMAN BAGGETT: You're still on pause. Does that make sense?

MS. JENNINGS: Can I ask one question?

MR. MONTEVIDEO: We would not have any objection.

CHAIRMAN BAGGETT: There's no objection, but does that make sense? I know Dr. Gold can't come back and we can't stay until 8:00.

MS. JENNINGS: Maybe I could ask a quick question of Mr. Welch while they're conferring?

I wanted to clarify. In the BMP manual that you provided, you are aware of the disclaimer stating that none of the Regional Boards or State Board endorse that manual?

MR. WELCH: Yes. I am aware of the disclaimer, but it is and was designed as a statewide guidance.

MS. JENNINGS: By the industry, those -- you referred to them as regulators. It's by the industry and the cities like the permittees before us.

MR. WELCH: There were a number of people involved in the development of the stormwater quality task force guide. In fact, they're listed. At least the members of the working group are listed on page 1. I won't read them all.

CHAIRMAN BAGGETT: Staff for the respondents?

MR. LEON: Your proposal is fine by the Regional Board. In fact, what we would propose is Mr. Nahai is willing to come back tomorrow. He's the person we wanted to take out of turn. He is willing to come back tomorrow morning.

CHAIRMAN BAGGETT: So you prefer to do your whole case-in-chief tomorrow instead of tonight? Okay. If there's no objections, that's one.

MR. HELPERIN: Would that mean that we would be going before the Regional Board and changing the order then?

CHAIRMAN BAGGETT: It sounds like they're willing to wait. Does that present a problem to you?

MR. HELPERIN: Dr. Gold is not here at the moment.

CHAIRMAN BAGGETT: He's here.

So the Regional Board, that will be continued to tomorrow, so we're slowly -- so we have from the petitioners, we have two witnesses that will not be able to return tomorrow, I understand. You have two witnesses that you want to cross tonight.

MR. MONTEVIDEO: The two witnesses that are going to be leaving are Dr. Gold and who was the other one?

CHAIRMAN BAGGETT: It's just Dr. Gold.

MR. NAHAI: I'm willing to come back tomorrow morning, but my question would be how long are you proposing to go this evening.

CHAIRMAN BAGGETT: We've got to be out of here by 7:00. I would like to go to Dr. Gold. Finish up WSPA and do Dr. Gold.

MR. SMITH: How long does WSPA have to go?

CHAIRMAN BAGGETT: 20 minutes.

MR. HELPERIN: It's fine with us, especially that it would allow our other witness to leave now but obviously we would have to with the understanding he would not be able to testify tonight if things change.

CHAIRMAN BAGGETT: We will only finish WSPA's case-in-chief and continue with Dr. Gold, cross-examine Dr. Gold and the two witnesses, if you desire.

MR. HELPERIN: That's fine.

CHAIRMAN BAGGETT: Very good.

Let's continue.

MR. WELCH: WSPA will call Ron Wilkness.

RON WILKNESS,

having been previously sworn, testified as follows:

STATEMENT OF RON WILKNESS

MR. WILKNESS: Good afternoon, Mr. Chairman and Members of the Board. My name is Ron Wilkness. I'm with the Western States Petroleum Association.

As you may know, Western States Petroleum Association is a trade association. Our territory is the western United States, and it is the majors (inaudible). Many of our member companies will be building or remodeling retail gasoline outlets and will of course be impacted by the requirements of the SUSMP adopted by the Regional Board.

I would like to preface my remarks by stating that the RGOs are truly unique among the nine categories of planning projects to actually (inaudible) SUSMPs, and I will be telling you why this is so. My comments will be specific to retail gasoline outlets and I would also like to apologize for my informality. I'm recovering from surgery and I haven't yet learned to tie a tie with one hand.

I joined WSPA in 1993. I've been involved with matters pertaining to stormwater run-off at service stations since 1994. I presented testimony to the Regional Board both on the June 1999 Long Beach municipal permit and the Los Angeles County SUSMP. So I have had some considerable personal involvement with these issues.

I would like to start my testimony by telling you that WSPA takes pride in our efforts to reduce any adverse impacts that stormwater may have. For example, we recognized the impact of used motor oil, so several years ago we partnered with the City of Los Angeles to co-sponsor a used oil recycling program. And my little plastic funnel here has at the bottom -- in fine print it says, "recycle used oil." Here's a toll free number to call for information. This is a public service of the Los Angeles County Department of Public Works and Western States Petroleum Association.

I have several other examples of our involvement with stormwater quality issues. We have participated in several studies on the quality of stormwater run-off from RGOs. We (inaudible) a study to evaluate stormwater BMPs and the study was run by Geomatrix. Mr. Timothy Simpson of Geomatrix is the witness that will be following me and he will be telling you more about that study. In any event, all of this work led up to our participation for retail gasoline outlets. This guide as you have heard was published as the work product of the California Stormwater Quality Task Force. The task force created a working group. We were a part of that working group, I was personally, Mr. Simpson was, a couple representatives from our companies were.

We met over the period of approximately one year to develop this guide, and I think that you have a copy of the guide included as one of the exhibits.

CHAIRMAN BAGGETT: The Board has a copy.

MR. WILKNESS: Thank you. I would like, if I may, to read two sentences from the letter of transmittal from Robert Hale, the chairman of the task force, identifying -- describing the purpose for the guide.

I quote, this guide was produced and published by the California Stormwater Quality Task Force, an advisory body of municipal agencies complying with stormwater regulations. The purpose of this guide is to assist municipal agencies and retail gasoline outlets -- I'm sorry -- subject to stormwater regulations in attaining compliance with such regulations. The Clean Water Act identifies BMPs as a means by which the discharge of pollutants is reduced to the maximum extent practicable. MEP means that you must take into consideration the gravity of the problem, physical feasibility, public health, and social benefits.

WSPA agrees with the need for stormwater BMPs. We value the benefits that come from the implementation of appropriate BMPs and we continue -- as counsel has already told you, we continue to support the task force BMP guide as the definitive set of stormwater BMPs for retail gasoline outlets.

The guide is also recognized as the most appropriate set of BMPs for RGOs by numerous stormwater regulatory agencies. For example, up in the Bay Area, it is simply referred to as the standards that must be complied with. The Los Angeles Regional Board specifically included the BMP guide by reference in their June 1999 order for the City of Long Beach, although curiously there is no longer any mention of the BMP guide in the L.A. County SUSMPs or in their more recent proposed order for the County of Ventura. The guide is not even -- as you heard, the guide is not even listed as one of the references.

With that by way of background, I would like to speak briefly to the issue at hand. Please remember that our concerns are solely with stormwater requirements applicable to retail gasoline outlets. I would like to briefly address the nature and extent of any problem caused by run-off from RGOs, then I would like to talk about the mitigation requirements of the SUSMP.

First, is there a problem? We truly believe that run off-from a well-maintained RGO does not cause any significant adverse water quality impact. The Regional Board in its attempt to justify the need for the SUSMP, and in particular mitigation requirements and numerical standard, has not produced any data to the contrary and neither has anyone else, at least certainly not that we have ever seen.

I have mentioned that RGOs need to be well maintained. What do I mean by well maintained? We would suggest that the criteria for a site to be deemed well maintained should be implementation from the provisions of the task force BMP guide. I would like to emphasize that the BMP guide also applies to existing stations. There are separate requirements that we devised when we developed the guide for new or remodeled sites and separate requirements for existing sites.

Uniform implementation of the requirements of the BMP guide would ensure that stormwater run-off from RGOs does not cause adverse impacts. We do not believe that any additional requirements are either necessary or appropriate.

I would like to talk now about mitigation techniques. We were pleased to see that the Regional Board included some of the provisions in the BMP guide in the L.A. County SUSMP. However, the additional requirements in the SUSMP are not appropriate for retail gasoline outlets. These additional mitigation requirements are either to treat the run-off or to promote its infiltration into the soil, and there are significant problems associated with both of these two proposed mitigation measures when applied to an RGO.

First with respect to treatment. The Regional Board has not provided any information supporting the efficacy of any form of treatment for run-off from RGOs and certainly no data regarding performance in the field. There are two types, two primary types of treatment for infiltration and gravity separation.

With respect to filtration, experience tells us filters and what has been fairly commonly required is a catch basin or catch basin inserts. These plug rapidly and become simply totally ineffective. I've heard they cause ponding. I've also heard that newer designs have some sort of overflow provision so when the filtration units themselves flood, it allows water to flow through, untreated.

Dr. Horner has alluded in his testimony this morning, alluded to new catch basin inserts that are being studied at UCLA in the laboratory. Perhaps these will be interesting, but again laboratory data is an awful lot different from data in the field and again, there is definitely the question about heavy installed or implemented task force BMPs. There are residual gravity separation devices that at least two conditions be satisfied, controlled flow rate and relatively high inlet pollutant concentration. Neither of these two conditions can be satisfied at a retail gasoline outlet.

Very troublesome to us is the optional or alternative for infiltration. The task force BMP guide clearly states the requirement for using impervious pavement at RGOs and it does so for a very good reason, protection of the subsurface environment. If there is an accidental spill of gasoline and such spills are an unknown occurrence, I don't believe that we want to provide direct conduit for product, gasoline in this case, to run into the ground, and that would be exactly the case with any form of infiltration that I can think of.

As your Board is aware, the State Board's Division of Clean Water programs is currently proposing amendments to the USC regulations to protection of the subsurface environment. The concept of providing for infiltration of RGOs runs completely counter to the goal of the USC program. And again, I'm not talking about infiltration of stormwater but I'm talking primarily about our concern about infiltration of gasoline product.

I would like to conclude by emphasizing the following points.

Number one, California Stormwater Task Force BMP guide is the definitive set of BMPs and they're applicable to both new and existing RGOs. These effectively reduce potential pollutants and run-off from well-maintained RGOs to the maximum extent practicable. The group of regulators -- we were there as participants I guess, but they were the ones that published the guide.

Additional mitigation measures, that is measures beyond those in the BMP guide such as those required by the SUSMP, weren't justified. These additional measures have still not been justified and were not justified (inaudible) SUSMP.

As far as mitigation options are concerned, once again, we don't believe there is data that filtration works. Therefore, WSPA would respectfully request that SUSMP will not be required of RGOs.

I thank you for your attention. I would be happy to answer any questions.

MR. WELCH: WSPA will call Timothy Simpson.

TIMOTHY SIMPSON,

having been previously sworn, testified as follows:

STATEMENT OF TIMOTHY SIMPSON

MR. SIMPSON: Good afternoon, Board Members. Could I ask how much time we have left?

CHAIRMAN BAGGETT: You've got about ten minutes.

MR. SIMPSON: My name is Timothy Simpson. I'm a principal at Geomatrix Consultants, a California-based consulting firm. I'm here today on behalf of Western States Petroleum Association to discuss the SUSMP requirements for retail gasoline outlets.

My brief background, I hold bachelor and masters degrees in civil engineering and I've been involved in stormwater management and compliance issues for the past ten years. I'm a licensed civil and geotechnical engineer in the state of California.

Over the past ten years I've established nine statewide stormwater compliance groups under California general industrial standard stormwater permit, and these groups involved nearly 500 facilities located throughout California. I currently manage eight monitoring groups, and I'm also serving as a consultant on water quality issues for a wide variety of dischargers, including landfills, scrap yards, auto dismantling facilities and one of California's major airports.

The majority of the work I've done over the last ten years involves collecting and interpreting stormwater quality data and consulting on the efficacy of various stormwater management practices. A lot of my practice is helping clients spend money to improve water quality, helping them decide how to spend that money effectively so there's a beneficial impact on water quality.

It's already been mentioned the report that was done by -- I was a principal author and you've been provided Exhibit B in the materials that were provided from WSPA and it's our report entitled Stormwater Best Management Practices for Retail Gasoline Outlets. I would like to briefly describe the purpose and the results of that study.

The report that you have is the final work product from the two-part study that we did. The first part was performed in 1994 and included a characterization of water quality from a number of gas stations that were -- that we called normally operated and maintained. We all know there are outlyers out there. There are dirty gas stations out there. There's also clean stations. There's definitely a difference when people manage stations.

We selected those stations that were mainly the member companies of WSPA that were well managed and didn't cherry pick trying to find the clean ones. We tried to find a diverse cross-section of stations based on the number of vehicles that were fueled.

When I say normally operated and maintained, those are stations that implement regular management practices. There's a reason they look clean. It's because they sweep the stations, they perform regular site inspections and they implement standardized spill prevention and mitigation procedures. It's very important.

We did this characterization to provide a basis for various structural and non-structural management practices and to compare the results to other sites, to compare gas stations to other dischargers. The findings of the study, which also included extensive data search of all the data that was available at that time regarding gas stations, suggested that the normally operated and maintained retail gasoline outlets are not the, quote, hydrocarbon hot spots, that they had been characterized by regulators in the past. Also, the concentrations of metals, hydrocarbons and solids were no higher than a lot of other sites such as roads and parking lots which indicated to us that they don't warrant to be singled out for special regulation.

Additionally from our study we went back recently, and using the multi-sector, the federal multi-sector permit which has established benchmark concentrations which weren't available at the time of our study, we looked at those benchmarks and compared them to what we found in our study, the mean concentration from our study.

We found that suspended solids, which include hydrocarbons and most metals, were significantly below the benchmark concentrations. Those aren't effluent limitations, those are identified by EPA and they're termed monitoring triggers by EPA, but EPA has also said if you fall below the multi-sector benchmarks, your discharge will pose little concern on water quality impairment. That shows that implementing normal management practices has a real positive impact on water quality from gas stations.

The second part of our study was to use the characterization data that we had collected and to evaluate the various pollution prevention measures and treatment BMPs that could be used for RGOs in the ultra-urban environment with very limited space. The outcome of our study was the recommendation that the BMP focus, the money that should be spent on BMPs should be spent mainly on pollution prevention practices which are those practices that are relatively simple and they're generally simple facility modifications that result in clean, well-run service stations that are not a problem for the water quality perspective. Just some brief examples of what we identified, use of overfill prevention equipment, posting signs against topping off tanks, using canopies and Portland cement on fuel islands, a very important one, avoiding run-off across fueling areas, eliminating the hosing down of service stations, regular sweeping of exposed areas, having standardized and implementing those standardized spill prevention plans, and very important, employee training.

In contrast we found there are significant problems associated with trying to treat run-off from gas stations. First, our characterization study indicated that the best way to characterize stormwater is that it's episodic, and when it does rain you get a lot of rain, and it's got relatively low concentrations of contaminants. That's a very difficult engineering challenge to solve how to deal with that.

For example, we looked at oil water separators which are often installed at gas stations in response to regulatory requirements. Under ideal conditions, an oil water separator will be treating down to about 10 to 15 parts per million for petroleum hydrocarbons. What we found in our study was that the high end of our concentrations for oil and grease and petroleum hydrocarbons was about five parts per million. So what we're putting into these boxes is much lower than what we hoped to achieve out the other end. So the efficiency in these oil water separators just isn't there for these low effluent concentrations.

Other problems we found with treatment BMPs being effective for gas stations is that they can be expensive and difficult to maintain, and as a result they don't get maintained. A study performed in Maryland that was cited in our document found that none of the hundred oil water separators that were installed in the metro D.C. area had ever been maintained, and as a result they became sumps that collected contaminants and basically discharged those contaminants during storm events. They became more of a problem than they were solving.

We also found other issues associated with installing any sort of vault to collect run-off at gas stations. From a practical perspective, any device that's going to collect run-off is also going to collect any spilled product, which can create a significant explosion hazard and make it much more difficult to clean up spills when they do occur. If the spills are difficult to clean up, then they're not going to get cleaned up through this box. You're not going to know it's there. It's going to be buried. The attendant is not going to know it's there. It creates an explosion hazard and -- a potential explosion hazard, and it's going to go unnoticed and the first storm event it's going to be discharged. It's much easier not to have the box in place. The spill will occur, the attendant sees it and follows the spill prevention plan and mitigates that spill.

It's already been mentioned that right after our study was completed we worked with the water quality task force to discuss appropriate best management practices for retail fueling operations. Jeff Bruso (phonetic) of the Bay Area Stormwater Management Agencies was the chair of the group. I was a participant along with representatives from the State and some Regional Boards. Bruce Fujimoto was part of that group as well as Xavier Swamikannu, and I do recognize that the state did not endorse the plan, and I remember the discussion of that. The state, they were participants in the process. The State and the Regional Board said that they couldn't endorse the plan because it would constitute a regulation but they were active participants in the process that occurred over a year period.

The goal of the work group was to utilize the experience and judgment of the 14 work group members to evaluate the structural and non-structural BMPs potentially applicable for retail fueling operations and develop a set of technically valid BMPs. The outcome of the work group's effort was the best management practice guide which has been provided. Many of the BMPs described in the task force BMP guide are contained within the SUSMP. However, the one significant difference between the task force BMP guide and the SUSMP is that the SUSMP requires the mitigation through infiltration or treatment of the first three quarters of an inch of run-off.

I would like to discuss real quickly what that requirement means for gas stations. The one method that a lot of dischargers will probably try to use is the infiltration, and a lot of our practice is to mitigate soil and groundwater issues. And believe me, we don't want to infiltrate stormwater at gas stations. Although it's job security for a hydrogeologist, it's not good for the soil and groundwater of California to infiltrate at gas stations.

The other method is to treat the first three quarters of an inch, and I've already discussed the problems associated with that. The task force also looked --

CHAIRMAN BAGGETT: Close.

MR. SIMPSON: The task force also looked at those BMPs and said that the effectiveness and efficiency of these BMPs and other BMPs not listed was insufficiently peer reviewed and, therefore, they cannot be recommended for use statewide. And there's no new information that has shown that these BMPs were effective. There's a recent study done by County of Sacramento that's evaluated all of the various ultra-urban stormwater BMPs and it shows that 13 of the 14 are not acceptable for use in the ultra-urban environment.

In summary, I urge the Regional Board to simply adopt the BMPs that this task force came up with, and the real benefit those could be adopted at all gas stations, not just the ones slated for redevelopment. And that's going to have ultimately a much more positive impact on the water quality.

Thank you.

CHAIRMAN BAGGETT: Thank you.

We now have -- let's continue with Dr. Gold. I think he is the last.

We'll continue. Last is Dr. Gold.

DR. GOLD: Heal the Bay.

CHAIRMAN BAGGETT: Heal the Bay. NRDC's witness.

MARK GOLD,

having been previously sworn, testified as follows:

STATEMENT OF MARK GOLD

DR. GOLD: Good evening. I'm Dr. Mark Gold. I'm the Executive Director of the environmental group Heal the Bay. I'm an expert here for today. My background is I have a bachelor's and masters in biology from UCLA. I have a doctorate in environmental science also from UCLA, and I'm a member of EPA's Federal Advisory Committee for urban wet weather. I'm a member of the faculty at UCLA in the school of public health and water quality, and also I've conducted research on local water quality for about the last 15 years.

Just some background. Unfortunately with the order, some of this really should have been heard earlier but that's the way it goes. The economic benefits of coastal waters, this is based on the State Department of Resources numbers, the study done under Governor Wilson a few years ago, that ocean-dependent activities generate about $9 billion annually for southern California. It's actually -- and then $10 billion statewide coastal tourism. Of that, approximately $1.5 to $2 billion is generated annually in L.A. County coastal tourism, and Santa Monica Bay alone, 50 to 60 million people visit the Santa Monica Bay annually.

Characterizing the urban run-off problem in L.A. County, it's pretty much widely agreed upon that stormwater run-off is the largest source of impairments to Santa Monica Bay. Southern California has one of the worst run-off problems in the country.

I can go into each one of these categories in detail, but I don't have much time. We have beaches with very poor water quality. Many of them have poor water quality during dry weather, and about 75 percent of the beaches have poor water quality during wet weather. There's been numerous cases, numerous studies where aquatic toxicity has been found in both run-off and sediments in front of storm drains, contaminated sediment problems, trash and debris problems and increased erosion sedimentation and habitat degradation caused by pollutant run-off and peak run-off flows.

To give you a background on what you, as the state of California, have done in putting together -- the Regional Board has put together the 303-D list of impaired water bodies in 1998. That's the one that I'm referring to. As you know, this list was approved first by the Regional Board then by you, the State Water Board, and finally by EPA.

In Region four alone, we're unfortunately blessed with 156 impaired water bodies and water body segments. 734 specific impairments caused and then 19 major pollutants of concern. Common contaminants of concern, many are associated with polluted run-off of heavy metals such as copper, lead and zinc, oil and grease, PAHs, trash and debris, TSS, pathogens, nutrients and pesticides.

A little further into the contaminants of concern in urban run-off in and around the L.A. region is that numerous studies have found that concentrations of contaminants of concern in the region's storm drains exceed federal and state water quality criteria. There was in 1993 a UCLA study done for the American Oceans Campaign that demonstrated that just recently the 1988 and 1999 L.A. County monitoring points, data points, actually exceeded those standards, and then if you look at beach water quality, the routine monitoring program from the L.A. County Department of Health Services, the City of Los Angeles and the L.A. County Sanitation Districts shows you time and time again that bacteriological standards and health department standards are exceeded.

And then SCCWRP, Southern California Coastal Waters Research Project, has done numerous studies over the last 20 years that demonstrates that water quality exceeds a number of existing water quality standards.

On the beach contamination issue, which has been studied at length, that's actually been a lot of my research, has demonstrated that storm drain water has high concentrations of indicator bacteria. Even antiviruses get in there, and you also see at the beach very high concentrations of bacteria where people swim.

In 1996 the epidemiological study, completed under the auspices of the Santa Monica Bay Restoration

Project, demonstrated that those people who swam right in front of storm drains were far more likely to come down with upper respiratory infection as well as acute gastroenteritis. There's a demonstrated adverse health effect related to stormwater that occurs. This is during dry weather. During wet weather, as I reiterated before, over 75 percent of the beaches have poor water quality and exceeded at least one health standard.

On toxicity, there has been studies that have shown toxicity of stormwater flows within the region at Ballona Creek as well as Malibu Creek, Bisete (phonetic) Bay, as well as others. SCCWRP in 1996, this was using the sea urchin fertilization test, as well as the abnormal environmental development test -- the sea urchin fertilization test is far more sensitive, and if I recall correctly, roughly a dillution of around six to one or so still caused significant toxicity in run-off from Ballona Creek.

SCCWRP also did another extensive study on Ballona Creek working with USC and they demonstrated that within Ballona Creek a well-developed toxic plume extended into Santa Monica Bay up to two miles offshore. So they found toxicity in samples collected during a storm again in sea urchin fertilization tests. Usually the toxicity is caused by -- in fact, in Ballona caused by zinc -- as well as copper and zinc as we all know is heavily associated with automotive and run-off sources.

Also, the L.A. County of Department of Public

Works 98-99 annual report demonstrated that those toxicities in Ballona Creek run-off in sea urchin fertilization tests.

On trash and debris, again SCCWRP's southern California bight study they had been doing on and off for the last five, six years, what they found just in doing their Bendix (phonetic) surveys and sediment collection is that 25 percent of the bottom of Santa Monica Bay contained man-made materials. That is trash from run-off is basically getting in there. I won't get into too much detail other than the fact financially, the annual cost to clean up all the trash on the beach, not to mention the receiving waters, literally costs millions of dollars every year.

Contaminated sediments, we often have contaminated sediment on hot spot problems at the mouths of our storm drains, on our toxic hot spots. There's 14 sites of concern, that is hot spots, that have been identified in the L.A. region. This is from the bay protection toxic cleanup program.

In Marina del Rey and Ballona Creek, for example, where it's widely agreed upon that the source of contaminated sediments at the marina entrance channel and at the mouth of Ballona Creek is indeed Ballona Creek, it's been estimated 725,000 cubic yards is identified as contaminated with pesticides as well as heavy metals and PAHs. And the good news on that front is that a vast majority of that has been just recently dredged up and disposed of at the Port of Long Beach slip fill project, but normally that costs approximately a hundred bucks per cubic yard for disposal. I think that's important to note as well.

We see this sort of accumulation of sediment frequently at Ballona Creek, as well as the L.A. River. We actually have seen circumstances where the marina channel, entrance channel, has been shut down where boats can't get in and out because of sediments coming from run-off, as well as we've seen the Catalina Shuttle shut down for some period of time because of shoaling at the mouth of the L.A. River.

The high flow rates caused by urban run-off can cause ecological impairments. We've seen that in a number of different regions, Malibu Creek Watershed. We've seen sedimentation erosion (inaudible). Malibu Surfrider Beach is the most polluted beach along Santa Monica Bay. That would be because of Malibu Creek and the watershed around it. A great deal of habitat degradation, stream bank erosion, slope instability, those sorts of things caused by high peak loads of run-off causing problems within that watershed.

On water quality impacts of increased population, imperviousness, a lot of this work has been done by the Center for Water Protection, Tom Scheuler (phonetic). I think you got quite a bit of the material submitted from the January hearing. You see things like increase in peak discharges, increase of volume run-off from storms, increase in run-off velocities, the increase in the frequency and severity of floods, reduced stream flow during dry weather due to reduced infiltration, and then reduced infiltration and groundwater recharge.

On ecological impairment, you can see biological integrity gets reduced and the (inaudible) assemblage is reduced diversity as well as loss of sense of species, and that's directly related to increased impermeable area within a given watershed. Similar research has been done within the state of Ohio as well as the state of Washington.

Then the final slide, the role of new and redevelopment in creating the problem. When you have increased stormwater pollution, you have high volumes, high velocity of surface run-offs and high concentrations of pollutants within the run-off. By creating these impervious surfaces, obviously developments with a dramatic effect of increasing quantity and quality of stormwater run-off. In fact, in a lot of work that Tom Scheuler and others have done, you really start seeing permanent adverse effects ecologically on that 10 percent impervious surface within a watershed or subwatershed.

That's the extent of the comments that I have. There's a couple of things I sort of want to clear up from earlier testimony. One is as an aside.

The San Gabriel Valley has been drinking infiltrated stormwater for over three decades, the Whittier Narrows and Montebello Forebay Project. That's something that I would just like you to know. That's specifically stormwater and reclaimed water that's used for groundwater recharge there.

On catch basin filters, there's been a lot of discussion as well. Michael Stenstrom, professor from UCLA, could not make it for today. A lot of people expected him. In the study that has been completed, I might add, contrary to popular belief, roughly 80 to 85 percent pollutant removal efficiency for oil and grease and PAHs for absorbent filters. This was done in a lab. There's also been about a year's worth of work in the field where they've taken absorbent and run the tests in the lab again after the material has been out in the field for sometime.

Lastly, on the Tree People's infamous Tree People slide that keeps popping up, and I can't believe this one got in this, the Tree People house was designed -- are you guys ready for this -- for a 133-year flood. This is not like your typical storm. The fact that everyone is talking about cost of cisterns and those sorts of things, obviously you're missing the point of the whole Tree People exercise. This was a 133-year storm.

BOARD MEMBER BROWN: That was for a 133-year storm. How is that different from the three quarter inch?

THE WITNESS: Three-quarter-inch storm, if I'm not mistaken, is less than the one-year mean event storm, the average storm for a year.

BOARD MEMBER BROWN: You put information on economics and that was appreciated, particularly the broad scale. That helps us. I would suggest that you've also put up some good slides showing the concerns and the shape of Malibu Creek and such.

One thing that we've worked hard on is trying to do watershed master planning as opposed to addressing specific issues. We get a lot of mandates ourselves and try to address TMDLs and streams programs that we get that are individually submitted to the state that we have to respond to individually as opposed to trying to do watershed master planning, which is the thing that you mentioned, water, soil conservation, grasses and that range on down to control of what the homeowner may or may not do.

So with that in mind and with the information that you have submitted that the problem is evidently very real -- and I don't think anyone is doubting that -- the question that I have and has been presented here several times is, how best can we fix it. And I didn't hear anything on that from you and I'd like you to, if you have something on it that relates to watershed master planning, as an example, or the limited dollars that we have as a community in order to address these issues.

And when you go ahead and piecemeal things like we have had to do on this state level because of mandated programs, we really question if we are spending our dollars that we have in the most efficient manner possible, where if we had the opportunity to do master planning of watersheds, we would have a higher level.

So the question begs, with your knowledge and background on this information, is what we're asking these people to do, is that the best expenditure of all of our efforts and money or is there a better way of addressing the issue and earning more for our investments?

THE WITNESS: In answering the question, my organization -- I've been involved in numerous watershed planning efforts, as Mary Jane can attest to. I've chaired the steering committee for the Santa Monica Bay Restoration Project as well as I've been involved in that since its inception. I've been part of the Malibu Creek Watershed planning forever, and our founder, Dorothy Green, is the chair of the L.A. San Gabriel River Watershed Council.

Our point on stormwater is that there is no one magic bullet in solving this problem and one of the focuses here is not on all the other factors that are within the stormwater permit. We are literally focusing on new and redevelopment here today. In that regard, I honestly believe based on my background in this field that putting new and redevelopment standards in place where it's a heck of a lot easier to do it at the new and redevelopment stage to implement BMPs that are effective there rather than going back to retrofitting and built-out facilities and buildings is a very, very smart way to go in reducing pollution coming off of urban areas.

So we strongly believe that and our organization has been involved in finding out more about this tomorrow. I co-wrote Santa Monica's ordinance with Craig Perkins and their city attorney's office back in 1992, and we've learned a lot more about the real world experience (inaudible). Santa Monica was a success there.

CHAIRMAN BAGGETT: Any questions from Board Members, staff?

Cross-examination.

THE WITNESS: This will be nothing compared to the deposition I just had on the DDT shelf.

MR. MONTEVIDEO: I hope that's the case, Dr. Gold.

CROSS-EXAMINATION

BY MR. MONTEVIDEO:

Q. Good evening, I guess it is by now. My name is Richard Montevideo and I'm with the petitioners.

A few questions. First, there was some discussion about that Tree People article and that is a study that was done by the Tree People. Do you recall --

MS. JENNINGS: If you want to stand up, could you hold the mike please?

MR. MONTEVIDEO: I'll just sit down.

Q. Do you recall the size of the cistern used in that experiment?
A. Not off the top of my head.
Q. Would it surprise you -- would the number 3600 gallons surprise you?
A. I've seen it and it's pretty substantial. I wouldn't be shocked by that. And again, it's for the 133-year storm. It's not for a three-quarter-inch storm.
Q. So you think that 3600 gallons is a substantial cistern?
A. For water storage on a single-family home, yeah, probably.
Q. How much -- there was some discussion earlier today about the amount of run-off from a quarter acre. Do you have any estimates as to the amount of run-off from a three-quarter-inch storm over 24 hours?
A. It's a little late in the day. I don't think I'm going to be doing math answers right now.
Q. So you can't answer the question?
A. No, I could, I just would have to go back and calculate it out.
Q. Can you give me a ballpark?
A. Three-quarter-inch storm, so --
MR. HELPERIN: Objection. The question calls for speculation. If you would like Dr. Gold to do the calculation, he can do the calculation, but I don't think it makes sense for him to make a guess right now.
CHAIRMAN BAGGETT: I would sustain the objection

unless you've got it off the top of your head.

THE WITNESS: I don't have it off the top of my head.

CHAIRMAN BAGGETT: Sustained.

Q. BY MR. MONTEVIDEO: The cost of the Tree People study, I believe that cistern was $10,000 for the product itself and the installation. Do you recall that being the case?

A. I've talked to Andy Lipkis, and obviously Andy is the President of Tree People, if you don't know. That was designed especially for that particular site, and so it was literally put together as a one-time manufactured unit. If there was a mass-produced unit, I know I've heard him say that would come down to about two or three thousand bucks.

Q. Let's take a look at the article.

If you look down at the bottom of the article it says, "Lipkis said the cost of installing similar recycling systems could be reduced to about $10,000 per home if a manufacturer can be found to mass produce the cisterns."

Does that refresh your recollection?

A. No. I've talked to him subsequent to that and he thought it would come down dramatically even more, but he's not here to verify.

Q. So you don't agree with the number that's in this newspaper article.

A. It's not what Andy has told me.

Q. Okay.

A. I would like to reiterate that the design of this was not just for stormwater purposes. It was also water conservation purposes and that was really one of the major points of the system was to reduce water --

Q. You understand that the cost is being attributed direct to what Mr. Lipkis said; correct? The $10,000 is being attributed to what Mr. Lipkis said.

A. Right, two years ago.

Q. Is it true that the three quarters of an inch standard was developed by the NRDC and the County of Los Angeles?

MR. HELPERIN: Objection. Calls for speculation. Lack of foundation. Dr. Gold has no basis for knowing that.

MR. MONTEVIDEO: If you don't know, just tell me, Dr. Gold.

CHAIRMAN BAGGETT: Can you answer the question?

THE WITNESS: I don't know. I'm not sure if that's exactly where it was determined.

Q. BY MR. MONTEVIDEO: Let me see if I can refresh your recollection. This is an article that showed up. It's a part of the administrative record. I believe it was also submitted. In addition to being part of the administrative record, I believe it was also submitted as part of the NRDC's documentation. It has your name at the end as the co-author?

A. Right.

Q. Did you co-author the article?
A. Yes.
Q. Do you recall when you wrote this article?
A. I don't recall the exact date. I'm sure it's on there somewhere.
Q. I just don't see it, so I'm asking.
A. Sometime in January.
Q. Of this year?
A. Yeah.
Q. Okay. Do you see the reference to the proposal before the Board is based on one developed by the Natural Resources Defense Council and Los Angeles County to address the pavement equals pollution reality? Do you see that?
A. Which paragraph? I'm sorry. Yeah, I see it.
Q. Does that refresh your recollection on who developed the three-quarter-inch standard?
A. No. That refreshes my memory on what's in the article. That might be an overly simplistic assessment. I'm not really sure where it was exactly developed since I'm not a party to the lawsuit.
Q. So you didn't necessarily draft that particular part of the article?
A. No, actually I didn't.
Q. Okay. I don't know unless I ask the question, Dr. Gold. You drafted other parts but not that part?
A. I -- yes. Just yes. Yes, I did not write that part.

Q. "Yes" is good. Is it true that the three-quarter-inch standard was the standard that in your discussions with Mr. Dickerson -- let's back up.

You did have discussions with Dennis Dickerson, the Executive Officer of the Regional Board, about the three-quarter-inch standard; correct?

A. Among many other things in relation to stormwater issues, yes.

Q. Is it true in your discussions that you informed Mr. Dickerson that you would not go below three quarters of an inch of rain?

A. Yes, that's true.

Q. Is it --

A. And the rationale was because the environmental community unanimously agreed that a three-quarter-inch storm was already a compromise and all of us wanted at least a one-inch standard.

Q. So because of that, you refused to go below three quarters of an inch of rainfall.

A. Because the precedent had been set with the L.A. County already agreeing to the standard.

Q. Is it true that this standard came out with settlement discussions with the county as far as you know?

MR. HELPERIN: Objection.

MR. MONTEVIDEO: Again, I'm just asking for his knowledge, Mr. Chair. If he doesn't know, he can tell me.

THE WITNESS: I really don't know.

Q. BY MR. MONTEVIDEO: Do you recall attending a meeting with Mr. Dickerson -- by the way, for the record, what I have on the screen right now is a series of one page of notes dated 10-1-99. It says with NRDC SUSMPs. These notes came directly out of the administrative record. They are identified as tab 5 or something in that range of Volume 2 of the administrative record.

Do you recall having a meeting with Mr. Dickerson sometime in October where you were discussing the SUSMP that was in issue?

A. I don't recall. I'm seeing names like Rich Horner, et cetera. I don't know who was at the meeting. I meet with Dennis and can attest to I'm at the Regional Board pretty much twice a week. I'm not sure. I probably did or didn't.

Q. You should work there, I guess. You see the reference to the three-quarter-inch standard -- three quarters of an inch was reached after settlement discussions closed. Do you see that right here?

A. I see that on the screen.

Q. Do you recall any discussions of that nature in your meetings with Mr. Dickerson?

A. I don't recall.

Q. Okay. Is it your opinion that the same standard that applies to regular development should be the standard that should be applied to all redevelopment within the subcategories, that is you think there shouldn't be any distinction between the standards used for new development versus redevelopment?

A. Using the definition of redevelopment that exists within the SUSMP, yes. Not all of it. There was a lot of discussion about redevelopment and if someone added just a little porch or something, that that obviously wouldn't constitute redevelopment. There was a great deal of discussion on what actually redevelopment was.

Q. Well, if somebody added a porch on a hillside home, would that constitute new development?

MR. HELPERIN: Objection. Vague and ambiguous. Is Mr. Montevideo asking if that would constitute new or redevelopment under the permit, which would call for a legal conclusion, or is he asking if that is the definition that Dr. Gold was using when he made his prior statement?

CHAIRMAN BAGGETT: Sustained. Would you rephrase.

Q. BY MR. MONTEVIDEO: When you made your prior statement that putting in a porch was not redevelopment, what is that based on?

A. What I was stating was, just to refresh your memory, was that there was a great deal of discussion of what redevelopment was. And in fact, if I'm not mistaken, there might have been a change the day of the hearing or a couple days before the hearing on what redevelopment was.

R0073877

So the point was that your general initial question, which was do you think it should apply to all development and redevelopment, I was just trying to get a clarification on redevelopment.

Q. Understood. But then you made the comment about the porch. Was that based on your understanding of the SUSMP definition of redevelopment?

A. It was in the discussion 50 percent of -- I can't remember exact off the top of my head, but something like 50 percent of the whole developed area or something like that being impermeable.

Q. It's your opinion the standard should be the same regardless of whether it's new development or redevelopment?

A. Right. New development, significant redevelopment, correct.

Q. Is it your opinion that that's consistent with what's happening across the rest of the country?

A. I would not be able to answer that question. I don't know.

Q. Again, Mr. Gold, if you don't know, just tell me.

A. That's what I did.

Q. Okay. But your counsel keeps jumping up and down.

MR. HELPERIN: That's fine. There is a principal about laying a foundation before you ask a question. If Dr. Gold has no reason to believe it, I'm going to object on foundation. He can also say that he doesn't know.

CHAIRMAN BAGGETT: You'll have an opportunity to address the legal questions to the legal witnesses tomorrow, so if you could.

Q. BY MR. MONTEVIDEO: Do you -- is it your opinion, Dr. Gold, that -- there's been a lot of discussion today about some hypotheticals and some actual realtime examples, but I want to get your technical opinion on whether somebody living, for example, in the city of Rancho Palos Verdes puts on a new roof should have to comply to the same standard as a new gasoline station going in around the corner from that home. Is that your opinion?

A. I think -- are you asking a regulatory opinion? What are you asking?

Q. Technically do you believe that somebody putting in a new roof in an environmentally sensitive area should have to comply with the same technical standard that a new gas station going in around the corner should?

A. But you're asking me to make the presumption that somebody putting on a new roof and lives on a hillside that's going to be applicable to, and that's hard for me to believe.

Q. Assume that the SUSMP is applicable to that scenario.

A. I can't make that assumption. That's not how I read it.

Q. I'm asking your technical opinion on whether or not you think, in fact -- do you have the same concerns with pollutants from a hillside residence who's putting in a new roof versus a gasoline station going around the corner?

A. They would be different pollutants but the concerns I would have for a hillside development would depend on where, if it's in an ESA, depending on the slope of that particular house and the pad in which it is, it could cause significant erosion and sedimentation problems in downstream habitat. It could be sensitive habitat. So that would be a concern there.

At gasoline stations, I would be much more concerned about contaminants that are gasoline or automotive repair related which are more things like PAHs and metals and those sorts of things.

Q. So you have greater concerns with the gasoline service station?

A. No. I have different concerns, not greater.

Q. Would you apply -- do you think the same standard should be applied?

MR. HELPERIN: Objection. Vague. When you say "the same standard," there are lots of different types of standards. Are you talking about the numerical standard? Are you talking about what types of BMPs should be applied?

MR. MONTEVIDEO: Numerical.

MR. HELPERIN: Numerical. Numerical sizing standard? Numerical for effluent limits? What kind of numerical standards?

CHAIRMAN BAGGETT: Sustained as vague. Clarify.

Q. BY MR. MONTEVIDEO: In your opinion, you believe the same .75 numerical design standard as referred to in the L.A. SUSMP should be applied?

A. Yes, I do. But the beauty of the standard is that it doesn't say thou shalt only infiltrate, thou shalt only treat. It gives you an option there, not to mention it gives you a list of literally a couple of dozen, if not more, BMPs that are designed to basically remove different sorts of pollutants and that's really the flexibility that one would use in deciding what to put on that particular development.

Q. So I own a home. It's 2,000 square feet. It's on a 5,000 square foot lot. It's primarily all hardscape. How do I comply with the SUSMP program?

A. The beauty is I don't think you have to.

MR. HELPERIN: Objection. How would you comply with the SUSMP calls for a legal conclusion.

MR. MONTEVIDEO: Mr. Chairman, I would like to hear the testimony of Dr. Gold.

CHAIRMAN BAGGETT: I would sustain that. I wish you would get an opportunity to the legal witnesses tomorrow. You're dealing with a biologist who is an expert and stated his expertise.

MR. MONTEVIDEO: I believe this is a technical issue. I'm really trying to figure out --

CHAIRMAN BAGGETT: It's an engineering issue.
MR. MONTEVIDEO: If Dr. Gold can't answer it --
Q. If you can't answer it, then just say so.
A. I'm a water quality expert. I actually did in my sort of flippant manner. You basically gave me a single-home scenario that just doesn't -- I don't see in the permit.
Q. I'm the homeowner. I've been told it has to apply. How do I comply with the standard? Just help me out.
MR. HELPERIN: Objection.
THE WITNESS: It's the same thing again.
CHAIRMAN BAGGETT: It's the same.
MR. MONTEVIDEO: Mr. Chair, with all due respect, it is really a technical issue. If he doesn't know how to comply --
THE WITNESS: I'm saying it's not applicable.
CHAIRMAN BAGGETT: He's answering the question. I don't know what else you want.
MR. MONTEVIDEO: It is a hypothetical. I've asked him to effectively assume that it will apply, and I'm asking him how he will apply the standard. So for purposes of a hypothetical --
CHAIRMAN BAGGETT: I'll sustain the objection. Let's move on.
Q. BY MR. MONTEVIDEO: You're a UCLA graduate?
A. Three times over.
Q. Three times over. Did Mr. Swamikannu also go to

UCLA?
A. Yes.
Q. Did you happen to be schoolmates?
A. Yes, we were.
Q. And you mentioned Dr. Stenstrom.
A. Yes.
Q. Was Dr. Stenstrom your professor at the time?
A. He was a professor.
Q. One of your professors?
A. One of my professors, one of many.
Q. Was he also one of Mr. Swamikannu's professors?
A. Yes.
Q. How long ago -- how far back do the three of you go?
A. About a dozen years or more. 12, 14 years.
Q. Is your relationship with Mr. Swamikannu pretty strong?
MR. HELPERIN: Objection.
THE WITNESS: I'm married with three kids. I don't know.
MS. JENNINGS: I don't think there's any probative value. I'm sure 27,000 other people went to UCLA, too.
CHAIRMAN BAGGETT: What is the objection?
MR. HELPERIN: Relevance.
CHAIRMAN BAGGETT: I would concur.
Q. BY MR. MONTEVIDEO: Let me ask you this, Dr. Gold. I presume you have a very good working

R0073883

relationship with Mr. Swamikannu that goes back to your school days; is that correct?

A. It's pretty good.

Q. And it goes back a ways?

A. Yes.

Q. Does he often rely upon your work in his work?

A. No, as a matter of fact. That's something I've talked to him about.

Q. You've got to get that straightened out, don't you. Do you know if he relied upon your work in connection with this three-quarter-inch standard?

A. I can say unequivocally he did not.

Q. He just happened to come up with the same standard on his own?

A. You're going to have to ask him.

MR. MONTEVIDEO: That's all I have.

CHAIRMAN BAGGETT: Thank you.

Mr. Welch.

MR. WELCH: A couple of questions.

CROSS-EXAMINATION

BY MR. WELCH:

Q. Mr. Gold, are you aware of any studies that have compared the cost-effectiveness of implementing the source control and structural control BMPs such as in the task force BMP guide for gasoline stations to the treatment BMPs that the SUSMP would require?

A. Not laid out like that. The most recent study

R0073884

that I'm aware of was the USEPA funded ASEE work that was done basically looking at a wide variety of BMPs in a wide variety of different sources, looking at basically pollutant removal and efficiency. The cost data on that was just pretty poor.

Q. And you also mentioned a study by Dr. Stenstrom relating to filters?

A. Yes.

Q. You didn't participate in that study; did you?

A. No.

Q. You don't have a copy of that study here today; do you?

A. No, I do not.

Q. Are you familiar with it?

A. It was done under the auspices I think partially under the Santa Monica Bay Restoration Project, if I'm not mistaken, but I know most recently the County Department of Public Works has been using it a lot to make determinations on which BMPs would make the most sense for new development and redevelopment.

Q. Are you familiar with the November 1999 study that was done for the Sacramento Stormwater Management Program relating to filters?

A. No, I'm not.

MR. WELCH: Mr. Chairman, at this time in rebuttal I would offer the Sacramento Stormwater Management Program November 1999 report in rebuttal to the testimony of Mr. Gold's UCLA study. And I have

copies here. I've made copies for the Board.
MS. JENNINGS: Is that by Larry Walker?
MR. WELCH: Yes. It is Larry Walker Associates.
MS. JENNINGS: Just to let the Board Members know -- we should hear from the other people. That is something that we certainly have and I don't know the value, but I think it is probably something we already have and wouldn't have a problem with it.
CHAIRMAN BAGGETT: Is it in the records someplace?
MS. JENNINGS: I don't think it's in the record, but it's sort of widely known. Anyway --
MR. HELPERIN: I'll object to the extent that's not already in the record, the introduction of exhibits that were not in the record.
MR. LEON: I would object on the matter that he hasn't clarified at exactly what point or points Mr. Gold has spoken to that this would rebut. Is it just in general throw it into the package or what?
MR. WELCH: Certainly I can clarify that Mr. Gold testified and referred to a study by Dr. Stenstrom at UCLA on the effectiveness of filter inserts in controlling stormwater run-off pollution. I believe he testified that they had 80 to 85 percent effectiveness. The November 1990 study that I referred to, it was done for the Sacramento Stormwater Management program, evaluated the effectiveness and data that existed for a number of different types of these filters

and found that the data that is in existence did not support the claims that were made by the manufacturers of the filters and for the efficiency of removal and found that none of the filters that were available to test on the market were considered acceptable.

THE WITNESS: I haven't reviewed that study, so I can't really say anything about it.

CHAIRMAN BAGGETT: I'll allow its admission into evidence.

THE WITNESS: I was going to say one thing. The field has changed dramatically on that particular BMP in the last few years. So that's something you should be apprised of.

MR. WELCH: I'll distribute copies of the study. It's a November 1997 study.

CHAIRMAN BAGGETT: Thank you, Mr. Welch.

Mr. Leon.

MR. LEON: Thank you.

CROSS-EXAMINATION

BY MR. LEON:

Q. Mr. Gold, I'm Jorge Leon, the Regional Board's counsel.

A. Greetings.

Q. How are you?

A. Fine.

Q. We've heard some testimony earlier that oil and grease in stormwater is not an environmental concern. Do you have any comments on that?

A. Oil and grease is often used during monitoring really as a surrogate for PAHs poly (inaudible) hydrocarbons, which are a major concern in stormwater. They have very, very high toxicity. They're carcinogens. Many of the PAHs and some of the hot spots and some of the impaired waters are listed near storm drains because of PAHs. So I think they are indeed a very significant concern.

Q. Thank you. We also heard that the numerical mitigation measure will address the issue of beach closures which result from pathogens in dry weather flow. Do you have any comments on that?

A. I think to some extent they will and not necessarily -- not the closures -- if you're familiar with L.A. County and their closure policy and with AB 411 and the State Health Department standards, there's really only a mandatory closure in the event of a sewage spill, but what you have in essence is permanent postings because of high bacteria counts in the surf zone. And with obviously more development, there's a lot more pets that people aren't cleaning after, a lot more restaurants where you have restaurants mats that are being hosed down and all the high bacteria counts that are associated with that.

So increased urbanized areas usually lead to much, much higher bacteria counts. As a matter of fact, if you look at the monitoring of L.A. County beaches over the last 10 years, invariably the most polluted beaches are adjacent to storm drains.

MR. LEON: Thank you. No further questions.

CHAIRMAN BAGGETT: Thank you, Dr. Gold.

I would prefer -- I think I would propose to counsel that we go to redirect and recross and allow 10 minutes for closing statements tomorrow. Is there objection to that? That will be the ruling.

Second issue tomorrow, the way I see we've got an hour and 30 minutes of cases-in-chief, we've got 40 minutes in closing statements. That's a little over two hours. We still have two other cross-examinations potentially. What we could do is we could try to get started at 8:00 if you want to guarantee that we will be out by lunch. Is there a preference to the parties to accommodate?

MR. LEON: We would prefer 9:00.

MR. HELPERIN: We would prefer later.

CHAIRMAN BAGGETT: Also I would prefer -- we need to have a closed session tomorrow.

MR. MONTEVIDEO: My only concern with starting at 9:00, if the Board is planning on finishing at noon regardless of what happens, then I --

CHAIRMAN BAGGETT: We've come all the way down here. That's why we're going late. We're trying to accommodate. We will have enough time. 9:00, 9:30 is that easier for traffic? 9:00?

MR. LEON: Everyone is saying on this side of the table 9:30 would be a little better because we're going to have to deal with setting up the tables again.

MS. JENNINGS: I think we can leave the tables.

MR. MONTEVIDEO: It would be nice to finish up as soon as possible, I guess.

CHAIRMAN BAGGETT: We will go with 9:00 because it's noticed. We have one last witness who will not be here tomorrow?

MR. MONTEVIDEO: Dee Zinke will not be here tomorrow.

CHAIRMAN BAGGETT: Do any of the parties have questions or anything else?

MR. MONTEVIDEO: Also, Mr. Chair, I should point out I did not catch Ms. Ferraro. She was our last witness. She was here for a minute ten seconds roughly. I'm going to have to attempt to make calls.

CHAIRMAN BAGGETT: Is that a problem?

MR. HELPERIN: Who was the witness?

CHAIRMAN BAGGETT: Mrs. Ferraro.

MR. MONTEVIDEO: Do you have any cross-examination?

CHAIRMAN BAGGETT: Does she need to return tomorrow?

MR. FLEISCHLI: We do have just a few questions.

MR. MONTEVIDEO: I didn't catch her before she left and I don't know if I can get her back tomorrow or not.

MR. HELPERIN: It's not critical.

CHAIRMAN BAGGETT: With that, let's continue so we can get -- I would like to leave in 15 minutes myself.

DEE ZINKE,

recalled for cross-examination, was examined and testified further as follows:

CROSS-EXAMINATION

BY MR. FLEISCHLI:

Q. Steve Fleischli, Santa Monica BayKeeper.
A. Pleased to meet you.
Q. Pleased to meet you. I wanted to ask you a couple of simple questions and they will not be nearly as arduous as DDT.
A. Good, since I'm not a Ph.D. in anything.
Q. Fair enough. You're here representing the Building Industry Association?
A. Yes, sir.
Q. Excuse me?
A. Yes, I am.
Q. Can you tell me, is the Building Industry Association a trade group?
A. Yes. It is a non-profit trade association for the construction industry.
Q. Can you tell me how many members of BIA you represent or how many construction companies or builders BIA represents?
A. I represent one chapter of the BIA Southern

California and that chapter has about 400 company members which equates to about 12,000 active volunteers.

Q. And do you know in terms of those 400 company members what the gross revenues are for those organizations?

A. No, I don't. In fact, it is an extremely wide variety. About 10 percent of our members are in the development end of the process. We go all the way down to individual interior design shops, banking, plumbers, subcontract roofers. It's a very huge disparity in our membership.

Q. In terms of the overall total that you represent, not each particular one of the 400, is there any --

A. I don't have a number off the top of my head, no.

Q. So you would not have a number of the net profits of those organizations?

A. No, I would not.

MR. FLEISCHLI: Fair enough. I'm done.

CHAIRMAN BAGGETT: Any other?

MR. LEON: No.

CHAIRMAN BAGGETT: Mr. Welch.

MR. WELCH: No.

CHAIRMAN BAGGETT: Any other? If not, we are recessed until tomorrow morning at 9:00 where the Regional Board will be up.

* * *

STATE OF CALIFORNIA

I, Terri L. Emery, CSR 11598, a Certified Shorthand Reporter in and for the State of California, do hereby certify:

That the foregoing proceedings were taken down by me in shorthand at the time and place named therein and was thereafter transcribed under my supervision; that this transcript contains a full, true and correct record of the proceedings which took place at the time and place set forth in the caption hereto.

I further certify that I have no interest in the event of the action.

EXECUTED this **8th** day of **AUGUST**, 2000.

Terri L. Emery

R0073893

BEFORE THE STATE WATER RESOURCES CONTROL BOARD

STATE OF CALIFORNIA

PETITIONS OF THE CITIES OF BELLFLOWER, ET AL., THE CITY OF ARCADIA, AND WESTERN STATES PETROLEUM ASSOCIATION (REVIEW OF JANUARY 26, 2000 ACTION OF THE REGIONAL BOARD, AND ACTIONS AND FAILURES TO ACT BY BOTH THE REGIONAL BOARD AND ITS EXECUTIVE OFFICER PURSUANT TO ORDER NO. 96-054, PERMIT FOR MUNICIPAL STORM WATER AND URBAN RUN-OFF DISCHARGES WITHIN LOS ANGELES COUNTY)	SWRCB/OCC FILES: A-1280 A-1280(a) A-1280(b)

TRANSCRIPT OF PROCEEDINGS

June 8, 2000

9:00 A.M.

Community Meeting Hall
Torrance Cultural Arts Center
3350 Civic Center Drive
Torrance, California

REPORTED BY:
Terri L. Emery,
CSR No. 11598
Our File No. 1-64807

R0073894

APPEARANCES:

STATE WATER RESOURCES CONTROL BOARD

ART BAGGETT, Chairman
JOHN BROWN, Board Member
MARY JANE FORSTER, Board Member
PETER SILVA, Board Member

OFFICE OF CHIEF COUNSEL
BY ELIZABETH MILLER JENNINGS
P.O. Box 100
Sacramento, California 95812-0100

FOR CITIES OF BELLFLOWER, ET AL. AND CITY OF ARCADIA:

RUTAN & TUCKER
BY RICHARD MONTEVIDEO
611 Anton Boulevard, 14th Floor
Costa Mesa, California 92626-1950

FOR WESTERN STATES PETROLEUM ASSOCIATION:

MAYER, BROWN & PLATT
BY LYMAN C. WELCH
190 South LaSalle Street
Chicago, Illinois 60603-3441

FOR LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD:

LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD
BY DENNIS DICKERSON, EXECUTIVE OFFICER
320 West 4th Street, Suite 200
Los Angeles, California 90013

STATE WATER RESOURCES CONTROL BOARD
JORGE A. LEON, SENIOR STAFF COUNSEL
901 P Street
P.O. Box 100
Sacramento, California 95812

FOR NATURAL RESOURCES DEFENSE COUNCIL

NATURAL RESOURCES DEFENSE COUNCIL
BY ALEX N. HELPERIN
6310 San Vicente Boulevard, Suite 250
Los Angeles, California 90048

FOR SANTA MONICA BAY KEEPER

SANTA MONICA BAY KEEPER
BY STEVE FLEISCHLI
P.O. Box 10096
Marina del Rey, California 90295

I N D E X

TORRANCE, CALIFORNIA, JUNE 8, 2000 - 9:00 A.M.

* * * * *

CHAIRMAN BAGGETT: We're back in session. Where we left off was the Regional Board's case-in-chief.

MR. LEON: Good morning, Chairman Baggett and Board Members.

We will go ahead and start off today with testimony from Dennis Dickerson and then I will follow with some legal comments, coverage of some of the legal issues that have been discussed in the petition.

We'll start off with testimony from Dennis Dickerson, the Executive Officer, and he will talk about the development of the SUSMP and many other issues related to the issuance of the document. I will cover legal issues and Dr. Xavier Swamikannu will follow me discussing the technical basis of the SUSMP. Following him will be our Chairman, Mr. David Nahai, with the Board Member perspective.

With that, we'll start off with Dennis Dickerson.

DENNIS DICKERSON,

having been previously sworn, testified as follows:

STATEMENT OF DENNIS DICKERSON

MR. DICKERSON: Thank you and good morning, Mr. Chairman, Members of the State Board.

For the record, I am Dennis Dickerson, Executive

Officer of the Los Angeles Regional Water Quality Control Board.

Last January the Regional Board adopted a proposal for controlling the pollutants contained in stormwater run-off. Aspects of the plan are now being challenged, and today's hearing will consider the basis on which our Regional Board took action.

As we go through this hearing, please keep in mind this appeal does not represent all the cities who are permittees. Indeed, it does not represent the principal permittee, the County of Los Angeles, nor the largest municipality, the City of Los Angeles, and I should note that I personally appeared before the City of Los Angeles, before the Council, to argue the need for the SUSMP and they wholeheartedly agreed with that proposal. Nor does it consider the next largest, the City of Long Beach. With the City of Long Beach we entered into a long series of negotiations with respect to the resolution to litigation. They had appealed the first permit, the '96 permit, and as a result of some very difficult negotiations, we ended up with the City of Long Beach adopting even the more stringent permit than you are considering through the SUSMP here today.

Of 86 permittee cities, only 33 representing about 18 percent of the Los Angeles County population chose to challenge the plan. The remainder are pursuing the necessary steps to implement the plan by October 8th, 2000, and in particular I would like to point out tomorrow there's going to be a workshop sponsored by the County of Los Angeles Department of Public Works to specifically discuss the implementation of the SUSMP that you're considering today. It's my understanding that there are some 400 people who are scheduled to participate in that workshop to talk about the technical aspects of the SUSMP proposal. I'm going to skip that slide.

When you view the Los Angeles basin from above, you see a vast expanse of developed lands. The buildings, roads, parking lots and sidewalks all serve to convey stormwater to the ocean as quickly as possible, altering the natural system that once allowed for infiltration and the wetlands that acted to delay the passage of fresh water to the ocean. The 10 million people who now live and work in the L.A. basin today knowingly or unknowingly contribute to the detritus of urban life which contaminates our stormwater. This contamination is a serious problem that threatens the public health and the environment.

To begin, we would not be here were it not for the serious problem southern California faces regarding stormwater pollution. We know from monitoring data that urban land uses generate large loadings of pollutants including toxic metals which in turn form toxic hot spots and sediments. Litter is ever present and at times is discharged in volumes in huge floating rafts of litter that repeatedly soil our beaches.

Oil drippings from cars, fine copper dust from the wearing away of auto brake pads, wastes in every description, unless intercepted, all find their way to the storm drain system, our rivers, and ultimately our beaches and the ocean. This fact we cannot escape.

The urbanization of land is inherently polluting. More development, absent the mitigation measures before you, will inevitably result in greater pollutant loading.

Monitoring data from Los Angeles County clearly identifies the problem of incredible magnitude. Here we see that average seasonal loadings of critical pollutants from the City of Los Angeles are measured not in pounds but in tons. The City of Los Angeles represents 29 percent of the pollutant load. The remaining jurisdictions contribute an additional 71 percent of the total, dramatically increasing the loading of these critical pollutants.

A recent report by the Southern California Coastal Water Research Project documents impacts of stormwater run-off on the receiving waters of Santa Monica Bay, and this particular report was introduced to you yesterday briefly.

The study reviewed data from 1996 through 1998 with a focus on Ballona and Malibu Creeks. Key results from the study show that stormwater plumes persist up to three days, show product toxicity in nearly every sample collected, and is toxic up to two miles offshore and that zinc and copper are the contaminants most responsible for that toxicity.

In addition to the immediate effects that contaminated water cause, offshore sediments are also contaminated with various pollutants and this is documented more than one mile offshore. And here on the next slide you see a cloud of surface layer toxicity extending outward from Ballona Creek nearly two kilometers following a storm event that occurred on or shortly before December 10th, 1996. The area shown in red portrays the areas most affected by chronic toxicity.

The study also shows that the results of stormwater pollution can be seen for months and years following discharge as contaminants become trapped in offshore sediments. The SCCWRP study documented sediment contamination more than one mile offshore.

Litter is also a significant pollutant and is so prevalent that this region has invoked enforcement of the notice to meet and confer provision over the Los Angeles County municipal stormwater permit finding that the existing stormwater management plans are inadequate to resolve this problem. We are using the notice to meet and confer provision of the permit as intended, to address violations of receiving water standards and to address a serious condition of nuisance.

Not surprisingly, many of our waters are listed on the federal 303-D list of impaired waters. There are hundreds of individual listed impairments. Coliform, litter and heavy metals and various organic compounds have found their way onto this list. Here you see a few of the specific impairments that apply to the L.A. River, Ballona Creek, the Long Beach Harbor and Santa Monica Bay.

Southern California's beaches are world class. They are part of our state and national cultural heritage. Millions visit our beaches each year and our coastal economy is valued at over $2 billion each year. Sadly, the value of beaches is best understood when they are no longer available for use. Last year's crisis with the polluted Huntington Beach highlights the serious impacts that stormwater and urban run-off can have on the local economy. People do get ill when they swim in contaminated waters.

Recently the southern California beach crisis has reached such a level of concern that it has reached the editorial page of the newspapers and editorial cartoons.

So do we need to do something to address this problem? Clearly the answer is yes, and I find it lamental that the penalty for being engaged in a dialogue, trying to work with people and trying to find a solution and being open and responsive is thrown back, taken out of context, and used as a rally device to suggest that our proposal has no credibility.

As you know, the mechanism for addressing the stormwater problem is the Los Angeles County Municipal

Stormwater and Urban Run-off Permit. This permit is found (inaudible) contained in the Clean Water Act amendments of 1987 and recognize the need to address stormwater by creating a current process in which each municipality would be obligated to control stormwater pollutants to the maximum extent practicable.

The obligation to address new development is clear and it's a clear requirement of federal law and regulation. We must have a plan in the permit that addresses this topic. The current permit was adopted in 1996 and built on an earlier permit adopted in 1990.

It is now ten years after the first permit was adopted, and the time has clearly arrived for the development community to share in contributing to the solution of stormwater pollution as envisioned by the 1987 Clean Water Act.

Within the findings of Board Order 96-054 is a clear statement of purpose that BMPs be required to be used that reduce pollutants so that the discharge of stormwater will not cause violations of water quality objectives nor create conditions of nuisance. We know that run-off of existing developed areas do not meet this criteria.

Our expectation is that new development will apply mitigation measures to limit the contribution of additional pollutant loadings to the maximum extent practicable. The SUSMP's content is prescribed by the permit which sets clear expectations for what a SUSMP will cover. Significantly it clearly states that it be designed to reduce run-off volume and that developed land retain, where practicable, permeable surfaces.

Additionally, stormwater controls are to be identified. Stormwater filtration and storage are to be maximized using a variety of techniques, and parking lot pollution is expressly required to be minimized in that definition.

Development controls to address stormwater pollution are necessary and essential to minimize the additional pollution that would be inevitable if new practices and designs are not adopted. Development controls reduce the need for costly downstream solutions, are consistent with our requirement to allocate our loads to non-point sources through the TMDL program, and are consistent with the State Board's recently adopted non-point source pollution control plan.

Page 117 states in part before development occurs, a number of pollution prevention and treatment options such as setbacks, buffers or open space requirements can provide treatment of the inevitable run-off and associated pollutants.

The SUSMP is one of the means by which the non-point source plan is to be implemented in the Los Angeles region. As approved, the SUSMP contains specific requirements for various categories of development shown here on this slide. The SUSMP affects new and substantial redevelopment, the latter being triggered by a 5,000 square foot threshold. It establishes a fundamental principle that run-off on newly disturbed land shall not result in an increase in run-off that would increase erosion and natural drainages.

This was an item that was contested yesterday, but I would like to note that that is the language that was submitted by the permittees themselves. We have not altered that in the final document. The SUSMP applies to the maximum extent practicable federal standard for reducing pollutants of concern.

As approved, the SUSMP contains provisions for parking lots and environmentally sensitive areas. As I noted, parking lots were expressly included in the SUSMP definition. Their absence in the original proposal submitted by the permittees required their inclusion in the December draft the Regional Board staff issued.

Environmentally sensitive areas are also added as a category. Please note the permit does not preclude additional development categories from being listed in the SUSMP, and it is clear that discharges from developments into these areas pose special obligations and concerns.

The SUSMP also contains design criteria for BMPs which requires those best management practices to mitigate pollutants from the specified volume of water. While several options are provided to calculate this volume of run-off, for developed areas this translates to three quarters of inch of run-off in a 24-hour period.

It is important to note that the run-off volume is dependent upon the amount of land developed versus that which is left in a natural state.

The intent is to ensure that run-off from impervious areas is adequately managed to remove pollutants. If more land is left permeable, the lesser volume of run-off is required to be managed. The lesson is clear. The more the land is altered, the greater the responsibility of the developer to ensure the project is inherently controlling the pollutants.

It is important to note that the Regional Board has not ordered the use of any specific BMP. What the Board has done is to say that the most polluted stormwater run-off must be subjected to some form of mitigation to reduce its pollutant loading. The Board separately adopted a list of BMPs that can be used to fulfill this requirement. What was lacking at that time was a design criteria; that is, to say how much water must the BMP be able to mitigate to be effective.

If you know what your most polluted run-off will be, or rather if you know that your most polluted run-off will be the first flush, which we generally agree to be the case, it is only common sense to make a BMP large enough to address that portion of run-off which is most polluted. Higher volumes will contribute more pollutants, that's sure, especially litter and sediments, yet these higher volumes are expressly allowed by the SUSMP to pass through.

A limit of three-quarter-inch volume criteria is well within the maximum extent practicable criteria that we must apply. Further, as you have already heard, even more stringent criteria are in use in other jurisdictions.

Much has been made about the retention capture consequences of the SUSMP. Let's remember that capture is only one option. Filtration is also an option that obviates the need to hold large amounts of water and the costs associated with that approach.

The Board carefully considered and included provisions that allowed design criteria to be waived under certain conditions which would make their application impracticable. These include limitations of adequate space, unfavorable or unstable soils, risk of groundwater contamination, or any other reason upon approval of the Executive Officer. I would like to really emphasize that point because it provides a great deal of flexibility to the SUSMP.

The waiver provision provides that appropriate flexibility and recognizes the existence of conditions where the design criteria structural or treatment BMPs are not appropriate. Additionally, the SUSMP allows permittees to accept a registered P.E. or licensed architect certification that the development plan design meets SUSMP criteria. This substantially reduces the cost of implementation and allows for in essence a system that is transparent in implementing permittees.

There is no unfunded mandate imposed on cities by this program. Because of its long-term vision, the payoff from investing in the SUSMP approach would be realized mostly in the future as the relative percentage of affected property increases over time. I've called the SUSMP to be designed for the future because pollution control benefits will mostly be realized as new and redeveloped property reduces, but certainly not eliminates, stormwater loadings. The SUSMP provisions will mean that our future communities will be inherently less polluted as compared to today.

Perhaps most telling of the petitioners' mind set is the offer made in good faith to include a rooftop exemption. My hope in proposing the idea was to offer a compromise. The rooftop exemption would have, in effect, dramatically reduced the effect and size of the three-quarter-inch design criteria. By excluding a substantial portion of run-off volume from a given area, run-off that should arguably contain fewer pollutants, the BMPs could be smaller and so less costly.

Even so, even this concept was not embraced by the petitioners, and absent my strong endorsement -- absent rather any strong endorsement at the public hearing, was not carried into the final SUSMP as approved. So I asked if even this approach was unacceptable to the petitioners, would any design criteria be acceptable to them? I think you heard their answer yesterday.

So in the final analysis, what is a BMP? It is a fiction or a reality? To be the latter for a BMP to be effective, it must meet some objective design standard.

The Regional Board and its staff have invested a large amount of time for consideration in this matter. In addition to the formal process outlined here, we held numerous meetings with petitioner cities, the BIA, in formal and semi-formal settings to explore the issues associated with the SUSMP. These meetings were augmented with many phone calls and formal conversations. Any suggestion that adequate public notice was not offered is without merit.

While it is suggested that the design criteria were the result of last-minute changes, they were fully discussed at the September 16th Regional Board hearing, discussed in meetings with permittee and BIA representatives, and noticed in the December SUSMP draft proposal. It should also be noted that an early draft prepared by the permittees themselves contained numerical design criteria for BMPs.

The Regional Board SUSMP adoption process was offered. The permit expressly allows for the Regional Board to approve elements of the permit at a public hearing affording public review and comment. This provision supersedes the authority for approval of a SUSMP by the Executive Officer and clearly establishes the finalcy of the Regional Board over the modification of plans which become an enforceable element of the permit.

As early as April 1999, the Regional Board asserted its interest in and intention to be engaged in the SUSMP provisions. Here I would just like to diverge for a moment and clarify one point that was made yesterday having to do with the submission of a SUSMP proposal to the Regional Board at the last minute as was argued.

There was a change sheet that was provided to the Board the day of the hearing and that was in response to many comments that we received, and often we received comments at the very last minute and up against the gun, trying to get those changes in place. In that particular instance there was so many changes, mostly minor in context, but we wanted to make sure the Board had a document, a strike-out version that showed what those changes were rather than having to flip back and forth and figure that out. So that particular document was provided to the Board. It was not provided to everyone else in the audience. We simply didn't have time to pull that together. So that explains what that document was.

One thing I really do want to note is that it appears to me, at least, the petitioners accepted the primacy of the Regional Board's action by appealing the Regional Board's decision within the statutory 30-day window allowed for such appeals, and our legal counsel will be addressing that and other issues shortly.

The Regional Board did modify the SUSMP from that submitted by the permittees. Rather than being inappropriate, that is exactly the authority that is invested in the Board for them to exercise. In contrast, the permittees believe it is necessary to reach consensus and what should be required of them is permanent. The petitioners assert that they, not the Regional Board, determined what criteria meet the maximum extent practicable language and consequently what the permit requires. That result is demonstratively wrong.

Now Dr. Xavier Swamikannu will follow me and provide technical information with respect to the program.

CHAIRMAN BAGGETT: We have a couple of questions.

BOARD MEMBER FORSTER: When I ask questions, it doesn't count. Well, I agree with you, Dennis, about why you probably had to redo a document so the people could understand. We all are also subject to people giving us things at the last minute, and trying to incorporate them into big decisions is nearly impossible. You have my sympathy.

A couple of things, Dennis. I remember at your hearing, since I sat in the audience, that you had some exemptions that were proposed and they weren't well received by some of the interested parties, but I don't remember what those exemptions were.

MR. DICKERSON: I think the principal exemption was the rooftop exemption, and the effect of the rooftop

R0073912

exemption really would have been to reduce the three quarters standard significantly because what you would have done is you have taken that portion of surface area from the rooftop, and provided you had a situation, and this is written in the proposal, that you were able to take that run-off from the roof and run it directly into a storm drain, which would not have affected any erosion issues such as we have in L.A., you can run it right to a storm drain and released any increased volume into the channels. It wouldn't flow over a parking lot, it wouldn't pick up additional contaminants.

That was the idea and that would have dramatically reduced the need to design bigger BMPs. I should note, though, that since actually that hearing, I did attend a meeting where some results of a deposition study were discussed and that that study we talked about or it was relayed to us the aerial deposition perhaps is having a much more significant effect. So I think in hindsight it's something that might not have been pursued so aggressively on my part.

Another provision that is in there with the waivers, those waivers allow for quite a bit of flexibility on the part of the permittees and it especially addresses groundwater that has come up in discussions here. The whole purpose is to avoid that exact issue.

BOARD MEMBER FORSTER: Did the cities -- in the original proposal, did the cities have the power of a waiver and then the Board requested it review instead of the cities?

MR. DICKERSON: The waiver has -- the waiver has two provisions in it, and I probably need to go back exactly, but I think there was some waiver provisions plugged in automatically which the cities can adopt now. And there are provisions, additional provisions, which they can come to the executive board's, or rather the Executive Officer, and say here's a good case for an additional waiver and give us the authority to do it and that's provided.

BOARD MEMBER FORSTER: My only concern with that is that it would be easier for the public to be able to get a waiver directly from the city when they're doing a plan than to have to just stand in line and wait until you could get to them.

I have a little sympathy for -- I was a Planning Commissioner for people who go get a loan, want to build something and have to wait for all the permits and are paying on the loan. I'm just looking for what is the most efficient way to help a member of the public get a waiver if they're entitled to a waiver. This is not to dilute the purpose of what you're doing, it's just to make things more efficient.

MR. DICKERSON: We really did build in quite a bit of flexibility for the local community to address that.

BOARD MEMBER FORSTER: The last question I have is did you -- did you -- how did you go about redevelopment, in-fill low income housing? Did you labor over that like how would you trade off the unintended consequence of trying to redevelop in areas where it's very low socioeconomic and you're trying to keep the cost of houses down and trying not to add any additional expenses?

MR. DICKERSON: With regard to redevelopment, there's a provision in the permit, or rather the SUSMP, that talks about 5,000 foot threshold. So really what you're talking about there are properties that are really quite significant in terms of how much redevelopment is going on. And I think that particular notion would really exclude a large portion of that affect on lower population or lower income areas.

It was of great concern to the Board. The Board transcript, which I reviewed again this morning, the Board talked about affordable housing, how they affect that area, and they were very concerned and wanted to address that.

BOARD MEMBER FORSTER: Thank you.

BOARD MEMBER BROWN: Dennis, the concern I have is that we don't trade one problem for another. I understand that containment facilities, really cisterns or otherwise, to help knock the peak off storm falls and reduce velocities through channels, downstream erosion in downstream locations, but obviously single-family homes and individual homes it is a very expensive way of doing that and it's probably not the main purpose of why we're doing this, I would suggest. Maybe I ask.

Assuming that the main concern that we have is water quality and not the responsibility of water quantity peak flows, if the concern is water quality, that can be divided up into two major concerns, suspended solids and dissolved solids. The suspended solids can obviously go without being taken care of and that's one concern, but the more major concern that I have is the copper, the zinc and the benzene and MTBE and the materials that are dissolved in which filtration, as you know, will not have any affect at all, and if we are constructing containment zones or infiltration zones or percolate this as some of the BMPs, then the concern I have is that we're trading a surface quality problem for an eventual groundwater quality problem.

I'm trying to visualize in my mind what BMPs at a service station, as an example, other than the prevention of bad things happening, what BMPs can we go ahead and request or require that they do that would not swap the surface water problem for an eventual problem. That's one question. Let me ask a couple more. Go ahead and respond to that.

MR. DICKERSON: Thank you. I think the most critical facet of the whole system program is flexibility. We are not prescribing what BMP is used under any specific situation; neither is the Regional Board prescribing what the effectiveness of the BMP should be.

The assumption is that there is -- by allowing developers really to review common practices, by going to workshops like tomorrow, they are going to be able to identify what are the best BMPs to apply in a given situation. We don't get into that. We allow them to make those judgments and decisions based on best engineering practices and we don't even presume to get into that.

BOARD MEMBER BROWN: My background is in civil engineering. I worked for over 30 years. I'm just having trouble from that experience and trying to visualize something that we could force upon the proprietor that would not, as I say, swap one problem for another other than retention and reduction of the peak flows. You can do that and that's a concern, but that's a minor concern compared to the dissolved chemicals, benzenes and MTBE and such that we are faced with. Granted, something needs to be done.

I just want to make sure that what we're asking people to do is the right thing to do. It's a lot of money. I don't have the comfort feeling that we're there yet and what we're requesting or how we're requesting it could be accomplished. Something needs to be done, yes, but is your comfort level to the point that where we really know what needs to be done and we can start forcing the public to regulation to make these kinds of expenditures?

MR. DICKERSON: We know that, for example, sediments carry along with them a large portion of metals that we're concerned about, and so filtration really is going to address the large particle problem.

BOARD MEMBER BROWN: Granted the suspended solids, yes, and that's of a concern, but of a magnitude greater is dissolved.

MR. DICKERSON: I don't think there's any question about that, but we do not mandate through the SUSMP that that dissolved portion necessarily be the BMP or BMP be selected to address that problem. Any BMP that helps to deal with the problem overall is acceptable.

BOARD MEMBER BROWN: Well, no. No, it isn't. BMP, as an example, one of them is the containment or the filtration percolation. That's a BMP. And as an example, to me filtration and percolation would not be acceptable on a service station site. Period.

MR. DICKERSON: If it's not appropriate to be used, that's at the discretion of the developer.

BOARD MEMBER BROWN: That's different.

MR. DICKERSON: To say that's not appropriate for that spot.

BOARD MEMBER BROWN: I agree, but that's different than your statement previously was that any BMP would be beneficial. So my point is that we need to know which ones are appropriate and which ones are not. That's part of the issue. Single-family homes for retrofit and rehab, how do you feel about exempting those as a start? You can always add them later and see how the program addresses that, but there was some pretty good testimony. And regardless of whether you're low income or medium income or, I guess, high income, what's your feeling as far as exempting single-family homes?

MR. DICKERSON: Any exemption of any particular category is always an option and that was something that was before the Board for consideration. The real magnitude of some of the issues that we're looking at clearly do call for BMPs and I think that's a judgment call that really has to be made.

BOARD MEMBER BROWN: Thank you.

BOARD MEMBER FORSTER: One more question. I don't understand the discretionary, non-discretionary. I don't know if you're the one to answer that or Jorge or Xavier. So I guess what I don't understand is was discretionary and non-discretionary there from the beginning of your SUSMP that you modified and proposed to the Board? Was it added that day? I don't know what it means. I know what discretionary means, but I don't know what non-discretionary means.

MR. DICKERSON: I was looking at the transcript this morning and the non-discretionary, discretionary issue was addressed by the Board at the hearing, so it was part of the proposal. In essence we're talking about this morning, and it appears that really we don't have any substantial effect because of the categories we're talking about. The categories are such a magnitude really that they're almost all discretionary. I'm not sure it's a distinction with a great difference, an initial reaction.

BOARD MEMBER FORSTER: Well, I think the thing I heard yesterday was -- it was the porch example. If somebody wanted to add a porch they had to do something, and it was my opinion that is not what our goal is.

MR. DICKERSON: Right. And I think we were shaking our heads saying, "What's going on with that? That doesn't sound right."

BOARD MEMBER FORSTER: Okay. So maybe we have to look at that non-discretionary and define it better that we don't mean porches. That's all I have for right now. Betsy will help me. Maybe somebody else can bring that into their discussion.

MS. JENNINGS: I'm not sure if my questions are really for you, Dennis, or I can certainly defer them, but I think along the same lines when you got into discussions of things like porches, and I know you all were shaking your heads and saying no, we didn't mean that. I'm a little confused by two areas of definitions and I would like to have that addressed as to at least what you meant and whether it says what you meant.

The first is redevelopment. You just a few minutes ago indicated about 5,000 square feet. I have to say when I read this it seems to say creation of 5,000 square feet or 50 percent impervious surface, I guess regardless of the size, or making improvements to 50 percent of the existing structure. I don't know if that means increasing the land or just doing something to 50 percent, it could be all indoors. I think it's important for this Board to know at least what you intended and then maybe deal with what it actually says.

I guess the other aspect of that was for the environmentally sensitive areas, and I think this is also where we got into the porch idea. What type of project in an environmentally sensitive area do you mean to talk about because it's location, which the petitioners' attorney brought up, rather than type. I don't think it's totally clear, at least to me at this point. Is there a threshold that you're talking about occurring in an environmentally sensitive area and did the Board have an intent on that and does the language used actually express that intent?

MR. DICKERSON: I'll defer both of those to Xavier and Jorge. I agree we're looking at that as well.

CHAIRMAN BAGGETT: I have three questions, and you can defer these if you feel it's appropriate.

Does the Long Beach -- how did the Long Beach plan deal with large areas of retail gas outlets?

MR. DICKERSON: The SUSMPs were incorporated into -- the SUSMPs that were adopted by the Board in January were incorporated into the Long Beach permit by reference. It was part of the settlement that we made with them. When the SUSMPs were adopted by the Board, they became effective for the City of Long Beach as well.

CHAIRMAN BAGGETT: So they accepted the December draft or were they aware of your final adopted SUSMP?

MR. DICKERSON: They were there.

CHAIRMAN BAGGETT: When they cut the deal.

MR. DICKERSON: They were aware of the final SUSMP at the time.

CHAIRMAN BAGGETT: Which was --

MR. DICKERSON: It was some months before, and we considered -- that was June 30th of '99 we actually had that permit before the Board so that the final SUSMP wasn't even -- even the draft hadn't been submitted.

CHAIRMAN BAGGETT: So Long Beach didn't really adopt the rooftop issue or RGO issue or they didn't really discuss the details of some of these issues.

MR. DICKERSON: It was the final, but Long Beach did participate in the final discussions that went on before the Board at the time the Board adopted the SUSMP in January.

CHAIRMAN BAGGETT: I think you just talked about the 5,000 square foot threshold. I had questions on those. And I guess the remodel standard you just talked about. What triggers the standard for the SUSMP's application in a remodel situation?

MR. DICKERSON: I think that's the same point Betsy raised.

CHAIRMAN BAGGETT: The same. Any other questions? 38 minutes. Next.

XAVIER SWAMIKANNU,

having been previously sworn, testified as follows:

STATEMENT OF XAVIER SWAMIKANNU

MR. SWAMIKANNU: Chairman Baggett, Members of the State Board, my name is Xavier Swamikannu. I'm the acting Chief of the L.A. Region Stormwater Program. I was also one of the original state team members who developed the statewide strategy to implement the stormwater program pursuant to the 1987 amendments of the Clean Water Act.

In the matter before you I worked directly with our Executive Officer to provide management and oversight of the Board's Municipal Stormwater Permit program. I provided the technical expertise to support the Standard Urban Stormwater Mitigation Plan that is at issue here.

The SUSMP contains a numerical design standard for the sizing of BMPs. This sizing criteria was developed on stormwater run-off data for the Los Angeles area and utilizes methods recommended by the American Society of Civil Engineers and the Water Environment Federation in their manual of engineering practice. The criteria is not at all arbitrary or unscientific as claimed by petitioners.

The three-quarter-inch design criteria is based not only on good science and engineering principles but also on the experience of other states and jurisdictions that have adopted even more stringent criteria. In developing the three-quarter-inch criteria, we started with an empirical equation.

Here we see that the relationship between efficient treatment volume for a desired treatment percent, say 85 percent, is given by percent treatment coefficient multiplied by the area run-off coefficient multiplied by the mean precipitation volume. For southern California that result can range between 0.12 to 0.86 inch of run-off. In highly paved areas such as L.A., the value is at the higher end. For less urbanized areas, the value will be lower.

The American Society of Civil Engineers water and volume federation method utilizes the idea that there is a certain volume of water that can be captured or treated based on the nature of precipitation. Small rainfall events are common, while extreme flow events are relatively rare. To ensure maximum flexibility, four equivalent design standards or mitigation criteria for new development and redevelopment projects were included in the SUSMP. The ASCE method is the primary method and directly determines the volume of run-off that can be cost-effectively treated for water quality purposes.

The second method is similar and is described in the California BMP handbook. It uses the annual run-off volume capture method to calculate the volume of run-off that is to be treated.

The third and fourth methods are essentially the same. The three-quarter-inch rainfall criteria is a more specific statement of the 85th percentile rainfall value and uses the principle of diminishing returns.

On this graph the vertical axis represents cumulative rainfall run-off volume in inches. The horizontal axis denotes 24-hour rainfall events in inches. The graph shows that the largest volume of rainfall run-off is produced by rainfall events of less than one inch. The data for the plot comes from 50 years of precipitation records for the LAX area.

This graph shows the three-quarter-inch numerical design standard derivation for the Los Angeles region. On the vertical axis you have the cumulative probability of rainfall. The horizontal axis denotes the 24-hour rainfall totals in inches. The probability of a rainfall event equal to or less than three quarter of an inch is about 85 percent. The 85th percentile is the midpoint of the mean of the curve. The top of the mean of the curve would be indicative of the point at which returns start to diminish. The bottom of the mean of the curve would be about .6 inch and would represent a minimal effort.

Data for this plot was obtained from hundred year rainfall records for the downtown Los Angeles Civic Center station. This station is a representative station for Los Angeles County. Rainfall total in the Los Angeles area varies with geography. The closer one is to the mountains, the greater is the rainfall. In this graph, you see that the 85th percentile value would be higher for coastal areas in Los Angeles. In this case it is 1.2 inches for west Los Angeles, thus the value of a three-quarter-inch for the Los Angeles region represents an average value. Cities in the watershed can elect a different value so long as they use one of the methods. It is not one-size-fits-all.

Several other states have adopted design criteria for BMPs. Here you see the criteria for new development and redevelopment thresholds for three of these states -- Washington, Florida and Maryland. These states have years of experience behind them. In addition to several states, many more municipalities including Denver, Portland, Austin, Santa Monica, Calabasas and unincorporated Los Angeles County have implemented BMP design criteria for new development.

In general, the water quality design criteria and other thresholds for the L.A. SUSMP are less stringent than the other states. Our rainfall criteria of .75 inch compared to 1.3 inches for Washington. Our rainfall criteria is the 85th percentile rather than the 90th percentile or better for these states.

The redevelopment threshold for L.A. is comparable. Our requirements apply to only nine categories of development rather than for all categories of development as in these states. It is also important to note that the SUSMP does not impose any particular treatment control BMP.

Here we note the BMPs that one might choose to satisfy stormwater treatment requirements of the SUSMP -- a swale along the parkway, a detention basin integrated into the development as a scenic lake, catch basin and storm drain inlets to capture trash, among others.

In practice, a developer would select the project's source control and structural BMPs. The project plan will also identify treatment control BMPs capable of mitigating stormwater run-off from .75 inch of precipitation from the development after construction is complete. By mitigation I mean infiltration, capture or treatment. The selection of BMPs is left to the developer's discretion and the municipalities.

I will next address the cost analysis that staff conducted. The implementation of a federal regulation by a Regional Board does not require that a separate cost analysis be done. Nevertheless, staff worked with the City of Los Angeles staff to determine the cost of compliance for the design standards for a typical project, a five-acre $6.5 million dollar commercial development in downtown Los Angeles. The mitigation costs of the detention basin based on the numerical design standard worked out to less than one percent of the project cost. Details on the cost estimation are found in the administrative record.

Petitioners's testimony yesterday questioned the $33 cost figure for maintenance and cleanup. This is what it costs the City of L.A. Even if we increase the cost by a hundred times, it would still be less than one percent of the project cost.

In the second example for the same project, we evaluated costs for non-capture BMPs such as infiltration and vegetative swales. Again, cost including the design construction and maintenance amounted to less than one percent of the project cost. It is generally understood that water quality mitigation costs may reach about five percent of the project cost.

Our estimates were validated by testimony presented at the January 26th hearing by representatives of the environmental groups and the documentation that we included in the administrative record.

Designing for the future and for the environment can be cost-effective. Here we see a chart that identifies these cost savings. The vertical axis on the chart represents the percent change for conventional designs of a residential home subdivision. On the horizontal axis is the parameter of interest. As shown, the open space design reduces run-off by 25 percent and nutrient export by 40 to 50 percent. Development cost savings are from less piping, less concrete pavement, less street paving, less grading and similar infrastructure and development outlay savings.

Of special note, the Center for Water Protection in Maryland has prepared open space designs for residential development to reduce development cost by about 12 percent as opposed to the conventional design, and those references are included in the administrative record.

Similarly, the cost for development of a commercial shopping center using an innovative design as compared to a conventional design can lower the development costs as well. The innovative design achieves substantial reduction in impervious cover, surface run-off, and pollutant export. These designs are referenced in the administrative record and summary papers have been included in the Regional Board's exhibit supplement.

The Director for the Center for Watershed Protection previously submitted a comment letter to the Regional Board which is part of the administrative record on the subject of numerical design standards. The comment letter he writes that the design standards for L.A. are a fair, equitable and achievable threshold.

With respect to the experience of other states, we posed a series of questions to the stormwater program managers for the states of Florida, Maryland and Washington. One question was do water quality design standards impose undue burden and unsupportable costs. The Florida Department of Environmental Protection, which has the longest history of implementation, says it has not. The Maryland Department of the Environment adds the burden was primarily start-up costs that were to be expected. The Washington Department of Ecology comments that the cost of compliance was only incremental to development costs.

Another question we posed was have there been noticeable improvements to water quality as a result of implementation of standards and controls for new development.

The Florida Department of Environmental Protection responds that Florida's rule was substantially responsible for the reduced water quality impact on growth on receiving water quality in that state. Maryland answered that modest improvements in water quality were observed and expects more improvements once definite requirements are imposed with the new standards now. The state of Washington, the newest of the three, has of this time anecdotal evidence of improvements to water quality.

In summary, water quality BMP design standards and other SUSMP requirements for new development are founded on well established engineering principles and sound science. The ~~early~~ L.A. region's SUSMP requirements are not arbitrary and capricious as plaintiffs claim.

Several other states have clearly led the way, as has the County of Los Angeles and several L.A. municipalities. These municipalities, such as Santa Monica, have been implementing design criteria for new development BMPs for sometime. We should remember that the MS-4 program is a permit program with a clear statutory standard for compliance to reduce pollutants to the maximum extent practicable.

A consensus plan it is not, nor is it a

voluntary one. The burden of proof of compliance is on the petition, not the Regional Board. State Board Counsel Jennings' own memo on MEP discusses the comparative effectiveness burden of proof that petitioners must make, yet petitioners reject treatment control BMPs outright and attempt to shift the burden of proof to the Regional Board. None of petitioners have come up with a better document for scientific design standard for water quality other than challenging as unscientific that adopted by the Regional Board.

I am completed.

CHAIRMAN BAGGETT: Questions? Pete.

BOARD MEMBER SILVA: This is a question in follow-up to what Mary Jane asked earlier. I'm also concerned about the fact that lots of different cities try to implement the BMPs and getting back to design criteria but also some concepts like you have here. I notice your quotes about a manual and whether you had thought about perhaps having a manual put together by the different cities and then delegated authority for approval to them so we wouldn't get into this burden that we talked about earlier about the EO having to sign off on all these different exemptions. I was wondering if you had thought about that, was that included.

MR. SWAMIKANNU: There are a couple issues that you have raised. The first one is the idea of a manual developed by the Regional Board. What I do expect is probably similar to what has gone on in other municipalities like Denver where the design criteria, say 90th percentile or one inch, is developed and then the BMPs that ought to be considered are sized for that design standard. They are all put together in a manual.

In Los Angeles, as Dennis indicated, there's a workshop tomorrow and the intent is exactly that. We have not (inaudible) but engineers come there and explain how they would comply, what kind of BMPs, how they would be sized to meet this criteria. We have thought through that process.

I think what we are doing is basically committing the Regional Board to develop the manual. My understanding is that the County of Los Angeles, being the principal permittee, being committed to the three quarter of an inch will develop that manual and tomorrow's workshop begins that process.

The second question which you asked about these waivers request coming to Dennis and whether we really would be a bottleneck in the process, the permit itself has three or four specific situations like limited space, risk of groundwater contamination, and a couple of others where the waiver authority is already given to the cities, so long as that's the explanation and all BMPs are considered. The city then can issue the waiver right there. It doesn't have to come to the Board.

The situation where it comes to the Board is a situation where it's a condition that nobody has anticipated. So there was a request that that be a public process. One party might think it deserves a waiver, another might not. So in that situation that request is to come before the Regional Board. The Regional Board then can make a decision as to whether there's a sufficient condition for waiver and then release that authority to the Executive Officer and further transfer that authority back to the city so the next time around in the similar situation it will not come to the Regional Board.

BOARD MEMBER BROWN: I'll ask you the same question I asked Dennis with the concerns of the dissolved chemicals, zinc, copper, benzene, MTBE, the concern being that we don't swap one problem for another. Give me a couple of examples of BMPs that would raise the comfort level that we're not swapping a surface water problem for an eventual groundwater quality problem.

MR. SWAMIKANNU: I'll try and address it in three different ways. The first is the risk of groundwater contamination has been evaluated by the EPA and there's a document which says when is the risk high, when you should not infiltrate. We referenced a document in our report to say that's first we have to look at and clearly infiltration is not the solution.

The second aspect is for years the petroleum industry and consultants have argued that ~~when~~ you infiltrate in an area where the soil is favorable to microorganisms degrading petroleum hydrocarbon products, that's in use in some circumstances we're concerned with hydrocarbons. In some situations natural attenuation has been proven, so that's an option.

The third one is there are systems for dissolved, one example comes to mind is called storm ~~receptor~~ treat, and because the quantity of water we're talking about is not flood~~ing,~~ event it's the more common event that systems like that might -- that storm -- the simplest explanation is wetlands in a box. It's something used to remove dissolved. So if you design it for this criteria, it might affect dissolved components.

Remember, we aren't making the choices here. We're just saying when you have to clean up stormwater, what portion of stormwater, how much stormwater should you cost-effectively design a BMP for, and I think that's the design criteria for ~~solid wastes.~~ storm water

BOARD MEMBER FORSTER: Do you want to talk at all about the discretionary, non-discretionary?

MR. SWAMIKANNU: I was thinking whether I or Jorge should address it, but Jorge said he would.

BOARD MEMBER FORSTER: Do you want to talk about the threshold in the environmentally sensitive areas?

MR. SWAMIKANNU: The environmentally sensitive areas is the recognition that these areas are not designated by the Regional Board but by the State Board, the California Resources Agency or the County Planning Department. So the issue then is ~~is~~ should it be location driven. The answer is yes. Is ~~that~~ there a threshold? There's nothing in the permit, but what I would submit, I have had some discussions with ~~the~~ a city that they can define, it gives them the opportunity to define which projects in an environmentally sensitive area need to meet SUSMP requirements. That's not defined now but it's basically a location issue. Is it every project? No. Is it these nine categories? Definitely. Is it more than that? Yes.

I think that's where there's some room for defining what other projects in an environmentally sensitive area might need to have some kind of ~~an order~~ control to ensure that the sensitiveness of the environment is protected.

BOARD MEMBER FORSTER: So am I to understand that you're leaving that up to the cities to define?

MR. SWAMIKANNU: Yes. Not define environmentally sensitive areas but what projects beyond these nine categories need to be addressed because we did not discuss what additional projects. We think it has to be -- it is more than these nine categories, but specific projects are open to discussion. I'm not a planner, so I do not know what they would be.

CHAIRMAN BAGGETT: Questions from the staff.

MS. JENNINGS: I'm not sure -- are you saying that that's an idea you have now or do you think that the statement you just made with the cities can decide which projects in an ESA have to meet the SUSMPs, do you feel that's expressed right now in the SUSMP or something you're thinking about changing?

MR. SWAMIKANNU: I'm not saying that I'm changing. I think what's expressed in the SUSMP is -- if it's an environmentally sensitive area and you go before the Planning Commission, they have certain codes for stormwater. Now, the question is that every project that comes before planning? The answer is no. It's not called out in the permit. It's not -- I have not evaluated all the projects.

I think you have to think about how this process is going to work. Once the SUSMP is approved, the municipalities change their codes to make this happen. During that code change process, they can define what additional projects in environmentally sensitive areas would be subject to the requirements. So I'm leaving it up to the cities at this point because I don't have the expertise.

CHAIRMAN BAGGETT: Thank you. You have 24 minutes remaining.

JORGE LEON,

having been previously sworn, testified as follows:

STATEMENT OF JORGE LEON

MR. LEON: Thank you, Mr. Chairman. I was going to go ahead and talk a little bit about the environmentally sensitive areas, and the only thing I really want to add to what Xavier said is that the Board found itself sort of between a rock and a hard place because while the environmentally sensitive area was not in the permit as one of the originally listed categories, we thought about it and realized that the locations where these things were, these areas, where these categories are, that's what makes them receptive to special attention.

We had to apply the more stringent standards because they are environmentally sensitive areas. So the categories that are listed in the permit are by project type but this, of course, is a category created and characterized by the fact that it's an area that requires stringent attention.

The permit itself does not limit the categories. It says at a minimum the categories that are listed in the permit. You know, every once in a while the speakers bounce back and forth between the terminology in the SUSMP, and I hope you're keeping up with the fact that sometimes we've been using those words interchangeably.

The permit is the stormwater permit which created the requirement for the development of the SUSMP. I guess it's a little late to try to set terminology, but I hope it's been clear for you.

With respect to waivers, I'll try to respond to some of the questions that came up. I did want to tie the questions that Mr. Silva asked along with the questions that Mr. Brown asked and the answers to those questions because the waiver provision that's in the SUSMP does specifically name possibility of groundwater contamination as one of the grounds for the applicability of the waiver. So the SUSMP does give the cities the discretion to create a SUSMP waiver. When we run into the situation Mr. Brown has talked about, there is concern about transferring one problem to another problem.

CHAIRMAN BAGGETT: Does that apply to RGOs, gas stations, or can it?

MR. LEON: It can. It's up to the --

CHAIRMAN BAGGETT: Their engineer design by the permittees?

MR. LEON: Yes.

BOARD MEMBER FORSTER: On the more conservative side, what if all the -- there's a lot of groundwater basins in the L.A. area. How do we -- how do we monitor that the cities don't just decide that oh, that will contaminate? Are we going to have a criteria or something that protects a rampant amount of waivers where they're not justified?

MR. LEON: That's a very good point. The waiver provision does talk about a means of expanding the waiver capability, but it doesn't talk about sort of drawing back the authority once it's been issued, and what -- I'm glad you raised it because it's something that we need to think about.

Maybe we need to make clear that the proposed ordinances are reviewed by the Regional Board before they are issued and adopted so that there's some type of means of protecting against rampant waiver issuance in cases where it's not justified.

Another couple of questions that came up had to do with redevelopment clarification of the language regarding the development. I don't believe it was the intent of the Regional Board on the development in developing the SUSMP to require in that example, sort of a far-fetched example, but it's a legitimate question about if you just reroof your house and not adding anything on, does that create the responsibilities.

At the table this morning we talked about it and we do believe it will probably have to make some kind of a clarification on that issue because currently it could be read a couple of different ways.

Finally on the note of the issue of discretionary versus non-discretionary, discretionary is the term, as Mr. Montevideo pointed out in one of the overheads from the permit, that's used in the permit. The permit does talk specifically about discretionary projects but the permit itself didn't define discretionary projects. There's no clause that includes a description of discretionary projects, and the Board inherently in its authority has the authority to change the terms of the permit.

When the Board reviewed the SUSMP proposal, the Board determined that if we used discretionary projects only as the category that is made a part of the SUSMP impacts, then what we're doing is perhaps leaving a gaping loophole out there because perhaps more projects that people work on out there in developments and redevelopments are non-discretionary. So the Board was concerned about leaving that big loophole where activities and construction projects are occurring that need be administerial non-discretionary, and if that's the case where we're still having the same water quality impacts of the stormwater discharge from those properties, and so the Board took it upon itself to make the modification and expansion from the list of impacted sites as listed in the permit and added in the SUSMP non-discretionary projects.

BOARD MEMBER FORSTER: I want to ask another question. For me it's better to ask as you go instead of trying to pull it all together at the end. I think that there's an interesting point to consider here. I want to see if it's your opinion.

I still don't understand what non-discretionary projects are versus discretionary. I don't understand what discretionary means, CEQA and all of that, and what non-discretionary means and the homeowner who comes in to add a room on for the new baby. I don't understand the difference and I'm wondering if there's compromise -- as you're looking through your stuff, I'm wondering if there's a compromise the permit says discretionary, the permit is renewed in 18 months, if that's where you add non-discretionary.

I just need a better understanding of that myself. I'm just not satisfied that I understand it.

MR. LEON: Right. I guess it's sort of -- to paraphrase the question, your concern is whether perhaps this was the better way to go at this time or wait until we get to the permit reissuance phase to take care of several issues.

BOARD MEMBER FORSTER: No. My question is there's the big picture that we're trying to do here in stormwater control, new development and just, you know, the next category of the Clean Water Act. The big picture, the goal, the target. Then there's this micropicture and I'm wondering if the micropicture is the non-discretionary, that the unintended consequences of going into a fully developed city where somebody is coming in to do something to improve their home and all of a sudden they're under this permit. And I know about the 5,000 square foot threshold, but in some of the older communities they were lucky enough in the old days to have a decent sized lot. They're not all arm length apart.

So I'm just trying to justify in my mind what are you getting at with non-discretionary. If you're getting at that little homeowner, I'm not sure that's equitable. If it's something bigger that I don't understand, then maybe it's equitable.

MR. LEON: I'll take a stab at it, but I would also invite my colleagues at the table to take a stab at it too because I do understand that you're looking at

R0073941

what is the impact on that smaller homeowner.

My perspective of it is that the Board was trying to accomplish two things at the same time -- accomplish capturing those projects that legitimately create water quality concerns for the stormwater and, therefore, ought to be all-inclusive and brought in the non-discretionary projects, but at the same time didn't want to create the inequity that you're talking about and has left that issue to a great degree to the permittees to decide upon the waiver provision.

In fact, if studies bear out that there are impacts on, for example, low income housing, on smaller projects where somebody is trying to regroup or build a small porch, the cities can come to the Board, if they haven't already adopted it themselves, and ask for the acknowledgement and approval of such a waiver.

My outlook is that the Board has done what it can based on the information that it has to address the water quality issues in a more conservative way but has built in some mechanicism to try to avoid --

CHAIRMAN BAGGETT: Maybe this will clarify. I'm under the assumption you're talking about a discretionary permit or non-discretionary permit by the jurisdiction that's issuing that permit.

MR. LEON: Right.

CHAIRMAN BAGGETT: Non-discretionary permit would be non-discretionary permits the jurisdiction gives, they don't vote yes or no they're within the

R0073942

setback limits. You have a building permit. You want to build a house. It's within the prescribed setbacks, prescribed design for that area. They have to issue a permit. It's non-discretionary on the agency, I assume.

MR. LEON: That's correct.

CHAIRMAN BAGGETT: A discretionary permit would be say you go in and apply. Say it's a ten-foot setback. You apply for a five-foot set back. The Planning Commission has discretion under certain rules in certain jurisdictions, depending on what the code is for that city, to allow under their discretion to issue that permit.

That's what's triggering these requirements in the SUSMP. It's the permit is required by that jurisdiction. There's may be some jurisdictions I assume without uniform building and planning requirements. This is an administrative -- no matter what happens, this is not a simple thing because you've got all these different jurisdictions, different planning codes and building codes. And that's what triggers discretionary or non-discretionary, not the EOs.

MR. LEON: That's correct.

CHAIRMAN BAGGETT: I think that's where the confusion is coming from. It's like the term "permit" versus the term "SUSMP."

MR. LEON: Permit or local permit or the --

CHAIRMAN BAGGETT: Are you talking about EPA's permit for MS-4, are we talking about -- we're throwing around terms here that can be very confusing. But that's where the discretion is. The discretion is at the local level, not what triggered this depending on --

MR. LEON: I apologize for the lack of clarity. We at the Regional Board have been involved in this for so long, we have a pretty clear idea of what we mean by discretionary, non-discretionary.

CHAIRMAN BAGGETT: It's planning talk.

MR. LEON: We use planning talk.

CHAIRMAN BAGGETT: It's not law and engineering, it's planning.

MR. LEON: What I would like to do now is cover the major legal issues that have arisen, the petition as in our discussion yesterday and today, and in a nut shell, of course we have two sort of major categories. We have the category procedural issues. The Regional Board, it has adopted the SUSMP process and the petitioners have alleged that we've adopted using the wrong process and that we haven't stuck by the procedural rules that are applicable. And the other major category has to do with substance and I'll try to cover both of those or at least highlight the major ones. Some of these I'll skip through quickly and some I'll cover a little bit more fully.

One of the arguments that I would like to cover in some depth has to do with the administrative review process that's set forth in the permit. The administrative review process is at Section two, Roman

3-A or .A, and it is a process that's set forth in the permit.

The permit was created by the Regional Board. The Regional Board has authority to make modifications to its permits and to make changes in the requirements of permits. It created it. It can change it. The administrative review process doesn't take away that authority that the Board enjoys. And in fact, in this case, as this slide points out, the Board did take over, so to speak, the development of the SUSMP process by several actions that occurred.

First, in April of '99 -- it's not shown up there on that slide, but in April you heard that the Board approved the list of BMPs that are applicable to this area. Then in July the deadline for implementation of BMPs and the development of this SUSMP passed. Again, in September the Board had another hearing where the Board entertained that SUSMP proposal. At that time the Board made very clear to the Executive Director that the Board wanted to create the SUSMP proposal itself.

There's a big distinction in the administrative review process between development of the review process and enforcement of the SUSMP. Mr. Montevideo has made extensive argumentation about the Board's process and indicated that it's the permittees' view that the Regional Board was somehow locked into a process that's set forth in the administrative review process.

It's our view that the Board really wasn't locked into that process once those certain things that I talked about on the previous slide occurred -- the passage of the deadline, the fact that the Board indicated to the Executive Officer that it wanted to review the SUSMP material and act on it, and also the fact that the actual conduct of the parties was such that it became fairly clear that we were going to miss the deadlines on getting implementation to occur. It also was very clear that we were, in fact, running into the deadline for reissuance of the permit itself which was adopted in 1996.

The target that the compliance component of what we're talking about would still be subject to the administrative review process. In other words, if we decided to take some kind of action, we would then be required to invoke the notice to meet and confer process and move forward because that's explicitly what the process says. The Board made no mention ever of changing that part of the administrative review process, but it did take over the process in terms of adoption of the limits of the SUSMP. And in fact, as you've already seen, the Board decided to make several modifications to the proposal that was brought before by the Executive Officer.

Now, even if the petitioners were to succeed in their argument that the administrative process applies in a strict fashion, it's argued that the administrative review process was satisfied because the elements that are discussed in the administrative review process were all met. The parties got the protection that they were looking for in terms of due process. They got notification that the Board was not satisfied with the proposals that they put forward in July and August of 1999. They had opportunity to respond to the Board's proposal in July and August of 1999. In fact, they did. The July proposal was rejected, the August proposal was rejected, and it was replaced with a proposal from the Executive Officer and the Regional Board.

Now, the petitioners characterize that as having basically something shoved down their throat, but that's not at all what happened if you look at the actual process that's described in the record of this proceeding. Was there a meet and confer? There were many discussions. There was a workshop in August of '99 with this staff. It wasn't a Board workshop. The staff did participate along with the parties in a lengthy workshop where the details of the specifics of the cities' proposals were discussed. So the first three elements were covered. There was submittal of proposal and there was public review.

Was there Executive Officer response? There was. I don't know how the petitioners can stand up here before you and tell you that those proposals were ignored. Those were the very words used. They were not ignored. They were acted upon. They were reviewed, considered very seriously. They were amended and given back as a proposal for a Regional Board proposal.

Was there Executive Officer acceptance and rejection? Yes, there was. We just discussed that. The only thing that is missing perhaps is a 120-day notification of enforcement. We haven't got into that stage yet. It's premature to worry about that particular aspect of it.

Now, if we were to accept the petitioners' argument that we need to stick to the process, what are we doing? We're making sure that there's delayed implementation, buying into the petitioners' arguments that basically they need to have the last say in how the SUSMP is prepared and we're not moving along with the timing that's set forth in the petition for implementation of SUSMP protections.

More than that, in terms of the process, we're giving them an opportunity to give us an unending proposal, rejection, proposal, rejection, proposal rejection. That's not what we intended, that's not what the Environmental Protection Agency intended. And in fact, they provided several comments to us, particularly in the MPDS program review to say this is not acceptable. You can't keep going on this way. We do have to put a limit on this back and forth and move forward with the adoption of a SUSMP.

Ms. Forester, did you have a question?

The question has been raised whether the Regional Board exercised proper authority under the federal law and state law in adopting the SUSMPs and yes, it did. There is ample authority that's briefed in our response to the petition and also briefed by the environmental organizations that appear today as co-respondents, and we rely on the provisions that are set forth on the slide above and also upon (inaudible) versus USEPA, '92, and the Defenders of Wildlife versus Browner, a '99 decision which gives the Regional Board and the State Board, all the states that have delegated programs, substantial authority, substantial leeway in determining what it is that needs to be done in these programs.

The next several slides will discuss and point out what the changes are that were made at the January 26th, 2000 board meeting. As a board yourself, you appreciate that every once in a while you get a matter before you that can't be adopted exactly as it is but could be perhaps considered with some changes.

Some of the changes that were made were a little bit more significant than the others, and in my years of experience with the Regional Board, we have many instances -- I throw out a number something like maybe 50 percent of the actions that the Board actually considers in a hearing where we have to make some kind of change on the fly, so to speak, at the hearing itself.

Now, many changes that are made by a board at the hearing can be subject to an objection that there has not been adequate public notification. We're generally concerned but we have to make a call which of those are subject to more notice and which ones are not. It's my view that each of the changes that was made was the logical outgrowth of those draft SUSMPs that had been prepared earlier and distributed to the parties for their comments. That is the standard that's applied by the Regional Board to the State Board and administrative agencies in two contexts, in rulemaking and in adjudicative proceedings on permits.

The basis for using the logical output test is you don't want to have to go back and delay implementation for regulation or a permit merely because there was not enough notice to the public of a change that is seen to be insignificant. Of the changes that were made to this permit were items that were all noticed. For example -- let's see if I can find one here -- the applicability of the SUSMP is one of the first ones we have on the board, and here we raise that question about discretionary versus non-discretionary categories.

This gives me an opportunity to make a clarification with respect to the applicability of the discretionary and non-discretionary projects, again using those terms as defined at the local planning level. The SUSMP applies to non-discretionary permits if those non-discretionary permits are an enumerated item as this change makes clear. There was a final version of the SUSMP, with changes that were made, issued by the

Executive Officer in March of this year. That includes this very text and the text that will be shown in the next several slides.

There was a little bit of discussion about the applicability of the categories to the City of Long Beach. As you recall, City of Long Beach had to be treated separately and made a couple of changes at the hearing that made clear the appropriate applicability of the categories and the language to the City of Long Beach.

Here's a slide talking about the definition of the environmentally sensitive areas and elimination of the rooftop exemption. Some of these benefit the petitioners. Some of these, I guess, are seen as a little bit more arduous in terms of what the contents of the final SUSMP are.

I would like to digress to make a point here that I wanted to discuss. As was mentioned by Dennis Dickerson during his presentation, there was a change sheet that was distributed to the parties and -- I'm sorry. It was distributed to the Board Members at the January 26th meeting. Some of the arguments that are made by the petitioners have to do with somehow a non-fair process of a distribution of the changes. Sometimes that's just the best we can do, and that being the adjudicative hearing.

When changes are proposed at the last minute, the Regional Board is responding to comments that are being submitted by the parties, and while the parties did not receive a copy of the change sheet that the Board Members had in their hand throughout the proceeding, if you take a look at the transcript it was made clear to the parties through sort of an interpreter, Dennis Dickerson and myself tried to keep the audience up as to which changes were being made when the changes were occurring.

Here's a couple of the other changes having to do with limited exclusion for small restaurants and the waiver provision, a statement with respect to the effective date of the SUSMPs and there had been discussion about that. There had been discussion of the next one, the commercial development. So these were all subjects of logical outgrowth of what had been noticed before.

This is another topic now that we're moving on to. The petitioners argue that the SUSMP somehow needs to be subject to the Administrative Procedures Act with respect to issuance of regulations. As it turns out, there is a specific code provision and that's Government Code Section 11352 which says the following: The issuance, denial or revocation of waste discharge requirements or permits pursuant to Section 13263 and 13267 of the Water Code and waiver is issued pursuant to Section 13269 of the Water Code are excluded from the EPA provisions.

It's an APA process which culminates in a lengthy process that includes notice to the public, comment period, responses, and finally approval by the Office of Administrative Law. That process was never meant to apply to permits and is specifically excluded. The SUSMP is a creature of the permit and so it is exempt from the APA provisions.

This is the unfunded mandate argument. There are provisions that specifically say that if you have a federal law that's being implemented, it's not an unfunded mandate that you have to deal with.

Did the Board have authority to implement and adopt the SUSMP? It did. And I'll move on since that's briefed in our submittal.

This just sort of summarizes the process that occurred and the adoption process and it was the applicable procedural process. Real quickly touching on CEQA, there's an argument that CEQA applies. Well, I would suggest that it does not simply because again, there's an exemption since this is a part of the permit, 13389 says it doesn't have to be applied. Also I would note that I believe the cities probably didn't go through a CEQA process when they provided their proposal to us.

There's an argument that the process was unscientific and arbitrary, and I think that Mr. Swamikannu's statements and Mr. Dickerson's presentation has made clear that certainly it was not unscientific or unarbitrated.

13360 says that we can't tell them how to conform to the requirements. We didn't do that. We gave them choices. The permittees had choices, so we don't run afoul of 13360.

In conclusion, the Board properly adopted the SUSMP both procedurally and substantively.

Thank you. Any questions?

Thank you.

DAVID NAHAI,

having been previously sworn, testified as follows:

STATEMENT OF DAVID NAHAI

MR. NAHAI: Good morning, Mr. Chairman, Members of the Board. I'm David Nahai. I serve as the Chair of the Los Angeles Regional Water Quality Control Board. I want to thank you for this opportunity to make my presentation to you. My presentation as you know is in the nature of a summation. It isn't strictly testimony. I recognize that, but I've been grateful for the weight that you think my comments will merit. I'm going to thank you also for focusing attention again on really a problem in our region that is absolutely undeniable.

I'm not going to go back into the issue of run-off problem that you've heard a great deal about, and the petitioners don't deny it, don't attempt to deny it. Instead Mr. Montevideo is clearly saying that everybody recognizes that we have an urgent urban run-off need in this region that must be addressed and the reasons for the pollution are fairly clear. The chief factor urbanization, or one of the chief factors in any event. And what has happened with this region as urbanization has progressed, we have developed such vast areas of impervious surfaces that they act as a conduit for stormwater to end up at the ocean. It's estimated that 50 percent of our rainfall runs off into the ocean. In an area so heavily dependent on water, that is really a giant waste. But not only is it wasted, it provides a rapid delivery system for carrying the whole array of toxic contaminants to the ocean.

Now, the need to deal with run-off, with urban run-off, has been recognized for many years. This is nothing new. It was statutorily mandated in the Clean Water Act. The first municipal permit was issued ten years ago and in 1996 the permit was reissued. So I'd like to step back for a second and just take a look at the statutory framework that we have. It's all in place already.

The 1996 permit mandates the adoption of SUSMPs in the seven categories. To try to talk now about regional solutions or what may have been done on a regional basis in another jurisdiction is, I would submit, a luxury that we don't have. The 1996 permit as we have it mandates the adoption of SUSMPs for at least seven categories and that's where we have to start.

The issue before you is whether the Regional Board acted properly on January 26th, not on whether we're going to revisit the issue of at least a minimum seven categories that we have to address here. On that basis, just a couple of other things I would like to mention just to give you my perspective.

The petitioners themselves submitted SUSMPs. They complied with that process. To now come before you and throw out really what are red herrings such as CEQA or the APA or the unfunded mandate argument, if all of these were legitimate arguments they should have been addressed with the 1996 permit, not now when we're talking about implementation of a subset of permits. If these arguments really have any merit, why was it these were not raised when the petitioners submitted their own SUSMPs.

Their SUSMPs didn't have a rooftop exemption, didn't talk about vector control, didn't talk about the parade of horribles that have been marched before you today such as affects possibly on affordable housing and so forth. It's telling that just because the Regional Board added two categories and imposed a numeric standard that now all of a sudden CEQA is to be discussed and the APA, and all of these really don't have applicability here and I think we need to be careful about the red herrings that have been thrown out.

The small homeowner, let me please address my understanding of it. We have nine categories. One category affects the homeowner who's building a house. That is if that person is building a house on a hillside or possibly if they are located within an environmentally sensitive area. We don't have a situation where every homeowner who wants to build a house on a lot is going to have to go out and comply with the list of BMPs, and the example about what if I want to replace my sink in my shed, where am I going to put my SUSMP, let's try to really deal with reality here and not speculate in wild hypotheticals that don't have any application.

Mr. Leon talked about the whole issue of all of the discussions that were held and dealt with the various procedural challenges which the petitioners have advanced, but as a Board Member I really find it hard to believe how we could have had more scrutiny of this matter. We had two full hearings, board hearings, a full-day workshop. There were a whole bunch of meetings and telephone calls and formal and informal meetings with the petitioners and their representatives, and there's a record that I understand is so voluminous as something to fill an entire box.

The petitioners may disagree with the results, but they can't claim they weren't heard. I sat here yesterday and listened to everybody's presentation and it was deja vu, as they say, all over again because there really wasn't anything new that was offered.

After all of that consideration and all of the deliberations, we adopted a set of regulations. Some have described those regulations as being called little steps with little feet. In other words, there are many,

many people who consider what we have done is relatively modest given the problem we have to deal with. But apart from that, the truth is what we've known is not revolutionary and not radical and not new.

We've heard testimony of all the jurisdictions way ahead of us by years who have adopted regulations, seven states, not to mention all the municipalities, three within our jurisdiction. Florida's regulations go back to 1982. Santa Monica's regulations back to 1992.

Now, what we haven't heard in the last day or so has been any record or any evidence from any of these jurisdictions that the dire consequences which the petitioners predict have come true. No mass bankruptcies, no flight of capital, no explosion in property prices, no giant mosquitoes taking George Bush hostage.

So you know, I mean -- so when you look at the experience that a state like Florida has had over 20 years, I would really submit to you that we must let experience override speculation. We have examples to follow. We're not inventing the wheel all over again in connection with these regulations.

The petitioners try to portray the SUSMPs as being somehow anti-growth. I would submit that the intent is exactly the opposite. This is an attempt to facilitate growth, to accommodate it. If we don't take these as has been described little steps with little feet, at this time we may even have to resort to much more drastic measures in the future, drastic measures which will have a true detrimental impact on our residents, on affordable housing and what's more on future generations of builders.

I would suggest that the SUSMPs really embody the principle that the future need of the many should outweigh the present interests of the few.

Just a couple more comments. I think it's worth emphasizing that roughly two thirds of the permittees did not join in this petition. The two thirds that didn't join in this petition represent 82 percent of the population of this region. What you have before you is really in comparison a handful of cities representing just 18 percent of the population in this region. I think that majority, and you can call them the side of majority if you like, by not joining in this petition have really given a vote of confidence to what the Regional Board has done.

They're really telling us they're willing to go along with this, that they understand how important it is, that they're willing to invest in the future of this area. They think that a $2 billion coastal economy is worth protecting.

Finally -- and I have to say this. The very fact that we have these cities and this building trade association allied here in this way represented by one lawyer advocating an identical position before you really convinces me that the numeric standard that we imposed is not only appropriate, it's absolutely essential.

And the final thing that I would like to do is to just read from one sentence, actually two sentences that came in from the letter of the state of California. It says, "Complying with Florida's stormwater rule is a way of life that does not impose undue burdens on local governments or the private sector." The second sentence reads, "We have no doubts that the implementation of Florida's stormwater treatment program has greatly reduced the effects of growth in Florida on water quality and is a major reason why this state has so few truly impaired waters." I wish we could claim the same.

Thank you very much.

CHAIRMAN BAGGETT: Any questions.

BOARD MEMBER FORSTER: I have one, not of your commentary. Yesterday, David, the representative of -- one of the representatives from the building industry asked if the Regional Board would consider an advisory in looking at some of these issues and it would be a group, a committee, made up of the different interested parties. And since time goes quickly and your permit will be up again, I'm wondering if you're open to that. I think it would be what we -- what our acting Chair has done up at the State Board. We have a committee on TMDLs that was recommended through the new Chaney bill, where we might have a committee on water transfers.

We're going back to when I was on the Regional Board we did this to Region 9. We had a committee on dairies and one of the Board Members tried to sit in on that. When you have these emerging or issues that have been around but just haven't gotten as ripe as they're supposed to and you brainstorm and bring together people that want to come to some -- not a consensus. You can't get consensus per se, but some technical collaboration on best things to do.

You know, it's my opinion that that's beneficial and you know it would be up to the Chair to decide or the Board Members that they think that's valuable, as our Chair has decided.

MR. NAHAI: I'm not sure whether it's up to the Chair to decide. Let me offer this as an example.

There comes some point in connection with any kind of public policy setting where one has to take a look at the amount of discussion that's already occurred and the arguments which have already been submitted and just what extent it's been examined.

When we take a look at the state of affairs that we have here, we have to remember, for instance, that the seven categories that were already mandated in the 1996 permit. For someone to try to open that up again under some kind of guise I think would be really inadvisible. That's already part of the law. To talk about whether we have a run-off problem in Los Angeles is, you know -- those things are clear to everybody.

If somebody wants to have a discussion about whether the redevelopment clause is clear enough, I think yes, that can be discussed, of course. If somebody wants to talk about when we talk about projects within the ESA exactly what projects are we talking about, I think that can be discussed. But as I say, after all of the hearings, and this will be almost two days of hearings before you, and given the fact that we have such extensive experience on the part of other jurisdictions, to allow the problem now to just get worse while we continue to talk about it I think may be a mistake that we'll regret.

There is no argument about a 100,000 square foot commercial development having to comply. Why -- nobody here has appeared to say that that kind of project should be exempt. Why delay moving forward on that front while we discuss whether Mr. Montevideo's sink replacement in his shed is something that's subject to these regulations?

BOARD MEMBER FORSTER: I didn't want to interrupt you because you're so eloquent. That's not what I meant. I didn't mean --

MR. NAHAI: I wish you had interrupted me.

BOARD MEMBER FORSTER: I just don't know how many opportunities we'll get to talk again. I'm just bringing it up as something you might consider as you prepare for the -- not this. The Board will go through -- we'll have a process and we'll come out with a response to this petition. I'm talking about life after this particular issue. I'm talking about preparing for the reauthorization of the permit. I just think that was a good -- I'm sure you had them before and just because I don't know about it, I'm sure you had them. I'm just suggesting you might want to --

MR. NAHAI: I thoroughly agree with you. As a matter of fact, one of the priorities that this Board has set year after year is the outreach priority and to try as much as possible to get consensus, but there comes a time where you have to make a decision. We've got a responsibility to make a decision.

BOARD MEMBER FORSTER: We agree.

BOARD MEMBER BROWN: David, your summary was very powerful. There's a time that you personally have spent on this and the Board and has not gone unnoticed or unappreciated and thanks.

MR. NAHAI: Thank you very much.

CHAIRMAN BAGGETT: Any questions? If not, let's take a ten-minute break and come back with NRDC and spend 28 minutes and see where we go from there.

(Recess taken)

CHAIRMAN BAGGETT: Back in session. Let's begin to do cross-examinations before NRDC et al. finishes their cases.

Mr. Nahai.

MR. MONTEVIDEO: Thank you, Mr. Chair.

CROSS-EXAMINATION

BY MR. MONTEVIDEO:

Q. Good morning, Mr. Nahai.
A. Good morning.
Q. First I also want to express my appreciation for your time; not only today and yesterday but the time that you've put into this. I generally believe that you are very sincere in your beliefs in what you're trying to do, and the only thing I would ask is that you give us some credence for what our beliefs and our concerns are.
You had raised some issues with respect to the issues that we're raising now were not raised before and that these are, in fact, red herrings or some language to that effect is what you used, and that we're really trying to cloud the issues at this point.
Do you agree there are significant differences between the SUSMP program as submitted by the permittees versus the SUSMP program your Board actually approved?
A. There are differences, of course.
Q. The one primary difference we've talked about the last two days is the .75 standard. Isn't that true that wasn't in the permittees submittal?
A. That's true.
Q. Secondly, there's been a lot of discussion about discretionary versus non-discretionary. Again, the SUSMP program that was submitted by the permittees did not apply to non-discretionary projects; correct?
A. I don't know that that's correct. I think the issue here is that the 1996 permit didn't have a definition of what's discretionary. So you would have to

resort to CEQA or other statutes in order to draw that line.

Since it didn't have -- and I'm just talking for myself as one Board Member now. Since the issue of discretionary versus non-discretionary as far as the 1996 permit was concerned, was something that wasn't quite clear, I think the Board's thought was that there's really no difference in terms of water quality impact between a discretionary project and a non-discretionary project, and we shouldn't have a loophole in which projects could be labeled non-discretionary for SUSMP purposes particularly.

Q. And maybe, Mr. Chair, it's a question of having an understanding or as to what it means to have a discretionary project versus a non-discretionary project.

A. If your question is is it true that the word "discretionary" appeared in the permit and that the Board's decision applies the SUSMP in the nine categories to all projects that fit within the nine categories, I think the answer to that is yes.

Q. And similarly, it was your intent and the Board's intent to apply their SUSMP program to all projects including non-discretionary projects.

MR. LEON: Excuse me. I'm going to object. You asked whether it was the Board's intent as well as the Chairman's intent. We either need to limit that or I'm going to interpose an objection having to do with the limited process questions.

MR. MONTEVIDEO: Mr. Chair, that was my objection yesterday morning. His testimony -- the deliberative process objection goes to the relevancy of my question, but that was my whole objection yesterday, the Board's testimony is irrelevant. Because he has been permitted to testify, hopefully I'm allowed to cross-examine him on the issues he's testified to.

THE WITNESS: Can I just -- you --

MR. MONTEVIDEO: Let me ask it this way. I'll withdraw the question.

CHAIRMAN BAGGETT: You're going to retract the question.

MR. MONTEVIDEO: Yes.

Q. Mr. Nahai, do you agree that the program that was adopted by the Board applies to non-discretionary projects?

A. Within the nine categories only.

Q. Yes. Understood. Within the nine categories.

Now, doesn't the SUSMP that you actually adopted include a definition for discretionary projects?

A. Yes.

Q. Okay. You're looking at the definition right now; correct?

A. Yes.

Q. "A project which requires the exercise of judgment or deliberation when the public agency or body decides to approve or disapprove a particular activity as distinguished in situations where the public agency or body merely has to determine whether there has been conformity with applicable statutes, ordinances or regulations."

Would you agree the latter part of that definition is non-discretionary projects?

A. Are you asking me for a legal opinion?

Q. You're a lawyer; are you not?

A. I'm not here in my capacity as a lawyer.

Q. Well, I'm just trying --

A. Why don't you tell me what your interpretation is.

Q. That's my interpretation.

A. I accept your answer for the record.

Q. Your point was -- I thought your point that you just made was well, it's not defined in the permit so we really don't --

A. Again, you see, this is where the confusion comes up. It's not defined in the permit. This is the SUSMP.

Q. Correct.

A. So when I say it's not defined in the permit, I'm referring to the 1996 stormwater permit.

Q. Understood, but the fact that you have a definition for discretionary but at the same time you have the SUSMP applying to all projects, either discretionary or non-discretionary, doesn't that tell us at least what discretionary means here? Doesn't that than also tell us that non-discretionary is everything other than discretionary projects?

A. Let me answer your question this way. The SUSMP was presented at the hearing. There were a number of changes that were made. The fact that a discretionary project may have remained in the final draft, the fact that this definition is there, it's there; but if your question is does the SUSMP apply to all projects within the nine categories, I keep wanting to emphasize that so that we don't go back into the sink in your shed or whatever your example was. If you want to point out the fact that this definition is there, I'll acknowledge it's there.

Q. And doesn't the definition, the fact that it's there, indicate that somebody knew within the Regional Board staff what discretionary was?

A. I think --

Q. You made the comment. I'm sorry. You made the comment that it's in the permit but there's no definition, so I presume you meant nobody really knew what it meant, but you have a definition here; right?

A. Is that the point you were trying to make?

Q. One of them. We have more.

A. You have more? Maybe I should wait until you make your various points. I'm just trying to point out that at the end of the hearing on January 26th, the Board made the decision that within the nine categories there shouldn't be a distinction and that there wasn't really a meaningful water quality distinction between what someone might call discretionary and someone else might call non-discretionary.

Q. I understand that now, but let's talk about that.

MR. LEON: Mr. Montevideo, just to maybe move past this, I will offer on behalf of respondents that this definition has no meaning for the permit. It was a carryover from previous drafts.

MR. MONTEVIDEO: The fact that it's in the SUSMP program still has no meaning.

MR. LEON: The definition.

CHAIRMAN BAGGETT: Continue with the cross-examination.

MR. MONTEVIDEO: Thank you.

Q. You're talking about loopholes and avoiding loophopes. Do you believe that somebody coming to the city, going to the counter at city hall, asking for a permit, an electrical permit, do you believe that that would be a discretionary permit or non-discretionary permit?

MR. LEON: That's irrelevant.

THE WITNESS: How do I know whether under a particular city's regulations asking for an electrical permit is discretionary or not? Mr. Montevideo, please.

Q. BY MR. MONTEVIDEO: Mr. Nahai, in all fairness, the cities then have to apply what you don't know to their citizens. So if the city says it's a non-discretionary project for somebody to come into city hall and ask for a permit, for an electrical permit or for some plumbing work that's being done, we have a non-discretionary project; correct?

A. What we're talking about are nine categories of development. We're not talking about electrical permits or sinks in sheds or anything like that. I understand that it's part of your purpose to cloud the issues and sow confusion, but I've got to go back to the fact that what the SUSMPs cover are nine categories of development.

There is no way that applying for an electrical permit would add impervious surface or result in the SUSMP provisions becoming applicable. So if you'd like to give me a realistic example, I'll try to respond to you as much as I can.

Q. Okay.

A. But I also don't want to go down the road of speculation and hypotheticals and stuff like that with you.

Q. I'm talking about real issues in real terms that the cities have to deal with. This is not speculation. These are issues that the cities are going to have to deal with every day because of this edict that your Board adopted. So that's what we're concerned about here. Let's talk about your real concern for real situations. You have a definition of redevelopment?

A. Yes. We've talked about that today.

Q. We have and do you think that this definition is limited to the addition of impervious surface?

A. I believe that, first of all, the definition is limited to the nine categories. And to the extent that there may be questions about this particular clause, I think that that can be discussed.

Q. But shouldn't the time to have discussed that been prior to the Board's adoption of the SUSMP program?

A. Maybe, or maybe there are issues that come up with statutes and laws and decrees all the time that are then gone back, reexamined in the light of events and looked at again. So I think the other thing is that we do have in terms of cities implementing regulations similar to this. We have cities within our own jurisdiction that have done it, apparently quite painlessly. We have states that have done it, again apparently quite painlessly. I don't think this is inventing the wheel over again.

Q. First, do you agree the definition of redevelopment could use some work?

A. No. I don't know what that means, could use some work. If you want to suggest specific language that you think would clarify it, I would be willing to tell you whether I think it's good language or not, but I don't know what you mean "do you think it could use some work."

Q. Do you agree that the definition of redevelopment applies whether or not impervious surfaces have been added?

A. No because it also talks about making improvements to 50 percent or more of an existing structure.

Q. Redevelopment means an already developed site, the creation or addition of at least 5,000 square feet of impervious surfaces, or the creation or addition of 50 percent or more of impervious surfaces or the making of improvements to 50 percent or more of the existing structure.

Redevelopment includes but is not limited to: The expansion of a building footprint or addition or replacement of a structure, structural development including an increase in gross floor area and/or exterior construction, or remodeling. There are a number of "ors" in there.

When you look at all those "ors" and put them together, somebody goes in and remodels their house and affects 50 percent or more of the interior of their house and they live in an environmentally sensitive area, do you agree this SUSMP would apply to them?

A. As I said, first it would have to be within the nine categories.

Q. It's an environmentally sensitive area.

A. With respect to this whole environmentally sensitive area, which is something you've made a great deal of throughout these hearings, let's not forget that there is a waiver provision in the permit which even allows the Board to delegate to the EO the right to waive entire categories of development.

So the necessary flexibility is there with respect to environmentally sensitive areas, to examine matters and take suggestions from cities as to whether there should be waivers, in addition to the particular waivers that are already within the city's jurisdiction such as a danger to groundwater or unstable soil conditions or size limitations and so on.

I would argue that the necessary flexibility is there as far as environmentally sensitive areas is concerned.

Q. But in answer to my question, do they have to comply with the SUSMP program?

A. What I don't want to get into testimony here as to whether in a particular circumstance a particular homeowner, or a particular commercial developer for that matter, may have to comply or not. I don't think that's a fair question to put to me.

Q. Five minutes ago you told me you wanted a real situation so I gave you the real situation.

A. I take it back. I hereby retract that suggestion. I should have known with you not to do it.

Q. May I at least have an answer to the question? There's been a lot of discussion about how broad this thing is and we say one thing and they refuse to answer questions --

MS. JENNINGS: Could I make a comment? I feel that you've asked the question. You've gotten answers you're going to get. You're basically getting into argument, which I this think is appropriate in your closing statements. I think it's also clear that the Regional Board has indicated they see the need for some revision of that. To continue just arguing with the witness I don't think forwards our process.

MR. MONTEVIDEO: This is the third person I've asked a question about the application of this thing, and every time I ask the question I'm told, "I can't answer it and I don't agree with the hypothetical," and objections come in.

THE WITNESS: The question is inappropriate, Mr. Montevideo. It's not an appropriate question.

MS. JENNINGS: My point is I feel like you've gotten -- it's been asked and answered and it's become argumentative and that the record is complete at this point.

MR. MONTEVIDEO: Fair enough. Fair enough.

Q. Mr. Nahai, do you agree that the definition of redevelopment that is in the Regional Board's SUSMP program was not in the permittees' SUSMP program?

A. I don't know that. I don't recall that.

Q. But you agree that the location of or the description of environmentally sensitive areas in that new location or area was not in the permittees' SUSMP program.

A. That new category was added by the Regional Board, yes.

Q. And as far as you know, the issue of applying it to non-discretionary approvals was added by the Regional Board?

A. Didn't you ask that question already? Are you going to go down that road?

Q. I'm not sure I got an answer.

A. There's no point in me answering the question.

CHAIRMAN BAGGETT: It's already been answered.

MR. MONTEVIDEO: Can somebody tell me what the answer was because I frankly --

THE WITNESS: I'm sure you can have the transcript played back.

Q. BY MR. MONTEVIDEO: I'm sure I can, too. Do you remember your answer?

A. No, I don't.

Q. Do you remember if you gave me an answer?

A. I believe I did.

Q. And what was it?

MR. LEON: Excuse me.

CHAIRMAN BAGGETT: This has been a long day.

MR. MONTEVIDEO: You're right. I'm just a little frustrated. It's been a long morning.

Chairman, I did have a few more questions for Chairman Nahai.

CHAIRMAN BAGGETT: Try to get to the point.

Q. BY MR. MONTEVIDEO: Chairman Nahai, you've talked about the fact there was only a handful of petitioners here and you've made some comments about the fact that the County of Los Angeles isn't part of this group and apparently is accepting the SUSMP program. You made a similar comment about the City of Long Beach.

The County of Los Angeles has a settlement agreement that effectively requires that they implement a program similar to this; correct?

A. I don't know. I wasn't -- I know of it but I can't testify as to it.

Q. Okay. You've mentioned --

A. It's my understanding there is a settlement.

Q. Yes. And you mentioned something about a Long Beach settlement agreement?

A. I didn't.

Q. Maybe it was Mr. Dickerson. You indicated that Long Beach had gone along with this; did you not?

A. I don't know whether I said that or Mr. Dickerson said that.

MR. LEON: It was Mr. Dickerson and I also mentioned it.

MR. MONTEVIDEO: Okay.

Q. Well, rather than go back, let me talk about the other programs that you've mentioned throughout the state. You talked about the Florida SUSMP program; right? You said Florida has been doing this, it works, and you even read a statement from their program.

A. What I said was that Florida has had stormwater regulations, I understand, since 1982 and I read two sentences from their letter.

Q. Do you know how many drafts of those regulations

R0073976

Florida had put together before they ended up with their final?

A. No, I don't.

Q. Do you know how many years the Florida regulation was in the making?

A. No.

Q. Do you know how many meetings of their Technical Advisory Committee they've gone through to arrive at their regulations?

A. No, I don't.

Q. Do you agree that your Board is understaffed and underfunded?

A. That's been a point that you've made and I think many governmental entities are pushed for resources. Our Board may be.

Q. Do you agree that it takes a lot of resources to put together a program of this nature?

MR. LEON: Objection. Vague.

THE WITNESS: That's not a question I can answer.

Q. BY MR. MONTEVIDEO: Okay. Do you remember Mr. Dickerson's plea to you at the time of the hearing the staff issue, I do hope you'll recognize that everything we've done is on the basis of one individual working full-time, already overburdened, already spending, diverting resources away from things that we should be doing just to focus on this issue --

CHAIRMAN BAGGETT: I think he can read.

THE WITNESS: Is this cross-examination to be used --

MR. MONTEVIDEO: Well, the issue --

THE WITNESS: Excuse me. Used as a device for him to make his final argument here? Is this just rehashing of the opening statement that you made?

MS. JENNINGS: I thought there was an agreement, too, among the counsel and our Chair about limiting the amount of time for cross-examination of witnesses and you had an agreement. In fact, Ms. Forster just mentioned that this comment was actually directed to herself as a State Board Member, not to the Regional Board.

I'm just failing to see the relevance. If you want to say the fact that they can only collect $10,000 from all of the cities because the legislature limits them to $10,000, yes, correct. It just seems we're trying to move this hearing ahead, and to be argumentative with the Chair of the Regional Board, it's your choice how you use up your hour, but it's not getting very far.

MR. MONTEVIDEO: This is my last question, Mr. Chair.

Q. The only point here was Florida and the other states have spent a lot of time, Chairman Nahai, and a lot of money and have a lot of staff to do this, and I guess the question is don't you feel you can use more resources and more time to get the job done?

A. I just answered that.

CHAIRMAN BAGGETT: He just answered that question.

THE WITNESS: I would like you to tell me how much time and how much money Florida spent.

MR. MONTEVIDEO: I can tell you they spent more than $10,000.

MS. JENNINGS: $10,000, just for the help of the Board Members here, is unfortunately what the legislature limits in fees and I think we estimate --

CHAIRMAN BAGGETT: We're aware of that. Can we move on? The witness is excused. Thank you.

THE WITNESS: Thank you.

CHAIRMAN BAGGETT: We have one other witness who was also requested, Mr. Wilkness.

Mr. Helperin, you had questions?

MR. HELPERIN: I will limit it.

RON WILKNESS,

having been previously sworn, was recalled for examination and testified as follows:

CROSS-EXAMINATION

BY MR. HELPERIN:

Q. Good morning, Mr. Wilkness.

A. Good morning.

Q. My understanding is your testimony is that you categorically rejected the idea of infiltration at retail gasoline outlets as an appropriate stormwater BMP; is that correct?

A. That's not entirely correct. My objection to infiltration is that at a gasoline station there is the real risk of a gasoline spill, and I don't have a comment on the wisdom of infiltrating water, but I do think that if you have infiltration it cannot distinguish between stormwater or liquid gasoline and it does seem highly inadvisable to allow liquid gasoline to penetrate directly into the soil.

Q. So you are concerned that if there were infiltration at a gasoline station there would be the potential risk that gasoline would infiltrate?

A. Yes.

Q. So you admit that run-off from retail gasoline stations does contain contaminants that are of concern?

A. No. What I'm saying is that the spillage of gasoline at a gasoline station is not unknown, an unknown occurrence, and there are a variety of reasons that could result in spillage. If the spillage is retained on an impervious surface it can be cleaned up.

Q. So if the -- if it were cleaned up and it was only the run-off from the station after the cleanup that was infiltrated, there wouldn't be a problem with infiltration; is that correct?

A. I think that if we were talking about only water, I'm not so sure there would be a problem, no.

Q. So infiltration is a possibility if you have good enough source control because as you've suggested, your BMP guide provides to ensure that there's no polluted run-off from the site, then the clean run-off could be infiltrated.

A. The BMP guide produced by the California Stormwater Task Force was undertaken basically at our initiative in consideration of the potential that a gas station poses to contaminated stormwater run-off. The BMP guide itself doesn't really preclude spillage. Spillage can be the result of a variety of occurrences --

Q. I see.

A. -- that are unrelated.

Q. So even if the source control recommended by the BMP guide were implemented, you agree that there would still be spills, that those source controls would not necessarily be effective enough or reliable enough to ensure that the run-off from the gasoline station wouldn't still contain contaminants.

A. No. That's not entirely correct either because within the task force BMPs there are statements that spills are to be cleaned up immediately using dry absorbents. There's also a discussion about stations operating -- excuse me, maintaining spill control plans and training their employees on the development of those plans.

Q. Then we're back where we started. If you can control it that well and you could infiltrate the remaining -- the actual run-off after a spill had been controlled and prevent it from mixing with the inflow.

A. The problem, sir, is that if there is a gasoline spill, it could run in any direction.
Q. I see. So it could escape?
A. Well, it could certainly reach -- in my view, there are certainly circumstances where a spill of gasoline could reach the site where permeable soil or permeable pavement has been installed.
Q. So then wouldn't treatment control devices at gas stations be a good idea to -- as a backstop for that gasoline that might escape and run in any direction and get off the site?
A. No because there's a problem with treatment controls. May I ask if you have a particular treatment control in mind?
Q. I'm trying to establish either your source controls are effective enough that there's no danger of contaminants leaving the site or they're not. If they are, you shouldn't have a problem with infiltration. If they're not, you should be willing to have a treatment control backup device; isn't that right?
A. I think the issue -- no. The issue I think is really this. What we're saying is that there is a risk of pollution at service stations caused by, among other things, the spillage of gasoline.
What we're saying is that this task force BMP guide that was produced by the group consisting primarily of representatives from regulatory agencies is viewed as a slate of best management practices that reduces the

discharge of pollutants to the maximum extent practicable.

Q. Is it foolproof?

A. I'm not aware of anything that's foolproof, but it does, in our view, result in run-off that poses no significant adverse risk. And what I have said all along is that we have not seen any data to suggest that if these BMPs are utilized at a station that there is a residual problem that we have to deal with, either through treatment or infiltration.

Q. Okay. Thank you. Here's a copy of your Exhibit B from your testimony. If you could please read me -- if you could turn to page IV, Roman numeral 4, and read me the sentence in the second paragraph.

A. Based on the results.

Q. That's right.

A. "Based on the results of several stormwater studies, it does not appear that the water quality of stormwater run-off from properly operated and maintained RGOs is appreciably different than water quality from a number of other sources, including parking lots and roads."

Q. Including parking lots and roads. So your own exhibit in your own testimony is that even a well-maintained RGO, even the kinds that implements all of the source control BMPs that you're recommending, the water quality from that well-maintained RGO is nevertheless similar to that of parking lots, which were specifically called out by the Regional Board as a type of land use that needed special attention because of the potential for pollutant run-off, and that was specifically mentioned by Dr. Horner as a particularly problematic land use. You're saying that run-off from well-maintained RGOs is similar to parking lots and roads.

A. There's one very important fact that I'd like to call to your attention. The date of this study is January 12th, 1996. The date of publication of the task force RGO BMPs is April 23rd, 1997, more than a year later. Although we stand behind the statement, I think it has to be taken within the context of time.

What I've been suggesting is that the criteria for deeming a station well-maintained really should now be -- or as of 1997, should be whether or not the site has implemented the task force BMPs.

Q. So it's your testimony your exhibit is no longer applicable.

A. This study was actually performed by Geomatrix and by Tim Simpson, and I think that he's probably more familiar with this study than I am.

Q. I'll pose the question to him. Thank you.

A. Perhaps he could address it.

Q. Let me ask you another question about your source controls. You said earlier that you think your source controls control pollutant run-off to the extent they are no danger to -- I'm sorry I don't remember your exact words, but you said it was sufficient to -- so that the run-off would not be of any concern. Would -- would WSPA be willing to accept numerical effluent limits on its run-off assuming these BMPs were implemented then?

A. I think there's significant problems in dealing with the numerical limit for service stations. Number one, service stations for very good reasons are extensively paved with impervious surface. I'm an engineer but not a civil engineer. I don't know by what means you would avoid the difference in run-off from an unimproved site to a site that has service station on it. So I don't think a numerical limit would be applicable, but I don't think it's necessary either.

Q. I'm sorry. I didn't quite understand your answer. The difference between an improved and unimproved site is what? How is that relevant?

A. I think what we're talking about is that the BMPs -- excuse me. The SUSMP applies to new or remodeled sites.

Q. I'm not talking about the SUSMP. I'm sorry if I was unclear. If we could apply all of the BMPs in your BMP guide, the BMP guide that was developed by the task force --

A. Yes.

Q. -- you seemed earlier to be confident the run-off would then not be of concern. Would WSPA be willing to accept the application of that BMP guide and the simultaneous application of numerical effluent limits?

A. Application of the BMP guide, not application of a numerical effluent limit. Excuse me. Let me make sure that I clearly understand your question.

Q. Please.

A. When you talk about a numerical effluent limit, are we talking about the numerical design standard or are we talking about a mass effluent limit?

Q. I'm talking about a mass concentration effluent limit on the run-off or the discharge from the RGO.

A. It seems that we might ultimately have that anyway with the TMDL process.

Q. We may indeed, but I was asking if you were confident in the source controls in your BMP guide that you would be willing to accept those effluent limits if the BMP guide were implemented as well.

A. I'm not sure I fully appreciate the implications of your question, so I don't know that I can intelligently answer.

Q. Okay. Let me ask you this: There's been a lot of concern about contamination of groundwater. Do you think if you were to -- if an RGO were to channel the run-off to a catch basin with an insert and then from there out into the storm drain system, do you think that would pose a threat to groundwater?

A. No.

Q. And do you think that if an RGO were to channel its run-off into a storm ceptor and from there to the

storm drain, would that present a threat to groundwater?
A. Not a threat to groundwater.
Q. If were you to channel the run-off from an RGO to a sand filter, would that be a threat to groundwater?
A. Once again, not a threat to groundwater.
Q. So there are many BMPs that are authorized by the SUSMP that have no threat to groundwater; is that right?
A. That's correct, but there are many other risks imposed by some of the BMPs that are contained as optional remedies within the SUSMP.
Q. Let's turn to your BMP guide for a moment. Who did you say developed that?
A. I'm sorry. I was distracted. Would you mind repeating the question?
Q. The BMP guide for RGOs, who developed that?
A. California Stormwater Quality Task Force.
Q. And who are they?
A. California Stormwater Quality Task Force, actually it might be convenient for me if I can find the applicable paragraph here in the document itself. Two sentences that, as I recall, I read in my testimony yesterday. I have in my hand a copy of the stormwater BMP guide produced by the California Stormwater Quality Task Force, and in a cover letter from the Chairman at the time, Robert Hale, I think this is responsive to your question. The guide was produced and published by the California Stormwater Quality Task Force, an advisory

body of municipal agencies complying with stormwater regulations.

Q. Great. Thanks. Here's Exhibit A to your testimony. If you could turn to page 1 of Exhibit A. Looking at the disclaimer, if you could please read the first sentence of the disclaimer.

A. "The statements and conclusions of this guide are those of the California Stormwater Quality Task Force (task force) and not necessarily those of the state of California."

Q. Thank you. If you could also read me the first two sentences of the second paragraph.

A. "The guide was produced and published by the California Stormwater" -- even though it's not highlighted?

Q. That's fine.

A. Let me start over. "The guide was produced and published by the California Stormwater Quality Task Force, an advisory body of municipal agencies regulated by the stormwater program."

Q. And the next sentence.

A. "This guide is not a publication of the State Water Resources Control Board or any Regional Water Quality Control Board, and none of these Boards has specifically endorsed the contents thereof."

Q. Thank you. So this guidance that you're saying the Regional Board should have adopted is really just the recommendation of a group of municipalities and not endorsed by any of the regulatory agencies of the state of California.

A. What I said is that the Los Angeles Regional Board actually did adopt these requirements in the permit that was issued to the City of Long Beach in June of 1999. This whole comment was incorporated by reference as I recall.

Q. Could you also read the last sentence in the disclaimer?

A. "Implementation of these best management practices cannot be construed as compliance with all other applicable regulations, including local requirements."

Q. So there are other requirements in addition to these that were anticipated even in this document?

A. Yes.

Q. You said there were two types of treatment that were available to gas stations, filtration and gravity separation; is that right?

A. Yes.

Q. But as we've heard -- I don't think we have it. That's okay -- from Dr. Horner, there are many different types of filtration and many types of gravity separation; isn't that right?

A. I believe that's correct.

Q. And just sticking to the two that you mentioned, I think, which was catch basin inserts and oil water separators, you said the filters plug rapidly and have

other problems. Is that true of vegetative filters?
A. I don't know that a vegetative filter has ever been applied to a service station.
Q. How about a sand filter?
A. Once again, I'm not aware of the applicability of sand filters to a service station. There is one categorical sort of problem with devices that involve an underground structure and that is the problem of gasoline and gasoline vapors in a confined space, and if you have some sort of a conveyance that would lead a spill into one of these underground structures, that same sort of conveyance will send vapors back up to a spot where they could conceivably be ignited.
Q. All I'm trying to establish is that the two types of BMPs that you discussed as being problematic, those problems don't necessarily apply to many of the other types of BMPs that are available to an RGO; is that right?
A. Those particular problems, yes.
Q. Thank you. And with respect to gravity separation, I think in your testimony you said that requires constant flow; is that correct?
A. Controlled flow, yes.
Q. Isn't it true that though higher rates of flow can produce problems such as washing out the materials in a gravity separating device, that lower flows would not present a problem?
A. Yes.

R0073990

Q. So couldn't you just have a bypass system so that higher flows would bypass the system and the lower flows would be fine and the flows it was designed for would be fine, and the higher flows would bypass?

A. Could, but I can't understand why you would want to introduce a bypass if you're trying to control pollution.

Q. Because there's a size limit.

Just one other thing I would like to ask you to read. That's the slide that we had up just a moment ago. You note that the BMP guide emphasizes use of infiltration but the BMP guide emphasizes the use of impervious surface.

Infiltration -- can you just please read me the -- I didn't highlight it here. I apologize. Actually, never mind. Let's take this one down. It's not the slide I wanted. That's fine.

MR. HELPERIN: I have nothing else.

Thank you.

MR. LEON: May I ask a couple of questions of Mr. Wilkness?

CHAIRMAN BAGGETT: I asked earlier and you didn't, but you do now?

MR. LEON: Something came up that he mentioned during cross-examination that I have to get clear.

CHAIRMAN BAGGETT: You can do it quick.

MR. LEON: Very quickly.

CROSS-EXAMINATION

BY MR. LEON:

Q. Mr. Wilkness, good noon. Jorge Leon with the Los Angeles Regional Board.

A. Yes, sir. Good afternoon.

Q. You mentioned that the BMP guide produced by the California Stormwater Task Force had been adopted by the Los Angeles Regional Board. Do you recall stating that?

A. I'm not sure exactly what words I used.

Q. Those were the words I heard. I need to get it clarified. Let me ask you a question to lead you on the correct path, I think.

It's my understanding that it was listed as an included reference. Is that your recollection?

A. No.

Q. What is your recollection?

A. My recollection is that again, to set the chronology straight, in June of 1999 the L.A. Regional Board adopted -- again I want to make -- my understanding is, and I don't want to use inappropriate terminology, but the essence was that the L.A. Regional Board adopted an order that was imposed upon the City of Long Beach and was a municipal MPDS permit. Am I right so far, Mr. Leon?

Q. They adopted a permit for stormwater --

A. Among the requirements in that permit for service stations, and this requirement was basically added at my suggestion and at my request, was incorporation by reference of the entire California Stormwater Task Force BMP guide. That was -- it was included in the order as the -- maybe that's a bad choice of words, but compliance was to be determined on the basis of adopting a site using these task force BMPs.

Q. Thank you very much.

A. I'm sorry. I didn't say that very well.

Q. I won't ask any more questions, but I will offer in the record to indicate --

CHAIRMAN BAGGETT: You can address that in your summation.

MR. LEON: Thank you. Thank you, sir.

THE WITNESS: Thank you.

MR. WELCH: Thank you, Mr. Chairman, for accommodating Mr. Wilkness.

CHAIRMAN BAGGETT: Let's do the last 20 minutes and decide where we have to go from there.

MR. HELPERIN: Mr. Perkins does have to --

CHAIRMAN BAGGETT: We'll finish your case-in-chief and we'll allow the cross-examination, assuming there are questions of the witnesses.

You have 28 minutes remaining.

MR. HELPERIN: 28 minutes? All right.

ALEX HELPERIN,

having been previously sworn, testified as follows:

STATEMENT OF ALEX HELPERIN

MR. HELPERIN: You've seen two pieces of our presentation already, unfortunately, but we had Dr. Gold yesterday afternoon who described the severity of the stormwater problem in southern California and you heard the testimony of Dr. Horner yesterday morning regarding how effective programs like this can be, in combatting the problem how common these problems are all across the country. The remainder of our program was to be in four discreet segments, and I think I'm going to cut back as the Regional Board has already addressed some of those issues.

CHAIRMAN BAGGETT: Appreciate it.

MR. HELPERIN: I was going to briefly expand on the legal underpinnings of the SUSMP, but I think that's pretty clear in both state and federal law. So I'll jump right to talking about the practical aspects of the SUSMP itself, how effective it will be, how much it will cost, how easy it will be to implement. Some of that I'll refer back to the testimony of Dr. Horner, and we also have to speak to you today Craig Perkins of Santa Monica who is uniquely qualified on these issues with his real-world experience in implementing the Santa Monica development program. And third, I'm going to need to take a few moments just to clarify some of the myriad of misrepresentations that were before this Board yesterday because there have been several statements about the implications and the application of the SUSMP that are simply false and have perhaps led this Board down the wrong path in understanding what the implications of the denial of this petition would mean. Finally, time permitting, I'll review some of the petitioners' legal arguments, God willing.

CHAIRMAN BAGGETT: You will have a summary also later.

MR. HELPERIN: Let me jump, if I may, very quickly to the wealth of data that there really is to support this kind of a program. You've seen already reports of BMP effectiveness in the record from industry, from the American Society of Civil Engineers, from academia, from Dr. Horner and others from government and other areas. There really is an enormous amount of data on these going back over 30 years.

As Dr. Horner testified, this EPA summary sheet is indicative of the types of results that he has seen in many studies with efficient pollution removal ratings well into the 50 to 80 percent cases in many of the BMPs that we're talking about here.

As EPA has noted, there are two separate groups that have developed complete databases on the issue of BMP effectiveness. Watershed Protection has a database with over 123 structural BMPs, American Society of Civil Engineers has a developed what EPA refers to as a comprehensive database on BMP performance. The allegation that these are not effective or that we don't know if they will do any good is simply not true. The evidence is overwhelming from all sectors of society about the effectiveness of these BMPs.

It's also true as you saw from Dr. Horner's testimony and many people have stated, but this is being done all over the country in much more aggressive programs than what we're talking about implementing here in Los Angeles.

The cost issues come up a lot. EPA and others have also done studies on that, and you can see here is a summary of what EPA considers to be the base costs for typical applications of stormwater BMPs. The numbers in the second column there are in terms of dollars per cubic foot of water treated, and if you run the numbers on these you'll see, for example, for a one-half acre site, assuming 100 percent impervious surface, we're only running from about $675 to $8,000 given these numbers, these ranges. Even on a ten-acre site, the numbers could be as low at $13,000, very high end about $150,000 to $160,000 for a very large 10-acre development.

Because of economies of scale those numbers are even smaller, so EPA did a study studying the actual capital construction costs for completed BMPs. These two slides are backwards. This is what we should have been looking at before. These are the dollars per cubic foot of water treated. This shows the total amounts. I apologize.

Just with that background, I wanted to then introduce Craig Perkins to talk about again the real-world application of this sort of program in Santa Monica.

CRAIG PERKINS,

having been previously sworn, testified as follows:

STATEMENT OF CRAIG PERKINS

MR. PERKINS: Good afternoon, or late morning, whatever it is. My name is Craig Perkins. I'm the Director of Environmental and Public Works Management for the City of Santa Monica. I've held that position for the last seven years. I've worked for Santa Monica for a total of 17 years. Prior to my current position I was Environmental Programs Manager and held various other positions with the city including Budget Director at one point in time.

I'm here today to talk about my city's program for stormwater mitigation, as well as our views on the SUSMP which is the basis of the discussion over the last couple of days. During the testimony yesterday that I heard I was not sure whether I was in a stormwater hearing or a bad novel at times. Could it be possible the proposed stormwater mitigations will be single-handedly responsible for the destruction of affordable housing in the region, the bankrupting of local governments and the pollution of precious drinking water aquifers, as well as the mosquito population.

Last night I had a fitful sleep as nightmarish visions passed before me, visions of displaced low income citizens chasing me down the storm drain channel as the main person responsible for compelling them out of their affordable housing because of stormwater mitigations. Joining the pursuit were the noble groundwater protectors from the Western States Petroleum Association astride their brave, red flying horses. Meanwhile, swarms of BMP-bred mosquitoes swooped down from the sky to block my retreat. Mercifully, I finally awoke in a cold sweat and realized it had all just been one bizarre hallucination.

So in the bright light of the new morning, how do we separate the real from the unreal as it pertains to the SUSMP? First of all, you should know that the stormwater mitigation requirements that Santa Monica has had for the last seven years are very similar to the SUSMP requirements. During those seven years, approximately 400 projects have complied with our municipal requirements. These projects have included single-family, multi-family, commercial, institutional and city projects.

Has one single project not been built in Santa Monica because of the severity of these restrictions? No. In fact, many developers have wanted to do more than the minimum requirements. Has the city granted any full or partial waivers to the requirements due to technical or economic infeasibility? Yes, we have, but less than a dozen in seven years.

Do we know about how much it costs to comply with the city's requirement? Yes, about one percent of the total construction cost on average, often times much less than that, but to our knowledge never greater than three percent of total construction cost. For example, our new $43 million health and safety facility, which is complying with our requirements is, in fact, going beyond our requirements. The stormwater compliance cost for that facility are about $200,000 or about one half of one percent of the construction costs.

Have these stormwater requirements caused a fiscal burden on city staff for administration, inspection and enforcement? No. I have one dedicated stormwater management position who is responsible for many more tasks than just oversight of our municipal ordinance. All of the tasks have been incorporated into the ongoing work load of existing permitting and planning staff, no different than any other city within this region does for every other building code requirement which may be new from time to time, year to year.

Has our board been responsible for a decrease in affordable housing construction in Santa Monica? Absolutely not. Santa Monica has the strongest commitment to affordable housing of any city in this region. Increased property costs and a lack of political will are the enemies of affordable housing, not stormwater pollution control regulations.

Are we concerned about groundwater pollution in gasoline stations? We are very concerned about soil and groundwater contamination at gasoline stations. What causes groundwater contamination at gasoline stations is leaking underground storage tanks and pipes, not BMPs. The City of Santa Monica has a little bit of experience with this as it pertains to the gasoline additive MTBE.

Let's face the facts. The risk of contaminated stormwater infiltration to cause groundwater problems at gasoline stations compared to the risks from leaks in gasoline tanks and pipelines is so minuscule that it doesn't even merit a debate. Isn't it interesting that the Western States Petroleum Association is so concerned about stormwater BMPs contaminating gasoline station sites when they were adamantly in favor of the proposed Lawrence Livermore study recommendations in 1995 that directed the state's Regional Boards to stop worrying about cleaning up gasoline contaminated soil because it posed no risk to groundwater. Maybe WSPA has now had an epiphany, maybe not.

Finally has Santa Monica been plagued with ravenous mosquitoes in the last seven years? No. I can roll up my sleeves and show you there are no red bumps due to those mosquito bites.

So, what is this appeal all about? It is about some people do not want to accept that we have to change the way we deal with stormwater run-off. The SUSMP is more than good common sense policy. We do not live in a perfect world and the SUSMP is not a perfect document, but the only way at this point that we can move forward in my opinion is to start the implementation process because it's during the implementation process the creativity of the design and development community will come to the fore, and that's what we've seen time and time again in Santa Monica.

Certainly we will need to improve the SUSMP down the line, but let's get started. By the year 2020, a population increase equal to an additional L.A. County will need to be absorbed into the state. We can either deny, deflect, delay or defer the stormwater measures that have to be adopted to cope with this future or we can have the courage and vision to do what we know is right.

I thank you very much for your time today, and I brought copies of our brochure which explains the specifics of our stormwater ordinance if you have more details that you need on that.

MR. HELPERIN: Thank you. I'd like to take just a moment now to clarify some of the misrepresentations, unfortunately. As I was saying earlier, there was a great deal of misinformation yesterday which was at best out of ignorance.

MR. MONTEVIDEO: Mr. Chair, I'm sorry. On that submittal, it is untimely. We would object on that basis.

CHAIRMAN BAGGETT: Unless it's in the record someplace.

MS. JENNINGS: I don't think it's evidence. I think it's just a brochure.

CHAIRMAN BAGGETT: I sustain the objection. I'm sure it will be -- it's a public document and we'll see it later.

FURTHER STATEMENT OF ALEX HELPERIN

MR. HELPERIN: So as I was saying, I'm going to go through some of the claims that were made yesterday with the possible exception that I'm Joe McCarthy and try to respond to each of them in turn.

First of all, what does this SUSMP not apply to? It does not apply to replacing roofs. Replacing roofs is not redevelopment under the definition in the SUSMP. It does not apply to retaining wall additions. Additions of retaining walls are not redevelopment under the SUSMP. Rewiring and replumbing and repainting a house are not redevelopment under the SUSMP.

The standard for redevelopment, if we have it, as you've seen is the creation or addition of at least 5,000 square feet of impervious surfaces, 50 percent or more of the impervious surface or improvements to 50 percent or more of the existing structure. I can't even imagine what an existing structure would look like if a retaining wall were to add 50 percent of the impervious surface or be 5,000 square feet or the addition a roof.

Similarly, single-family homes are not for the most part a subject of this SUSMP. Single-family homes may be the subject of it if they are on a hillside development or they're part of a 10 or more home subdivision, but you don't see a lot of poor homes being built on the hillside areas around Los Angeles and you don't have the cost of ten-plus home family subdivisions imposed on individual homeowners.

Those are collective costs. So the parade of the horrors that the petitioners have raised to these sorts of redevelopment or these sorts of initial developments are simply red herrings and you should put them out of your minds when you consider the efficacy of this SUSMP.

The next thing I wanted to discuss was the flexibility issue. Petitioners talked about the fact that the SUSMP requires them to contain or to infiltrate three quarters of an inch of run-off. That is again simply not true. The SUSMP requires few minor specific BMPs with respect to specific types of development, things like with respect to gas stations putting canopies over fueling stations. Beyond that, the BMPs are, as you've heard, completely at the discretion of the developers and the city planning approvers to decide what's the most effective and the most appropriate BMP. So they don't necessarily have to infiltrate anything at all.

In fact, there's the specific waiver provision in the SUSMP that you've seen that alleviates that requirement if there's any threat to groundwater, nor do they have to contain anything at all because all the water can be sent through a flow-through BMP. So the idea that you have to worry about how are they going to contain three quarters of an inch of rain or how are they going to infiltrate is another red herring that should be stricken from your minds when you consider whether this SUSMP is appropriate.

Third, you've heard people say that this won't clean up the beaches and keep the beaches open. That's true. No one claims this is going to clean up the beaches. There's a fundamental distinction here and a legal distinction that's being missed by the parties and that is the distinction between technology-based standards in order to control pollution to the maximum extent practicable on the one hand and water quality-based effluent limits on the other. We have to keep that distinction clearly in our minds.

The SUSMP is not a water quality-based effluent limitation. It's not designed to (inaudible) our water quality standards and it likely won't. It's a first step. It's a step that's required by the technology-based aspects of the Clean Water Act that say you have to implement the controls that are technologically available to control pollution to the maximum extent practicable, and the fact that this is being done by hundreds of municipalities all over the country should in and of itself be enough evidence that this is within the bounds of practicability, and whether it will get us to our water quality standards or not and whether it will keep beaches open is again a red herring and not relevant to the validity of this SUSMP.

Fourth, predevelopment run-off. There's been statements that the SUSMP will require that predevelopment run-off be kept below -- that post-development run-off will be kept below the predevelopment run-off. Again, that's false. The SUSMP does not say that. What it says is that the peak flows off of developed land can't exceed the peak flows from the predeveloped land, and that's to protect downstream areas from erosion and other areas of habitat degradation. That does not mean that the flow that comes off a post-development site is necessarily going to be lower than the predevelopment site. It only applies to those highest volume flows.

I've skipped through some of my slides here because I'm trying to hurry and I don't have a lot of time. I'm going to jump to some of the petitioners' claims with respect to the permit.

Mr. Montevideo's testimony yesterday focused almost exclusively on the argument that the Regional Board had violated its own permit. First of all, I would like to just point out that argument is entirely based on the assumption that the Regional Board can violate its own permit, and as we've pointed out in our briefs the Board can't -- well, it's based on the assumption that if the Board were to deviate at all from its permit that would be a violation.

As we've pointed out in our brief by the citations of the Smith V. Santa Barbara case and the Morrison case, it's not true the Regional Board can limit itself that way because an agency cannot limit itself in its ability to comply with the federal mandate to control pollution to the maximum extent practicable. So if this input requires the Regional Board, this SUSMP, if this is the way to get to MEP, then regardless of what the permit said that would not be a violation of it. That's an aside and I'm not going to dwell on that.

The fact is the Board did not deviate from this permit. The first provision of the permit that Mr. Montevideo claims was violated was the requirement that was -- the first claim that Mr. Montevideo has with respect to the permit violation was that the Board violated it by imposing requirements beyond that which the petitioners in their submittal had offered.

Clearly the Board has the authority to implement changes other than what the petitioners submitted. If it didn't have that authority, the entire review process would be meaningless. There would be no purpose for the Regional Board's review if they couldn't make changes.

Now, perhaps what Mr. Montevideo is saying there is that the Regional Board shouldn't have made the change itself. It should have simply sent the permit back to petitioners to have the petitioners make the changes. That kind of argument is the ultimate elevation of form over substance. It simply makes no sense. If Mr. Montevideo is saying that the Regional Board had to continually send the permit back over and over again, saying this is still not good enough, make these changes, this is still not good enough, make these changes, rather than making the changes itself and moving on with the program, then to honor that sort of procedural argument would be to completely cripple this program and make it impossible for the program to ever move forward.

Mr. Montevideo also claimed the Executive Officer should have followed the administrative review procedure. The administrative review procedure set up in the permit clearly has two separate sections -- first, a procedure for reviewing separate reports (phonetic) of documents; and separately, in addition, a method to resolve differences prior to initiating enforcement action. Those are two separate requirements. The first one is outlined here in section one, and the second one in section two.

The notice to meet and confer that Mr. Montevideo points to is only with respect to enforcement actions. There have been no enforcement actions begun here. This permit procedure is not applicable to the SUSMP. What is applicable is that the permittees have to submit the document to the Executive Officer. As you've seen, not only did they submit it but they submitted several versions. The Board was more than patient in accepting version after version that were not compliant with their demands before they eventually stepped in to make the corrections that needed to be made.

The Executive Officer notified the permittees of the results of that review, either approval of disapproval, which I think the fact that the Regional Board on September 16th said this isn't going to work, we're going to take this back and see what needs to be fixed, it was pretty clear they disapproved the permit. If that's not an explicit disapproval, then certainly a constructive disapproval.

The final claim related to this procedural issue is kind of a general due process claim the permittees didn't have sufficient opportunity to engage with the Regional Board and to discuss the various proposals.

As you can see, there were multiple -- you've seen this on other slides -- opportunities. There was a workshop, there were two separate hearings, there was public comment before the Board. It's my information that Mr. Dickerson and Mr. Swamikannu had approximately 50 informal meetings with various members of the permittees prior to the December release of the renewed version of the SUSMP.

We can see that there were at least seven different drafts of this SUSMP that were circulated before we came to the final one. There were early drafts circulated in early 1999. In May, the Los Angeles County SUSMP came out and what they called the final draft of their model SUSMP under the permit. In July they submitted their official proposed model SUSMP. It was again revised in August and then was submitted to the Board with changes recommended by staff on August 16th.

Finally, the other issue that Mr. Montevideo raised with respect to permit compliance was whether the SUSMP substantively met the requirements of the permit. Here is the language of the permit.

The two things they point to as being violative are the fact that cost-effectiveness, ease of maintenance and consistency with other environmental mandates were not explicitly considered allegedly. As I pointed out earlier, that requirement is within section B of the permit. It applies to the list of recommended development and the list of recommended BMPs. That process took place earlier and was completed in April of 1999. The SUSMP process down here is a separate process which is not limited by that requirement.

And the second claim they make is that the as-final SUSMP was not allowed to include two additional categories of environmentally sensitive areas and parking lots, but as you can see the language within the section C on SUSMPs says "at the minimum SUSMPs and guidelines shall be prepared for the following development categories." The permit explicitly made provision for an SUSMP that was broader than these seven categories. Nowhere in the permit does it say "at the minimum the SUSMP will include these categories and if it goes beyond that those must also be developmental categories." It doesn't say that. It doesn't say anything about going beyond this.

This is simply a minimum set of types of development to which it must apply. Beyond that, the "at a minimum" leaves it open to the Board in their discretion to determine what other types of categories are applicable or it should be applicable to.

I'm sure I'm almost out of time here, but I did want to address some of the legal arguments that petitioners made with respect to CEQA, unfunded mandates, Water Code, 13360, and just about anything else you can think of. I think I'll just pass on that because I'm out of time. How much time do I have?

CHAIRMAN BAGGETT: Three minutes.

MR. HELPERIN: Three minutes? Let's just go through very quickly, then.

CHAIRMAN BAGGETT: You don't have to use them.

(Laughter)

MR. HELPERIN: With respect to 13360, this again gets into the issue of the difference between a water quality-based effluent limit and technology-based standard. What the SUSMP is is a statutorily mandated compilation of required practices and minimum performance levels. It is very similar to the type of run-off limits that were approved in the Tahoe-Sierra case. In the Tahoe-Sierra case it construed Section 13360 in saying what it prevents is a regulation that prescribes the manner in which compliance may be achieved.

The SUSMP does not prescribe the manner in which compliance may be achieved and does not prescribe the manner to comply with the discharge standard because it's not a discharge standard. It's not a water quality-based effluent limit. It is again a technology-based standard, so there's no discharge standard per se in the SUSMP at all. There's no limit on what you can discharge and so 13360 isn't applicable.

Furthermore, even if that were to be interpreted as applying, the Clean Water Act, as you've seen from the other presentations, explicitly requires the use of SUSMPs in the statute and in the federal regulations, and the Water Code provides for overriding of 13360 if the federal act requires it. It says notwithstanding any other provision of Porter-Cologne, the Regional Board shall issue waste discharge requirements compliant with the Clean Water Act. So the Water Code explicitly says that even if 13360 were otherwise to be interpreted to being relevant, it's overruled.

Here's just an example of one of the places in the Clean Water Act where BMPs are specifically required and defined to include maintenance procedures, treatment requirements and operating procedures. So if there be any confusion about the existence of the mandate required by the Clean Water Act, this is required by the Act.

With respect to CEQA, as you've already heard there's an exemption under 13389 that this doesn't require the waste discharge requirement. That exemption doesn't apply.

There is an argument made by WSPA that this is not required based on the Defenders of Wildlife case. This is once again a confusion between the distinction of water quality-based effluent limits and technology-based standards. What Defenders of Wildlife said was that for municipal stormwater permits you don't necessarily need to have numerical effluent limits. That did not apply to technology-based best management practices. In fact, at the end of the case it explicitly approved the use of best management practices.

Finally, the unfunded mandates claim and APA claim. With respect to unfunded mandates, the requirement to reimburse local agencies for the state mandated costs does not apply to NPDES permits issued by the Regional Board. That's a quote from this State Board's opinion in 1990. Furthermore, Government Code sections explicitly exclude orders issued by the Regional Board pursuant to the Porter-Cologne Act for the requirement of reimbursement.

And finally, with respect to underground regulations, first of all the SUSMP is not a regulation as defined by the APA. Secondly, even if it were, there is again explicit exclusion for the issuance of waste discharge requirements and permits pursuant to 13363. Again, since the SUSMPs are part of a waste discharge requirement, this isn't applicable.

BOARD MEMBER FORSTER: You had five seconds.

MR. HELPERIN: I'm done.

CHAIRMAN BAGGETT: I would like to take a couple minute recess to meet with the parties up here, if I could, so we can discuss how we're going to proceed. Ten-minute recess.

(Recess taken)

CHAIRMAN BAGGETT: We're back in session briefly. We will go into closed session for about ten minutes, try to define the issues and then come back, and we want to do cross-examination and closing statements and work straight through until we're done.

We're recessed into closed session.

(Closed session held)

CHAIRMAN BAGGETT: Let's begin. It's 1:00.

Just for the record, the parties have agreed we've limited the cross-examination to two specific issues that the Board is particularly interested in hearing more about. That is the definition and the issue of redevelopment in the SUSMP permit and what language is pertinent in the modification proposed; the second area is of redevelopment and the three-quarter-inch design factor, whether that's applicable basinwide, should it be a different number, is that number correct, on what basis is it correct, the discussion of three quarter inches.

Then we will go to 15 minutes per party to cross-examine on whatever they want and do closing statements, however you want to spend that five minutes or thereabouts, and make a summation and close. That can be on anything the parties feel is relevant and that the

Board should consider.

It should be pointed out the testimony is quite voluminous and the record is quite broad. The Board is familiar with it and will become much more familiar with it in the coming month and a half as we have many executive sessions to deliberate the evidence and work among ourselves to craft a solution or make a decision on how we'll find.

With that, let's begin with NRDC, any witnesses -- NRDC et al., any witnesses you wish to cross-examine. If the witnesses could also sit up at the table, we think that makes more sense and have the attorneys approach and use the lectern.

MR. HELPERIN: Desi Alvarez.

MS. JENNINGS: Tell me all the people and they could be ready.

MR. HELPERIN: I'm going to just be calling three witnesses, Desi Alvarez, Dennis Dickerson and Xavier Swamikannu.

DESI ALVAREZ,

having been previously sworn, was recalled for cross-examination and testified as follows:

CROSS-EXAMINATION

BY MR. HELPERIN:

Q. Just two questions for you, Mr. Alvarez. To begin, the definition of redevelopment, you're familiar

with it?
A. I am.
Q. And do you know how it was developed?
A. There was a lot of discussion about the definition of redevelopment. This last definition of redevelopment I think was a surprise to us when we actually saw it in writing, the final final version, and that it would be all-inclusive because it tends to capture a lot more projects than I think anybody intended to capture.
Q. The first sentence of the definition has a three-part disjunctive which it says redevelopment means creation or addition of at least 5,000 square feet of impervious surface, creation or addition of 50 percent or more of impervious surface, and thirdly, making improvements to 50 percent or more of the existing structure.
The third part of that disjunctive, making improvements to 50 percent or more of the existing structure, is that particular phrase familiar to you?
A. Yes, it is.
Q. Do you know where that language came from?
A. Not specifically, but generically that was language that was discussed amongst all of us.
MR. HELPERIN: Thank you.
Dennis Dickerson, please.

DENNIS DICKERSON,

having been previously sworn, was recalled for cross-examination and testified as follows:

CROSS-EXAMINATION

BY MR. HELPERIN:

Q. How do you interpret this definition of redevelopment? Do you interpret it to apply to the addition -- or reroofing of a single-family home?

A. No.

Q. Do you interpret it to apply to the addition of a retaining wall?

A. No.

Q. Do you interpret it to apply to rewiring, replumbing or painting of a house?

A. No.

Q. And with respect to the third disjunctive that I was asking Mr. Alvarez about, can you tell us how that language got into this definition?

A. Yes. At the board meeting on January 26th, the Board entered into, at the end of the process of the day, a series of discussions about the nature of the changes that would be appropriate for -- to be in the final approved draft or final approved document.

On page 304 of the transcript, if the Board later wants to look at it, there is a discussion by our Chair where he's outlining a scenario that he wanted to make sure he captured within the context of the definition, and it really was applying to a fairly major kind of redevelopment. And so this is something that in terms of the final writing perhaps is not as perfect in its definition as it should be.

Now, along that line, we're more than willing and indeed I think had -- had we not gone through this entire process, a change of this sort would have been made much earlier as a result of normal discussions that go on, but unfortunately we've been deflected from that. I think it would be an easy matter to make a modification to provide that clarification to this particular definition.

Q. You agree that third disjunctive has some ambiguity in it?

A. Yes.

Q. And you're willing to clarify that?

A. Yes.

Q. And the rest of the definition, do you think it is clear?

A. Yes.

MR. HELPERIN: I have nothing more for Mr. Dickerson.

Mr. Swamikannu please.

XAVIER SWAMIKANNU,

having been previously sworn, was recalled for cross-examination and testified as follows:

CROSS-EXAMINATION

BY MR. HELPERIN:

Q. Is it true that you were -- that you developed the .75 inch numerical design standard that's in the current SUSMP?

A. I developed several options to treat basically the cost-effective volume of stormwater to remove pollutants. The three quarters of an inch standard is something that I looked at because L.A. County had considered that. But at the same time when I looked at what the basis was and the basis is based on the precipitation patterns in Los Angeles, using the concept of diminishing returns, when you plot the values you find a range where the mean starts to break and .75 for a representative station is in the middle of that break.

As I indicated in my testimony before, for coastal areas, even within Los Angeles, that pattern might be different, meaning the midpoint of the mean might be higher than .75.

Q. It seems a little odd perhaps that .75 is the exact same number that the County of Los Angeles has in its program. Isn't it true that during the Long Beach hearing there was suggestion that .75 inch design standard be inserted into the Long Beach permit -- that was back I think in July of 1999 -- in part based on the fact that the County already had a .75 inch standard?

A. When you consider the Long Beach permit, we looked at the share of new development and appropriate controls for new development, and one of the important things that came out was the necessity for some kind of design standard to limit the size of BMPs so that it's not costly. And I remember Dr. Gold asking the Board to impose a .75 standard at that time, to which I responded that we had not had the time to independently make our judgment on what an appropriate standard was, and so the Board at that time deferred the decision for a design standard to consideration when the SUSMP for L.A. County came up for review.

Q. So you had the option of adopting the .75 inch standard and deferred it so that you could independently review it and determine if it was the appropriate number?

A. That's correct.

Q. What was the model or the approach or the manner in which you determined it was the appropriate number?

A. The problem you're trying to address really is actually run-off. What's contaminated is not rainfall but more so run-off. And the presumption is that if it's totally impervious, all the precipitation ends up in run-off, but that's not generally the case.

So when I looked at the national models, they had different methods of calculating run-off and when I looked at the WUFAFC manual, there was a process that was laid out to calculate the run-off that needs to be treated based on this efficient model.

For Los Angeles, given the fact that much of the area is impervious, that value then is closer to .75

rather than somewhere lower like .3. Let me add that for a region like San Diego, the 85th percentile would be .6 and not .75, but the principle is the same.

Q. So you actually used these nationally accepted models and figures that represent local hydrologic characteristics in calculating the number?

A. That's correct. That's the independent judgment that I sought to bring to the process.

Q. And is there any variability or is it truly just .75?

A. It was variable because it depends on the rainfall pattern for each location.

Q. In the SUSMP there are other ways to calculate it?

A. I'm sorry. In the SUSMP there are four different approaches and when I looked at the four different approaches, the .75 is the easiest for anybody to understand because it's a fixed value to the rainfall precipitation. All the others involved some form of computation.

When I actually did the analysis of the four methods, and that is calculations in the administrative record, the values that come out of the four different methods are within ten percent of each other which means the .75 value is basically -- even though it might have been discussed with NRDC, it is a scientific approach to trying to address the design standard that is appropriate for BMPs.

Q. Just one last question. What about the fact that there are many different sources of stormwater pollution and different types of land uses and different types of contaminants that are of concern? Might it not be the case that you would want a different standard based on land use?

A. What we are talking about here is a design standard to address the most efficient volume of precipitation. We are not looking at pollutants. So I think if you're trying to address the difference in land uses within a particular area, you will be looking at the types of BMPs, not really the design standard because the design standard is based on the precipitation pattern, not the objective to remove any particular pollutant.

Q. One final question. What's wrong with .6?

A. .6 really, as I indicated, it's an average, .75 is an average for L.A. County. .6 was proposed initially in the draft by the permittees. The problem with .6 is that it's the low end of the mean, and perhaps we believe in averages and the average in this case is .75. For example, .75 would not be enough or would not be sufficient effort for west L.A.

Q. So .6 being the low end of the mean meaning that you still have an area on the curve where you could increase a little bit in terms of size and get a lot of bang for your buck.

A. The optimum really is the point at which the mean starts to level off. That's where the cutoff should be, and the cutoff usually is 90th percentile, which is what you see in other jurisdictions.

Q. 90th percentile?

A. 90th.

Q. What percentile are you using?

A. We are using 85th percentile.

MR. HELPERIN: I have nothing further.

CHAIRMAN BAGGETT: Any questions of the Board or any other parties?

MR. LEON: Thank you, Mr. Chairman.

CHAIRMAN BAGGETT: Do you have other witnesses or these are the witnesses?

MR. LEON: These are the ones.

(Laughter)

CHAIRMAN BAGGETT: This is the cast of characters.

MR. MONTEVIDEO: Mr. Chair, he shouldn't be able to cross his own witnesses again. That's really direct testimony.

CHAIRMAN BAGGETT: I would concur.

MR. LEON: The difficulty I have is that there was a misstatement I tried to correct through one of the other witnesses and has to do with the adoption of the BMP guide.

CHAIRMAN BAGGETT: In your summation you can summarize.

MR. LEON: All right.

CHAIRMAN BAGGETT: Do you have any witnesses you wish to call on cross-examination?

MR. LEON: No. I would have to call one of these guys. Thank you.

CHAIRMAN BAGGETT: Mr. Welch, do you have any witnesses you would like to call? I think this party is dismissed.

MR. WELCH: I may have just a couple of questions of these witnesses.

CHAIRMAN BAGGETT: Do you have any additional witnesses?

MR. WELCH: Mr. Dickerson and Mr. Xavier.

First, Mr. Dickerson.

CROSS-EXAMINATION

BY MR. WELCH:

Q. You mentioned -- you testified about the waiver provisions that are contained in the SUSMP?

A. Yes.

Q. And you said they would be appropriate in cases where there's limited space or potential for groundwater contamination?

A. I think I need to see a copy, if I may, so I make sure I'm accurate.

Q. Of the final SUSMP?

A. Yes.

Q. I'm handing you a copy.

A. Thank you. Okay. Right there are three specifics, extreme limitations of space for treatment, unfavorable or unstable soil conditions and site potential infiltration, groundwater contamination, risk of groundwater contamination because of unconfined land surface or an existing potential of ground -- do you want me to read them?

Q. Where in the record are you referring to?

A. On page 14 of 25 of the SUSMP document.

Q. And is that the section that outlines the appropriate circumstances for a waiver?

A. Yes.

Q. Would it be appropriate for one of the city permittees to grant a blanket waiver to retail gasoline outlets from compliance with the .75 design treatment standard recognizing the concerns of groundwater impact and limited space that apply for retail gasoline stations?

A. It would have to be based upon the fact that it's been considered and rejected as infeasible. That's the criteria. That's the initial criteria.

Q. And if a city permittee considered that and did reject the application of the .75 criteria as being infeasible for retail gasoline stations, would that be compliant with the SUSMP?

A. I think it would have to be based upon the specific -- the site-specific conditions as opposed to a category exemption. That's really what the waiver is about.

Q. So are you saying --

A. There's still the option for a permittee to come to us and submit an additional justification for impracticability. That's still something that's out there and that could be considered. I think that was where we were talking earlier about the categorical approach.

I would like to note that also on page 15 of 25, on the next page there's a limitation on the use of infiltration BMPs which deals with potential to contaminate groundwater. So that's also a consideration that should be taken into account.

Q. So for a gas station to comply with the SUSMP, you're saying that to obtain an exemption each individual city permittee would need to come forward and ask for a categorical exemption?

MR. LEON: Excuse me. I apologize. I'm going to object because this line of questioning appears to be seeking a concession on the applicability of the permit and it's beyond the scope of the two issues that we all agreed would be covered in the cross-examination.

MR. WELCH: Just in response, this is relevant to his testimony on direct and does --

CHAIRMAN BAGGETT: Proceed. Overruled. Proceed. Try to narrow to the two areas. It would be appreciated by the Board.

Q. BY MR. WELCH: Mr. Dickerson, again focusing on the .75 design standard, how would a city permittee be able to grant an exemption to retail gasoline stations?

A. The only thing I take question with is your using it in the plural, and here we're really talking about situations which are enumerated items here are very clear to site specific conditions. Now, if there was something of impracticability that was associated to a category, then you anticipate a permittee would need to submit that with justification. We certainly haven't seen any justification for that at the present time.

It would be very presumptive of me to make any judgment calls on that at this time. It's conceivable it could be done.

Q. If one of the city permittees came to that conclusion that it was infeasible for a retail gasoline station to comply with the .75 design treatment requirement, would it then be able to grant a blanket waiver to retail gasoline stations?

A. It would have to come to the Regional Board for review and we would have to evaluate that. It's what are the other justifications of impracticability, but there is a procedure that is allowed by the SUSMP for that to occur. Whether it would occur, I couldn't begin to judge.

MR. WELCH: Thank you.

CROSS-EXAMINATION

BY MR. WELCH:

Q. Mr. Swamikannu, are you a licensed engineer?

A. No.

Q. You testified earlier that there were some different ways that a gas station could comply with the .75 treatment requirements. Do you recall that testimony? You mentioned infiltration and storm ceptor and kind of a wetland in the box.
A. I provided some examples of situations.
Q. And those are examples of a way that a gas station might comply with the .75 standard?
A. The question was how do you dissolve contaminants as opposed to suspended, and I provided a couple of BMPs that address dissolved pollutants.
Q. And those different types of BMPs could be used to comply with the .75 design standard; right?
A. Yes. They could be used at gas stations, at municipal vehicle maintenance facilities, a whole series of establishments where there's vehicular activity.
Q. And you mentioned infiltration as a potential; is that right?
A. Infiltration is one option.
Q. And wouldn't infiltration raise a concern of potential groundwater contamination from a gas station?
A. In the SUSMP document that Dennis Dickerson referred to, there is a limitation on infiltration. There's also reference to an EPA document which clearly defines the conditions under which infiltration are not recommended and that document is referenced in the SUSMP. So that would be a basis to decide when is infiltration proper and when not.

Q. Can you say it's a blanket overall statement whether infiltration is appropriate for use in complying with the .75 standard for retail gasoline stations?

A. Please repeat that question.

Q. Can you say as a blanket statement whether infiltration can ever be appropriate for retail gasoline stations to comply with the .75 design standard?

A. The focus really should be on what is being infiltrated. Clearly if it's petroleum hydrocarbons, if you're talking about the area where spillage occurs, that particular area should be segregated. That should not be infiltrated.

Infiltration removes pollutants associated with heavy traffic that goes on at gas stations. Those can be retained in the first few inches of soil, and so perhaps by even modifying landscaping on a gasoline station you might be able to address that component. So I see a mixture of BMPs, not necessarily one that is the master solver of the problem.

Q. But if I understand what you were saying about gas stations, you would have a separation between the fuel area where there's a potential for spill and then a different grading for areas where the cars would drive onto the station; is that right?

A. That's right.

Q. And isn't that the type of structural control that's contained in the California Stormwater Quality Task Force BMP guide?

A. The structural control that's contained is a canopy over the area that you have fuel pumps. I'm not sure whether the document addresses run-off from the access roads to the gas station where you find heavy metals and others associated with automobiles.

Q. Let me point you to page 7 of the BMP guide. Doesn't that contain a discussion of grading similar to what you were talking about earlier as a structural control to prevent stormwater contamination from the gas station?

A. Are you talking about under the paragraph "fuel dispensing areas"?

Q. Yes.

A. That's correct. There's a discussion on grading. There's a description of preferred slopes and grading to keep run-on away from the fueling areas.

Q. Okay. And you participated in the working group that developed the California Stormwater Task Force BMP guide for the retail gas stations; correct?

A. That's correct.

Q. And that task force guide does not contain the .75 design standard that's contained in the SUSMP?

A. That's correct.

MR. WELCH: Thank you. I have nothing further.

CHAIRMAN BAGGETT: Any other witnesses you want to cross-examine?

MR. WELCH: No.

CHAIRMAN BAGGETT: Thank you.

The witnesses are excused unless you're going to call them.

MR. MONTEVIDEO: No, these gentlemen need to stay up here.

(Laughter)

CHAIRMAN BAGGETT: Is there anyone else you would like to hear from?

MR. MONTEVIDEO: Possibly Mr. Leon, but if I can wait and see. Thank you, Mr. Chair and Members of the Board.

CROSS-EXAMINATION

BY MR. MONTEVIDEO:

Q. Mr. Swamikannu, just a few questions for you, particulary on the .75 standard.

Based on your most recent testimony, it's my understanding that you started with the .75 standard because it was a standard that was utilized by the County; correct?

A. That's correct.

Q. Then --

A. But that is not the only standard.

Q. I understand. I understand. You have different ways to come up with a number and they're all within 10 percent?

A. Right.

Q. Okay. But you started with that approach because in effect it was in the settlement agreement with the County.

A. There are two other jurisdictions within L.A. County that already had numbers as well, so the three numbers I looked at. Three numbers I looked at. One is L.A. County and the other is Calabasas and the third was Santa Monica.

Q. Your starting point was the .75 as you calculated it?

A. Yes.

Q. And then you proceeded to do additional work to see if that was supportive?

A. I -- basically I wanted to understand the basis of .75 and so I investigated what the approach is for design criteria around the nation.

Q. Okay. I received some submittals earlier this week and there's been some discussions about those submittals. We received some documentation from your office on the state -- on the program in the state of Maryland, the state of Florida, and I think the state of Washington.

Those documents that were just recently submitted to us, is it accurate to say that you only just received those documents as well?

A. No.

Q. So you had copies or maybe it was a questionnaire that you received responses to?

A. Yes. The questionnaire was responded to in response to questions that I had to my counterparts in these states.

Q. Would it have been helpful to you to have had those questions responded to back in January prior to the time that the Board had looked at the issue?

A. Before we went for the board hearing, I was in contact with my counterparts in these states. If you look at the administrative record, the documents that are referenced are in the administrative record. For example, Washington's draft document, Maryland's draft document, the revised document.

Similarly, I downloaded information from the Florida program and reviewed these before I made the recommendation to the Regional Board.

Q. So it was the questionnaire -- it was actually getting written responses that you received recently that you didn't have before?

A. That's correct.

Q. When you look at those other states, what they have done in other states, is it correct to say that other states have applied different standards depending on the type of development, at least in some cases?

A. Yes and no.

Q. Please explain.

A. The criteria is applied to all development categories, 5,000 or more in two of those three states. In Florida it's 4,000 or more. The different criteria that Florida applies in some situations is simply because there is a threat to a sensitive environmental body where the threshold then is raised to 95 percent instead of the 90th percentile.

Q. Doesn't Florida recognize that there are different types of pollution, pollutants in different loads that come from different developments?

A. As I mentioned before, I talked to Eric Livingston from Florida and the issue raised is they have design criteria which BMPs are sized for, but they also have performance standards. And I think you're talking about performance standards as both criteria.

Q. When you combine those two, does it result in an overall different set of BMPs that may be available to one type of land use versus another type of land use?

A. The BMPs itself are specific to the kind of pollutants you're trying to address so your statement is correct. There are different kinds of BMPs for different places.

Q. Would you agree the other, particularly Florida, is more flexible in terms of the standards to be applied depending on the particular use?

A. No, because Florida has a minimum threshold and minimum is 80 percent removal of TSS, period. That's a performance standard. Anything else is simply more regional determination of how much more do we need to do as opposed to having total flexibility in terms of what needs to be done.

Q. So your testimony is that they have no more flexibility than you have?

A. They have a higher minimum threshold than we have.

Q. Okay. Florida has some -- has a different definition for redevelopment, do they not, than the Regional Board has adopted?

A. From my understanding -- I'd have to look at the document because I don't have my focus on that aspect.

Q. Okay. There are others as well. I think Washington, and if it's not Florida it may be Maryland, but my understanding of at least two of those programs is that they have a definition for redevelopment that is limited to the increase of 5,000 square feet of additional impervious surface.

Would you agree with that?

A. It appears correct.

Q. Okay. The definition of redevelopment that we have here is far broader than that. Would you agree?

A. I just have a suggestion. I think Dennis responded to that issue, so I would like him to respond to that issue.

Q. I appreciate that. You have more knowledge of the technical requirements and some of the other programs. That's why I'm directing it to you. I'm not sure Dennis has that much information about the other states. So in comparing what the other states have done versus what we have done, vis a vis the definition of redevelopment, it appears to me that our definition is much broader than what other states have done.

A. I can understand how one might interpret that to mean it's much broader.
Q. I'm just trying to understand whether or not you agree with that or not.
A. Part of the problem with writing definitions is that you get with what's suggested to you. In my understanding of the three-pronged definition here, the second and third prong was provided by the permittees to us. And so I think that's what the confusion is and I think what Dennis indicated is we might able to clarify so that our definition of redevelopment is consistent with that from other states.
Q. Then how would you clarify it? Would you give me a suggestion? Really I'd like to -- if you don't know, that's fine.
A. Basically this is -- I'm not committing my Board to anything. I'm not committing my Executive Officer to anything. I'm providing my opinion. In my opinion the definition could be addition of 5,000 square feet of impervious area.
Q. Period. End of sentence.
A. Yes.
Q. Okay.

CROSS-EXAMINATION

BY MR. MONTEVIDEO:
Q. Dennis, I didn't want to you think I forgot about you.

A. I was hoping.

Q. The definition of redevelopment, does the redevelopment threshold apply whether or not the particular project is discretionary or non-discretionary?

A. I think you would have to go back to the discussion that we had earlier on that. The Board, when it directed me to finalize the document, wanted us to include non-discretionary. So I would assume that it applies to non-discretionary and discretionary at this point.

Q. Okay. And obviously it depends whether or not you are in an environmentally sensitive area or a hillside development or one of those nine categories; correct?

A. It applies to those categories only.

Q. Okay. Now, help me out here. I'm trying to understand because there's been a lot of discussion about whether it applies to a single-family residence or not, a condominium project or not, or just some work that's being done.

Let me pick the example of Mayor Pro Tem Larry Forester in Signal Hill. He has a condo. It's on a hillside. He was remodeling. The example he gave was he was remodeling the inside of his home. If I remodel the inside of my home and I have to get electrical permits or plumbing permits or what have you and it's more than 50 percent of the interior of his home, as I read it, it seems like it applies to that situation along with a number of other situations. Do you read it in that same fashion or am I missing something when I'm reading these definitions?

A. I think I made it clear earlier in response to some questions that that particular definition probably does need to be looked at with respect to item number three or the third element of the definition. And as I made clear, the Board transcript -- what we were trying to do is take the concept from the Board transcript that our Chair wanted us to address, and it appears to be imperfect so we would have to go back and correct that.

Q. Isn't that problem compounded when you combine it with the application to non-discretionary projects?

A. I don't know for sure, but I'm going to have a guess here or at least a reasonable judgment call. Non-discretionary, as it applies to the categories, in my opinion probably is going to be a very unlikely event in the sense that we're looking at very specific thresholds or involvement here, especially with redevelopment, and I don't think you're going to have situations very often where that's even going to matter.

I think what the Board was trying to do was to close some kind of perceived loophole that could exist that they couldn't anticipate by including that in. They just wanted to make sure they weren't missing some big project that otherwise wouldn't have been addressed.

Q. Maybe it's just a fundamental disagreement or difference of opinion on what non-discretionary project means in cities. That's a very definitive term and it basically applies to all projects that need permits if you don't have to go to a planning commission or city council. Let me stop there and move on to the .75 standard for a minute.

The permit talks about different types of developments in developing -- using different BMPs depending on the type of developments. Consideration should be given to the type of development and the potential for stormwater pollution. I'm reading from the top of page 34. Do you see that?

A. I see the page. I can read it.

Q. Is it true that the .75 standard, and I know it can be calculated in different ways, is going to be the standard that's the standard that's the standard irrespective of which development you're talking about in these nine categories? That is, the same .75 standard is going to apply to a hundred-plus homes, 100,000 square feet of commercial development or a single-family residence on a hillside?

A. It applies to the categories I can see on page 34 of the permit as well as the other categories that the Board added to it, two other categories.

Q. Do you agree that the permit clearly allows the application of different standards? It almost implies it by Standard Urban Stormwater Mitigation Plans. Am I missing something? It doesn't allow for the application of different standards?

A. It certainly could be an option.
Q. Should we look at a different standard if you're talking about a single-family home or an in-fill project versus 100,000 square feet of commercial development? Wouldn't it make sense to give consideration to the fact there might not be sufficient space to address that standard?
A. If you're suggesting that the petitioners could have come to us at any time in this process and offered specific numerical standards for us to consider for each of those categories, we would be happy to do so. I don't believe they did.
Q. Part of the problem is getting beyond the battle over whether a standard, a specific standard, should apply, but in terms of moving forward on coming up with a number, does it make sense to try to bring the parties together to the table to try to look at whether a different standard or standards may apply to the various categories?
A. We tried very -- let me just say that we had an awful lot of discussions with not only the petitioners you represent but others as well who have not joined in this, and really I don't recall very much conversation in any substantive fashion through all those discussions about different kinds of standards for different areas.
Q. But putting aside where we've been, I guess where we're going to go, do you agree that would make sense to bring all the parties collectively together to

see if they can come up with a set of standards or a standard that would work for Los Angeles County?

A. From my position right now, we already have a standard in place.

CHAIRMAN BAGGETT: Are you about --

MR. MONTEVIDEO: Yes.

Q. Let me show you one other slide.

CHAIRMAN BAGGETT: Last slide then.

Q. BY MR. MONTEVIDEO: The state of Florida had recognized that the issues in terms of trying to address stormwater run-off were issues that involve a lot of different parties, and they actually did their best to attempt to build a consensus among the parties. Not that you can accomplish a consensus, but doesn't it make sense here to at least attempt to do that, to not have 40 different cities saying there's a problem here with other entities, saying let's see if we can work out something that makes sense for the different developments?

A. I think we did that very much in the process that we entered into in developing the current SUSMP, and I would also comment that we really, I think, have benefited greatly by the experiences of these other states and all the hours that they spent in coming up with standards that we then could refer to. So I think that's all been very helpful.

Q. Outside the public workshops, you had everybody at the same table? Did you have the environmental organizations with the cities and the planners and the developers at one table?

A. I think it's been referred to earlier as a certain amount of shuttle diplomacy that went on.

MR. MONTEVIDEO: Very good. Thank you.

CHAIRMAN BAGGETT: Thank you. With that we will have the five-minute summations and closing statements. We'll begin with respondents. NRDC.

We'll have a brief recess.

(Recess taken)

CHAIRMAN BAGGETT: Let's go back in session. The paper is changed. With that, we'll begin with NRDC and then the Regional Board, WSPA, and then the cities, et al.

MR. FLEISCHLI: Good afternoon. Steve Fleischli with the Santa Monica BayKeeper. My close will be brief.

I think one Board Member pointed out that the issues here were ripe for decision within the state of California. I would suggest they're not only ripe but they're rotten at this point because we are so far behind in terms of where we are in the state of California. I think that's been very, very clear with all the evidence in the record, in terms of the massive amounts of numbers, in terms of the numbers of other states that are moving forward with this. Let's move forward.

We've been working on this, at least in terms at the level of the Regional Board, for over a year now. It's almost exactly a year now. Every single time we've heard presentations from the municipalities at issue here that have petitioned, it's the same issues. It's the same discussion. There is no factual or scientific or legal or economic basis for what they're saying. They never come up here, they never come up and put up substantive information that will overturn what the Regional Board has done here, that will counter-weigh the massive amount of information that has already been provided in the record to support not only the .75 inch standard but the entire SUSMP proposal itself.

There may be some confusion about a few of the sections, the redevelopment section in particular. That does not seem like an insurmountable problem. If it wasn't always such extreme responses from some of these municipalities about the problems with the SUSMP, maybe we could have talked through some of these issues, especially the very minor ones that seem to be causing some confusion for people as to whether this applies to single-family housing with sinks and other issues like that and roofs. It doesn't really seem like that should be the focus of what the Board is looking at.

It comes down to the .75 standard. The .75 standard is uncontroverted. Experts from around the country have said that that is justified. Our own expert, Dr. Richard Horner, said that in his opinion, his technical expert opinion of working on these issues for several decades, that for Los Angeles at least one inch would be justified in this instance. It's preposterous to think we should go any lower than .75.

Lastly, I -- just to wrap up and maybe express the sentiments of David Nahai on this issue, and you might recall the Board itself did struggle with this long and hard. We had a meeting in September. They considered this issue. They didn't feel at that point in time that they could render a decision and they wanted to give the cities more opportunity to provide information, additional opportunity above and beyond what Dennis Dickerson had already provided to them. So they didn't make a decision until January of this year, nearly a year after this process had started and was already due in terms of a resolution by the terms of the permit.

So I would conclude by saying let's move forward to protect water quality in Los Angeles. The impairments are uncontroverted, whether it's heavy metals, whether it's fecal contamination, whether it's trash. It's all from new development projects. This is not the panacea to solve all our problems but it will help prevent it from getting worse.

Thank you.

CHAIRMAN BAGGETT: Thank you. Regional Board.

MR. LEON: Thank you very much.

We just want to close by thanking the Board Members for coming down to southern California to conduct this hearing. We very much appreciate your time and attention. Even having said that, I look forward to heading home to Sacramento right along with you.

There is one very minor housekeeping item that I would like to cover and that is the statement made by Ron Wilkness, a person who testified on behalf of WSPA. He made the statement that the California Stormwater Task Force had created a BMP guide that had been adopted by the Regional Board. In fact, it had not. If you think it's important, we would like leave to submit a copy of the Long Beach permit just to put that into the record.

MR. WELCH: We would have no objection to that.

CHAIRMAN BAGGETT: Would the other parties have an objection?

MR. MONTEVIDEO: No objection.

CHAIRMAN BAGGETT: It will be submitted for the record. Thank you.

MR. LEON: Thank you very much.

CHAIRMAN BAGGETT: Mr. Welch.

MR. WELCH: Thank you, Mr. Chairman and Members of the Board. I also thank you for your time and effort here yesterday and today. This is a very important issue for WSPA.

The Pollution Prevention Act of 1990 declares it's a national policy of the United States to prevent pollution at the source where possible and that treatment should be used only as a last resort. Here with the adoption of SUSMPs we find that the gun is being jumped and treatment is being required without even looking at whether it's necessary or appropriate.

As you've heard, we have put our scientific evidence into the record that shows that well-maintained retail gasoline stations do not cause significant stormwater problems or pollution when they're well-maintained. That's supported by our 1996 study.

Further, the California Stormwater Quality Task Force best management practice guide for retail gasoline stations, which we've also provided, sets out a number of source control and structural best management practices that can be implemented for retail gasoline stations.

It's our belief that if the California Stormwater Task Force BMPs are implemented, they will result in a far more effective control of stormwater pollution from retail gasoline stations because they wouldn't only apply to new and modified developments, but they apply to all of the existing retail gasoline stations.

The main difference between what the Stormwater Quality Task Force put together as best management practices and what's being required here in the SUSMP is the requirement for treatment, and that requirement is being applied to the retail gasoline stations even though the scientific evidence shows that from infiltration there's a risk of groundwater contamination, which I think is well-recognized, and for the other types of treatment devices we've shown the evidence just isn't there to show they're effective in treating the types of pollution that occur in the real world gasoline station.

We've also heard today that although there's this waiver provision in the rule, that the practicability of using that waiver option to work with the gasoline stations, it's just not practicable or feasible. If this SUSMP regulation goes forward, you'll have a number of different cities applying different requirements to gasoline stations. Some may try and apply waivers, some may not. All of this, any kind of waiver would have to go before the Regional Board and create numerous work.

What we've been trying to do at WSPA is prepare a statewide approach that will result in the most effective control of stormwater pollution from gasoline stations, and we believe that the work that was done by WSPA and then later by the members of the California Stormwater Quality Task Force, the work group which included representatives from the Regional Board and also from the State Board, we believe that that BMP guide has developed what will result in the most effective control of pollution.

We would submit to you that as part of your decision here with respect to requirements for retail gasoline stations that you direct the Regional Board to apply the best management practice guide to the retail gasoline stations. It makes sense to have one rule that applies across the board to all gasoline stations. It will result in the most effective control of stormwater pollution from gasoline stations.

I thank you for your time.

MR. MONTEVIDEO: Good afternoon again, Mr. Chair and Members of the Board. I also want to thank you for your patience throughout these last two days. It has been a long and arduous hearing and you have your work cut out for you. So I don't envy you, but I do appreciate your time and your efforts and your future efforts.

I want to end this where I began by saying this is not a question of who's in favor of water quality and or whether or not we have a water quality problem. Clearly we do. The issue frankly is how to best go about addressing the water quality problem that we have. There's been a lot of discussion about well, we have a process and the cities keep saying that the process hasn't been followed. We kind of followed it.

Congress has looked at this issue. They adopted and amended the Clean Water Act in 1987. They gave us guidelines to follow when they did that. They had reasons for doing that. Our state legislature followed by saying we're going to have you apply these same standards that Congress has laid down because we think this process needs to be followed because it's going to result in something that hopefully will work.

The process is an important part of what we're talking about today, and it's not just about the .75 standard. I wish I could say it was. The problem is that it's not only that standard that was not included in the permittees' SUSMP, there are some other issues, other items that maybe will make the application of the .75 so global that it will economically impractically burden the residents of the County of Los Angeles, particularly when you throw in and combine the .75 standard along with the definition of redevelopment, and you combine that with their last-minute addition of non-discretionary, and you combine that with their addition of environmentally sensitive areas. Those three combinations make for disastrous results.

When you ask the Regional Board about what this means, they're not really sure. That turns into our problem, not their problem because at the end of the day it's the cities that are going to have to deal with the lawsuits that will undoubtedly follow because we didn't apply it correctly or interpret it correctly.

We need to have provisions that are clear so that we first can implement them appropriately and second so that we can tell our citizenry what they really have to do, and finally so we can know that the actions that we're taking are in compliance with the Clean Water Act.

We've asked for clarification of these standards and of these particular provisions and we really haven't been able to obtain it today. And the reason I think we haven't been able to obtain it is because they thought they were doing one thing and thought they were doing another thing and they didn't look at the cumulative impact of what they really did and they didn't fully understand each step of what they really did.

Now, we need to have standards. We need to know what we're going to be doing and be able to apply that to our residents. The argument is well, we followed a process. Well, frankly, the process that was laid down in the permit would have resulted in a different result and a different SUSMP. The argument is well, you were not prejudiced because that process was not followed.

Then they go on to explain that by saying you weren't prejudiced because you simply would have submitted, resubmitted and resubmitted. We would have rejected, you would have submitted, we would have rejected, you would have resubmitted. By definition, that's prejudging what we would have submitted. They're telling you that regardless of what we submitted, they were going to reject it. That's the definition of prejudicial, prejudging.

We had a specific process in the permit. The process would have provided for us to meet and confer approaches to come up with the solution that would make sense for Los Angeles County and specifically to come up with the SUSMP program that would work. Had that process been followed, we would not have ended up with a SUSMP program with all these ambiguities and the problems with the application to in-fill projects and single-family homes. I feel confident we would have come up with a program that would have worked for the county if you put in -- if you brought to the table planners with builders with councilmembers with the environmental organizations. We could have come up with a program that would have worked. Unfortunately, we didn't.

We would ask the process be followed. You have 40 cities that are effectively taking issue with the action that was taken by the Regional Board, along with the building industry and even WSPA. Under your authority in the 13320, you have the ability to do several things or a combination of those several things. One, you can direct that appropriate action be taken. Obviously we think that makes sense. Two, you can take the appropriate action yourself. Three, you can refer the matter to another state agency. Four, you can do a combination of things.

In this case, we would suggest the following: We have a SUSMP program that technically under the permit because we were not provided the appropriate due process, our SUSMP program is in place or should be in place by law. This permit is only valid for another year. Let's have that program apply for the next year.

In the meantime, have this Board exercise its discretion to put together a panel, a committee, a task force, whatever you believe the appropriate name should be and the appropriate participants that should attend should be. We would suggest that committee be made up of not only representatives of Los Angeles County because other counties are waiting in the wings. We've heard testimony that San Diego put off their hearing. We heard testimony that Ventura has put off their determination pending what happens before this State Board in connection with the L.A. permit.

We would suggest, as was suggested in the state of Florida, that program implementation be shared by partnership involving all appropriate levels of government together with the public sector and all citizens. Cooperation and coordination among all of the partners involved in program implementation are cornerstones of a successful program.

Thank you.

CHAIRMAN BAGGETT: Thank you.

With that, does the Board have any comments? I'll just conclude before we close the hearing. I think it truly is a very important issue and I think the fact that our Board and staff came out here shows our dedication and interest to the issue, not just the State Board but for the people of the state of California.

A couple housekeeping issues. We will allow for closing briefs without new evidence. We will mail questions out by Monday, June 12th to the parties, specific questions that are of interest to the Board. There will be a ten-page limit. The list of specific issues of interest which will undoubtedly include the three-quarter-inch issue of the numeric standard and redevelopment language and possibly a couple other issues. The parties are not limited to commenting on those issues, but you are limited to ten pages.

The deadline for those written briefs will be July 7th, 5:00 p.m. due in the State Board's office in

Sacramento by that deadline if they're to be considered. The Board will adjourn to a closed session at some point after the briefs have been received in July to consider the material presented here today and the evidence in the record as well as the arguments made in the closing briefs.

We have options that range from uphold, deny, upholding the petition, denying the petition, remanding it back or modifying. So we have quite a range and we will be discussing that in executive session.

As Chair, I certainly appreciate the parties' patience and flexibility in this hearing. This is a new venture for this Board. I also appreciate Bruce, Marianne and Betsy's efforts in the journey they've made to come down and work with us. I also would like to thank my colleagues for their indulgence in embarking on this and willingness to travel to Torrance to conduct this hearing as a group.

With that, if there's no further business.

MS. JENNINGS: One last thing. I wanted to thank the Regional Board staff who did all of the set-up here and made it possible for us to all travel down here.

CHAIRMAN BAGGETT: With that, this hearing is a adjourned.

* * *

R0074052

STATE OF CALIFORNIA

I, Terri Emery, CSR No. 11598, a Certified Shorthand Reporter in and for the State of California, do hereby certify:

That, prior to being examined, the witness named in the foregoing deposition was by me duly sworn to testify the truth, the whole truth, and nothing but the truth;

That said deposition was taken down by me in shorthand at the time and place named therein and was thereafter transcribed under my supervision; that this transcript contains a full, true and correct record of the proceedings which took place at the time and place set forth in the caption hereto.

I further certify that I have no interest in the event of this action.

EXECUTED this 7th day of July, 2000.

Terri Emery

TERRI EMERY

United States
Environmental Protection
Agency

Enforcement and
Compliance Assurance
(2221-A)

EPA 310-R-00-003
September 2000

EPA

Profile of the Agricultural Chemical, Pesticide, and Fertilizer Industry

SECTOR 34 NOTEBOOK

EPA Office of Compliance Sector Notebook Project

R0074054

EPA Office of Compliance Sector Notebook Project

Profile of the Agricultural Chemical, Pesticide, and Fertilizer Industry

Sebtemper 2000

Office of Compliance
Office of Enforcement and Compliance Assurance
United States Environmental Protection Agency
1200 Pennsylvania Avenue, NW (MC 2221-A)
Washington, DC 20460

This report is one in a series of volumes published by the United States Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

Obtaining copies:

Electronic versions of all sector notebooks are available via Internet on the Enviroene World Wide Web at ***www.epa.gov/oeca/sector***. Enviroene is a free, public, environmental exchange system operated by EPA's Office of Enforcement and Compliance Assurance and Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization. Direct technical questions to the "Feedback" button on the bottom of the web page.

Purchase printed bound copies from the **Government Printing Office (GPO)** by consulting the order form at the back of this document or order via the Internet by visiting the on-line GPO Sales Product Catalog at ***https://orders.access.gpo.gov/su_docs/sale/prf/prf.html***. Search using the exact title of the document "Profile of the XXXX Industry" or simply "Sector Notebook." When ordering, use the GPO document number found in the order form at the back of this document.

Complimentary volumes are available to certain groups or subscribers, including public and academic libraries; federal, state, tribal, and local governments; and the media from EPA's National Service Center for Environmental Publications at **(800) 490-9198.** When ordering, use the EPA publication number found on the following page.

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
1200 Pennsylvania Avenue, NW (2223-A)
Washington, DC 20460
(202) 564-7017

For further information, and for answers to questions pertaining to these documents, please refer to the contact names listed on the following page.

SECTOR NOTEBOOK CONTACTS

Questions and comments regarding the individual documents should be directed to the specialists listed below. **See the Notebook web page at: *www.epa.gov/oeca/sector* for the most recent titles and staff contacts.**

EPA Publication Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*	Steve Hoover	564-7007
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-005.	Profile of the Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*	Scott Throwe	564-7013
EPA/310-R-95-008.	Profile of the Metal Mining Industry	Maria Malave	564-5027
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry	Debbie Thomas	564-5041
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	564-2628
EPA/310-R-95-012.	Profile of the Organic Chemical Industry *	Walter DeRieux	564-7067
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Profile of the Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Profile of the Pulp and Paper Industry	Seth Heminway	564-7017
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry		564-2310
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	564-7013
EPA/310-R-95-018.	Profile of the Transportation Equip. Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Profile of the Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Profile of the Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Profile of the Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Profile of the Metal Casting Industry	Steve Hoover	564-7007
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Profile of the Textile Industry		564-2310
EPA/310-R-98-001.	Profile of the Aerospace Industry	Anthony Raia	564-6045
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **	Seth Heminway	564-7017
EPA/310-R-99-006.	Profile of the Oil and Gas Extraction Industry	Dan Chadwick	564-7054
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide, and Fertilizer Industry	Michelle Yaras	564-4153
EPA/310-R-00-001	Profile of the Agricultural Crop Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-002	Profile of the Agricultural Livestock Production Industry	Ginah Mortensen	913-551-5211

Government Series

EPA/310-R-99-001.	Profile of Local Government Operations		564-2310

* Spanish translations available.

** This document revises compliance, enforcement, and toxic release inventory data for all profiles published in 1995.

R0074057

TABLE OF CONTENTS

R0074059

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AAEA	American Agricultural Economics Association
AAPCO	Association of American Pesticide Control Officials
AAPFCO	Association of American Plant Food Control Officials
ACPA	American Crop Protection Association
AFS	AIRS Facility Subsystem (CAA database)
AI	Active Ingredient
AIRS	Aerometric Information Retrieval System (CAA database)
ASA	American Society of Agronomy
BIFs	Boilers and Industrial Furnaces (RCRA)
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	CERCLA Information System
CFA	California Fertilizer Association
CFCs	Chlorofluorocarbons
CMA	Chemical Manufacturers Association
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSI	Common Sense Initiative
CSMA	Chemical Specialties Manufacturers Association
CWA	Clean Water Act
DAP	Diammonium Phosphate
DOT	Department of Transportation
D&B	Dun and Bradstreet Marketing Index
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FIRT	Fertilizer Industry Round Table
FQPA	Food Quality Protection Act
HAPs	Hazardous Air Pollutants (CAA)
HSDB	Hazardous Substances Data Bank
IDEA	Integrated Data for Enforcement Analysis
IFDC	International Fertilizer Development Center
LDR	Land Disposal Restrictions (RCRA)
LEPCs	Local Emergency Planning Committees
MACT	Maximum Achievable Control Technology (CAA)
MAP	Monoammonium Phosphate
MCLGs	Maximum Contaminant Level Goals
MCLs	Maximum Contaminant Levels
MEA	Monoethanolamine

MEK	Methyl Ethyl Ketone
MSDSs	Material Safety Data Sheets
NACD	National Association of Chemical Distributors
NASDA	National Association of State Departments of Agriculture
NASHA	North American Horticultural Supply Association
NCDB	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEC	Not Elsewhere Classified
NEIC	National Enforcement Investigation Center
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen Dioxide
NOV	Notice of Violation
NO_X	Nitrogen Oxide
NPCA	National Pest Control Association
NPDES	National Pollution Discharge Elimination System (CWA)
NPK	Nitrogen-Phosphorous-Potassium
NPL	National Priorities List
NRC	National Response Center
NRDC	National Resources Defense Council
NSP	Normal Superphosphate
NSPS	New Source Performance Standards (CAA)
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OPA	Oil Pollution Act
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
P2	Pollution Prevention
PCS	Permit Compliance System (CWA Database)
PRP	Potentially Responsible Party
POTW	Publicly Owned Treatments Works
PPI	Potash and Phosphate Institute
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEPs	Supplementary Environmental Projects
SERCs	State Emergency Response Commissions
SFIREG	State FIFRA Issues Research and Evaluation Group
SIC	Standard Industrial Classification
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
TOC	Total Organic Carbon
TFI	The Fertilizer Institute

TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TCRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
TSP	Triple Superphosphate
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
UIC	Underground Injection Control (SDWA)
UPFDA	United Products Formulators and Distributors Association
USDA	United States Department of Agriculture
UST	Underground Storage Tanks (RCRA)
VOCs	Volatile Organic Compounds
WCPA	Western Crop Protection Association

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Integrated environmental policies based upon comprehensive analysis of air, water and land pollution are a logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was originally initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded to its current form. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the

information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process who enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2223-A), 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Comments can also be uploaded to the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing this system. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or repackage the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2310.

II. INTRODUCTION TO THE AGRICULTURAL CHEMICAL INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the fertilizer, pesticide, and agricultural chemical industry. Facilities described within this document are described in terms of their Standard Industrial Classification (SIC) codes whenever possible.

II.A. Introduction, Background, and Scope of the Notebook

The scope of this Sector Notebook covers the manufacturing and production of fertilizers, the formulation of pesticide chemicals (both agricultural and non-agricultural) manufactured at separate facilities, and the production of other miscellaneous agricultural chemicals. It does not include the use, sale, distribution, or storage of such chemicals.

The Fertilizer, Pesticide, and Agricultural Chemical Industry is classified by the Office of Management and Budget (OMB) under Standard Industrial Classification (SIC) Industry Group Number 287. This classification corresponds to SIC codes which were established by the OMB to track the flow of goods and services within the economy. Industry Group Number 287 includes SIC codes:

2873-- Nitrogenous Fertilizers
2874-- Phosphatic Fertilizers
2875-- Fertilizers, Mixing Only
2879-- Pesticides and Agricultural Chemicals, Not Elsewhere Classified (n.e.c)

This notebook covers both fertilizer manufacturing and formulating operations including ammonia synthesis, nitric and phosphoric acid production, and the mixing, preparing, and packaging of nitrogenous and phosphatic fertilizers. Establishments engaged in manufacturing fertilizer materials or mixing fertilizers produced at the same establishment are classified under SIC codes 2873 and 2874. Mixing of fertilizer materials, such as compost, potting soil, and fertilizers made in plants not manufacturing fertilizer materials, is classified under SIC code 2875. This notebook does not include the mining or grinding of phosphate rock, which is classified under SIC code 1475, and it also does not include the use or application of fertilizers.

SIC code 2879, pesticides and agricultural chemicals not elsewhere classified (n.e.c.), hereafter referred to as pesticides and miscellaneous agricultural chemicals, covers only the formulating, preparing, and packaging of ready-to-use agricultural and household pest control chemicals. This industry code also includes establishments primarily engaged in the manufacturing or

R0074068

formulating of agricultural chemicals, not elsewhere classified, such as minor or trace elements and soil conditioners. This notebook does not discuss the use or application of pesticide products. Establishments primarily engaged in the manufacturing of basic or technical agricultural pesticides are classified in Industry Group 281 if the chemicals produced are inorganic or Industry Group 286 if the chemicals produced are organic. This notebook also does not cover the agricultural supply sector, SIC 5191, which is engaged in the wholesale and distribution of various agricultural supplies including fertilizers and pesticides. Also, there is little discussion of the potassium fertilizer industry as potash is classified under SIC 2819, Inorganic Chemicals n.e.c.

Federal government agencies, including United States EPA, are beginning to implement an industrial classification system developed by OMB to replace the SIC code system. The new system, which is based on similar production processes, is called the North American Industrial Classification System (NAICS). In the NAIC system, the manufacturing of nitrogenous fertilizers (SIC 2873) is classified as NAIC 325311, phosphatic fertilizers (SIC 2874) as NAIC 325312, and fertilizer mixing only (SIC 2875) as NAIC 325314. Pesticide formulating and agricultural chemicals n.e.c. (SIC 2879) is classified under NAIC 32532. Because EPA databases, and other databases used in this document, are still using the SIC system, the industry sectors described in this Sector Notebook are described in terms of their SIC codes.

II.B. Characterization of the Fertilizer, Pesticide, and Agricultural Chemical Industry

As the world population increases, crop lands are unable to meet the growing demand for food without employing some method of crop enhancement. There are five common practices used to meet the growing demand:

- increasing tilled acreage
- improving plant strains
- introducing or expanding irrigation
- controlling pest by chemical or biological methods
- initiating or increasing fertilizer usage

Increased utilization of the last two methods has created a large agrichemical industry which produces a wide variety of products designed to increase crop production and protect crops from disease and pests (Kent, 1992). Together, the production of fertilizers and the formulation of pesticides was a $18.8 billion industry in 1992, employing over 40,000 people (USDOC, 1995).

Plants require 18 elements to grow, the most important being oxygen, carbon, hydrogen, nitrogen, phosphorous, and potassium. Oxygen, carbon, and hydrogen are obtained from the atmosphere and water, while nitrogen, phosphorous, and potassium are naturally obtained from soil. However, under current high yield production methods, soils are stripped of the essential nutrients, requiring the addition of fertilizers (primarily consisting of nitrogen, phosphorous, and potassium) to resupply the land. The additional 12 essential nutrients are generally maintained in soil at sufficient levels for plant growth, but they may be added to some fertilizers (Kent, 1992).

Even before the addition of nutrients to farm lands, farmers were forced to protect their crops against pests with chemicals. References to pesticide usage date back to 1000 B.C. Pests are continuously adapting to pesticide chemicals requiring new pesticides and the usage of multiple chemical agents. The industry is rapidly changing due to biological adaptation of pests, laboratory discoveries, and government regulation (Kent, 1992). The pesticide industry is faced with the need for new formulations and the abundance of possible combinations, but restricted by cost factors and a sometimes lengthy registration process.

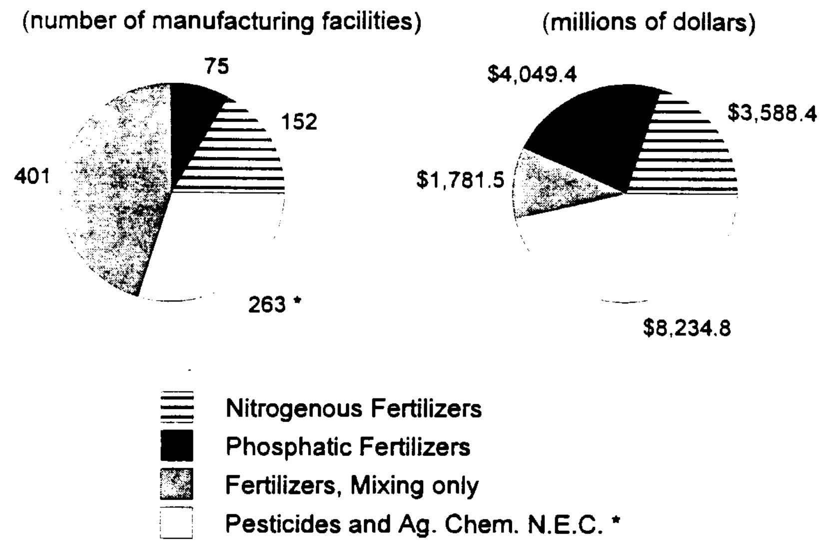
Pesticides are applied on about three-quarters of United States farms and households. Farmers' expenditures on pesticides were equal to 4.6 percent of total farm production expenditures in 1995, up from 3.9 percent in 1993. About one billion pounds of active ingredient of conventional pesticides are used annually in the United States; this usage involves about 21,000 pesticide products (including non-agricultural products) and 875 active ingredients registered under the Federal Pesticide Law, according to the *1994 and 1995 Market Estimates for Pesticides Industry Sales and Usage* (Aspelin, 1997).

II.B.1. Product Characterization

This notebook covers all aspects of fertilizer production and pesticide formulating and packaging. However, because the industrial processes, pollutant outputs, economics, size, and geographic distribution of the two industries are different, they are dealt with separately throughout the notebook.

Figure 1 compares the number of manufacturing facilities and value of shipments for each of the major sectors within the Fertilizer, Pesticide, and Agricultural Chemical Industry, as reported by the United States Bureau of Census. The figure shows that the fertilizer mixing industry has the largest number of facilities but the smallest value of shipments. This reflects that, compared to other sub-sectors within the Fertilizer, Pesticide and Agricultural Chemical Industry, these facilities produce a relatively small volume of product and sell a relatively low value product. Phosphatic fertilizer producers, on the other hand, comprise the smallest number of facilities but have a relatively large share of the industry's value of shipments, reflecting that individual facilities produce a relatively large volume of product.

Figure 1: Number of Facilities and Value of Shipments of the Fertilizer, Pesticide, and Agricultural Chemical Manufacturing Industry



Source: 1992 Census of Manufacturers, Industry Series: Agricultural Chemicals, United States Department of Commerce, Bureau of the Census, May 1995.
** United States EPA has identified over 8,000 establishments that could fall within this SIC code as it is defined by the OMB. See discussion in text below.*

The Census of Manufacturers reports 263 establishments that can be defined as producing pesticides and miscellaneous agricultural chemicals. These establishments reportedly account for almost half of the value of shipments for the sector. There are over 8,000 establishments identified by the United States EPA that manufacture, formulate and package pesticides and other agricultural chemicals and that could fall within OMB's SIC code definition for this sector. Many of these are small establishments and establishments that have a primary line of business other than producing pesticides and other miscellaneous agricultural chemicals. The Census only counts those facilities which report an SIC code as their primary line of business, thus the number of facilities shown above is not inclusive of all facilities involved in agricultural chemical production. Under the "Pesticides and Miscellaneous Agricultural Chemicals" heading later in this section, other pesticide producing establishment counts are presented based on EPA estimates and reporting under section 7 of the Federal Insecticide, Fungicide, and Rodenticide Act.

R0074071

Nitrogenous Fertilizers

The nitrogenous fertilizer industry includes the production of synthetic ammonia, nitric acid, ammonium nitrate, and urea. Synthetic ammonia and nitric acid, however, are used primarily as intermediates in the production of ammonium nitrate and urea fertilizers. Table 1 lists specific products classified as nitrogenous fertilizers by OMB.

Table 1: Nitrogenous Fertilizer Products (SIC 2873)
Ammonia liquor
Ammonium nitrate
Ammonium sulfate
Anhydrous ammonia
Aqua ammonia
Fertilizers, mixed, produced in nitrogenous fertilizer plants
Fertilizers, natural
Nitric acid
Nitrogen fertilizer solutions
Plant foods, mixed in nitrogenous fertilizer plants
Urea
Source: Standard Industrial Classification Manual, Office of Management and Budget, 1987.

Synthetic Ammonia

Synthetic ammonia refers to ammonia that has been synthesized from natural gas. In this process, natural gas molecules are reduced to carbon and hydrogen. The hydrogen is then purified and reacted with nitrogen to produce ammonia. Approximately 75 percent of the synthetic ammonia produced in the United States is used as fertilizer, either directly as ammonia or indirectly after fertilizer synthesis into urea, ammonium nitrate, and monoammonium or diammonium phosphates. One-third of the fertilizer nitrogen is applied directly to the land as anhydrous ammonia. The remaining 25 percent of ammonia produced in the United States is used as raw material in the manufacture of polymeric resins, explosives, nitric acid, and other products (USEPA, 1993a).

Nitric Acid

Nitric acid is formed by concentration, absorption, and oxidation of anhydrous ammonia. About 70 percent of the nitric acid produced is consumed as an intermediate in the manufacture of ammonium nitrate (NH_4NO_3), which is primarily used in fertilizers. Another 5 to 10 percent of the nitric acid produced is used in adipic acid manufacturing, an intermediate in nylon production. Explosive manufacturing utilizes nitric acid for organic nitrations to produce nitrobenzene, dinitrotoluenes, and other chemical intermediates. Other end uses of nitric acid are gold and silver separation, military munitions, steel and brass pickling, photoengraving, and acidulation of phosphate rock (USEPA, 1993a).

Ammonium Nitrate

Ammonium nitrate is produced by neutralizing nitric acid with ammonia. Approximately 15 to 20 percent of ammonium nitrate is used for explosives and the balance for fertilizer. Ammonium nitrate is marketed in several forms, depending upon its use. Liquid ammonium nitrate may be sold as a fertilizer, generally in combination with urea. Liquid ammonium nitrate may also be concentrated to form an ammonium nitrate "melt" for use in solids formation processes. Solid ammonium nitrate may be produced in the form of prills, grains, granules or crystals. Prills, round or needle-shaped aggregates, can be produced in either high or low density form, depending on the concentration of the melt. High density prills, granules and crystals are used as fertilizer, grains are used solely in explosives, and low density prills can be used as either fertilizer or explosives (USEPA, 1993a).

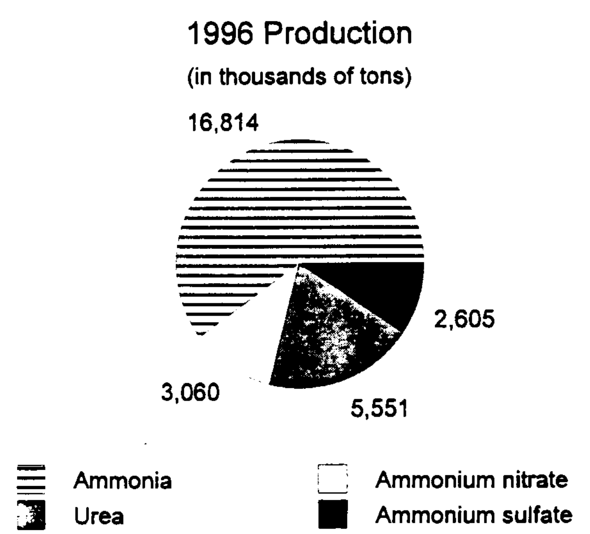
Urea

Urea, also known as carbamide or carbonyl diamide, is produced by reacting ammonia with carbon dioxide. Eighty-five percent of urea solution produced is used in fertilizer mixtures, with three percent going to animal feed supplements and 12 percent is used for plastics and other uses. Urea is marketed as a solution or in solid form. Most solids are produced as prills or granules for use as fertilizer or protein supplement in animal feed, and in plastics manufacturing (USEPA, 1993a).

Ammonium sulfate

It is not economically feasible to produce ammonium sulfate for use as a fertilizer. However, ammonium sulfate is formed as a by-product of other process such as acid scrubbing of coke oven gas, synthetic fiber production, and the ammoniation of process sulfuric acid (Hoffmeister, 1993). Therefore, the production of ammonium sulfate is not described in this notebook.

Figure 2: Product Distribution for SIC 2873, Nitrogenous Fertilizers



Source: Fertilizer Institute data as reported in Chemical and Engineering News, June 23, 1998. Figures are based on Fertilizer Institute surveys and may not represent the entire industry.

Phosphatic Fertilizers

The phosphatic fertilizer industry can be divided into three major segments: phosphoric acid, granular ammonium phosphate, and normal and triple superphosphate. Table 2 lists these, and a few additional, less common products classified as phosphatic fertilizers by OMB.

Table 2: Phosphatic Fertilizer Products (SIC 2874)
Ammonium phosphates Calcium meta-phosphates Defluorinated phosphates Diammonium phosphates Fertilizers, mixed, produced in phosphatic fertilizer plants Phosphoric acid Plant foods, mixed in phosphatic fertilizer plants Superphosphates, ammoniated and not ammoniated
Source: Standard Industrial Classification Manual, Office of Management and Budget, 1987.

R0074074

Phosphoric Acid

Phosphoric acid (H_3PO_4) can be manufactured using either a wet or a thermal process to react phosphate rock with sulfuric acid. Approximately 96 percent of the phosphoric acid produced in the United States is produced using the wet process. Wet process phosphoric acid has a phosphorous concentration typically ranging from 26-30% as phosphorous pentoxide (P_2O_5) and is used in the production of ammonium phosphates and triple superphosphates. Thermal process phosphoric acid is commonly used in the manufacture of high grade chemicals requiring a much higher purity.

Ammonium Phosphates

Ammonium phosphate ($NH_4H_2PO_4$) is produced by reacting phosphoric acid with anhydrous ammonia. Both solid and liquid ammonium phosphatic fertilizers are produced in the United States The most common ammonium phosphatic fertilizer grades are monoammonium phosphate (MAP) and diammonium phosphate (DAP). DAP has become one of the most commonly used fertilizers because it provides a large quantity of plant food, is compatible with most mix fertilizer ingredients, and is nonexplosive. It may be directly applied or used in irrigation systems as it is completely soluble in water. DAP is also preferred over MAP because it is capable of fixing twice as much ammonia per phosphorous pentoxide in solid form (Nielson, 1987.) MAP contains a higher concentration of phosphorous pentoxide than DAP. It is favored for use with alkaline soils and may be applied either directly or in a dry blend.

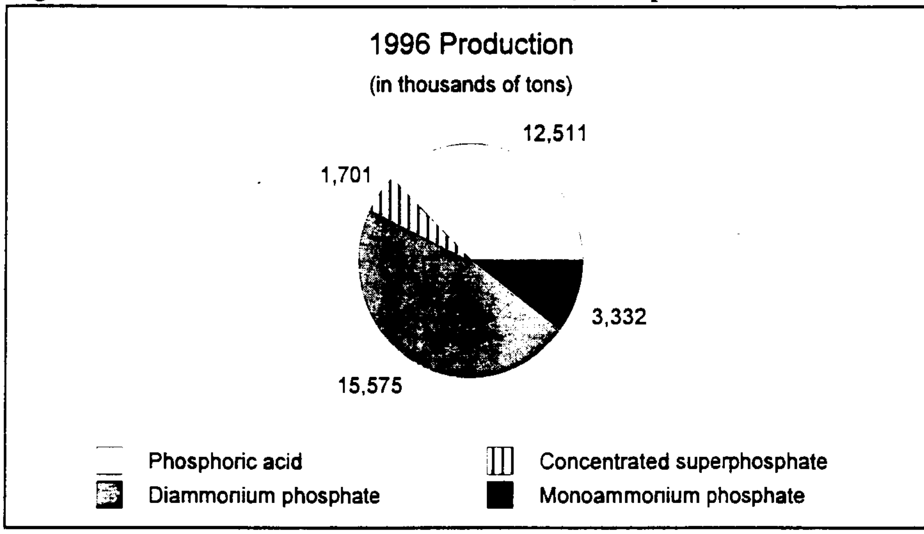
Normal Superphosphates

Like phosphoric acid, normal, or "ordinary," superphosphate fertilizers are produced by reacting phosphate rock with sulfuric acid. However, normal superphosphate (NSP) retains calcium sulfate which forms by the reaction between phosphate rock and sulfuric acid. For this reason NSP retains its importance wherever sulphur deficiency limits crop yields (UNEP, 1996). NSP refers to fertilizer material containing 15 to 21 percent phosphorous as phosphorous pentoxide (P_2O_5). As defined by the Census Bureau, NSP contains not more than 22 percent of available P_2O_5 (USEPA, 1993a). Production of NSP has given way to the higher-yielding triple superphosphates and ammonium phosphates. In 1990, production of NSP accounted for only one percent by weight of the phosphorous fertilizer industry. Because of its low P_2O_5 concentration, shipping can be prohibitively expensive due to the large volumes required. NSP is favored in low cost Nitrogen-Phosphorous-Potassium (NPK) mixes because it is a less expensive form of phosphorous, however, it is unacceptable for higher-grade mixes (Kent, 1992).

Triple Superphosphates

Triple superphosphates (TSP) are produced by reacting ground phosphate rock with phosphoric acid. Triple superphosphate is also known as double, treble, or concentrated superphosphate. The phosphorus content of triple superphosphates is over 40 percent, measured as phosphorus pentoxide (P_2O_5), which is its main advantage over other phosphatic fertilizers (USEPA, 1993a). TSP began to be produced in large quantities when wet process phosphoric acid production became available commercially. It is commonly produced along with phosphoric acid near phosphate rock supplies. TSP may be applied directly or as a bulk blend (Kent, 1992).

Figure 3: Product Distribution for SIC 2874, Phosphorous Fertilizers



Source: Chemical and Engineering News, June 23, 1998. Figures are based on Fertilizer Institute surveys and may not represent the entire industry.

Fertilizers, Mixing Only

A significant part of the fertilizer industry only purchases fertilizer materials in bulk from fertilizer manufacturing facilities and mixes them to sell as a fertilizer formulation.

Phosphorous is the single nutrient most likely to be applied in a fertilizer mixture, as seen in Table 3.

R0074076

Table 3: 1990 Direct vs Mixed Application of Primary Fertilizer Nutrients

Nutrient	Method, % applied	
	Direct	Mixtures
Nitrogen	80	20
Phosphorous	8	92
Potassium	65	35
TOTAL	61	39

Source: Hoffmeister, G., "Fertilizers," Kirk-Othmer Encyclopedia of Chemical Technology, V. 10, 1993.

Although the Bureau of the Census only counts 401 facilities reporting the SIC code for fertilizer mixing (2875) in 1992, other sources estimated the true number of fertilizer mixing facilities to be closer to five or six thousand in 1984 (Adrilenas and Vroomen, 1990). About half of applied fertilizers are bulk blends. Fertilizer mixing facilities generally serve a small area such as farms within a ten to fifty mile radius. The processes involved are simple and relatively little value is added to the raw materials purchased by mixing facilities. Nevertheless, there are many of these facilities and volume of production results in a $1.8 billion industry (value of annual shipments). The industrial process is simple and resembles that of the pesticide formulating sector. A brief discussion of fertilizer mixing processes is included in this notebook.

Pesticides and Miscellaneous Agricultural Chemicals

The pesticides and agricultural chemicals n.e.c. (referred to here as pesticides and miscellaneous agricultural chemicals) industry group (SIC 2879) formulates and prepares ready to use agricultural and household pesticides and other agricultural chemicals. The manufacture of pesticide active ingredients is classified under either Industry Group 281 for inorganic chemicals or 286 for organics which are not covered by this notebook. *(See Profile of the Inorganic Chemicals Industry and Profile of the Organic Chemicals Industry Sector Notebooks.)* In the United States, over 850 different pesticide formulations and preparations are produced. In 1995, 31 new active ingredients were registered in the United States (Aspelin, 1997). Most of these pesticides can be classified as either insecticides, herbicides, or fungicides, although many other minor classifications exist. Also included

R0074077

in this category are blends of fertilizers and pesticides produced at pesticide formulating and mixing facilities. Table 4 lists the pesticides and other products included in SIC 2879.

Table 4: SIC 2879 Pesticides and Miscellaneous Agricultural Chemicals, List of Products

Agricultural disinfectants	Insecticides, agricultural and	Poison, household
Agricultural pesticides	household	Pyrethrin
Arsenates and arsenites	Lime-sulfur, dry and solution	Rodenticides
Bordeaux mixture	Lindane, formulated	Rotenone
Cattle dips and sheep dips	Moth repellants	Soil conditioners
DDT	Nicotine and salts	Sulfur dust
Defoliants	Paris green	Thiocyanates
Fly sprays	Pesticides, household	Trace elements
Fungicides	Phytoactin	(agrichemical)
Growth regulants	Plant hormones	Xanthone
Herbicides		

Source: Standard Industrial Classification Manual, Office of Management and Budget, 1987.

In 1995, 77 percent (by volume) of all pesticides were used for agriculture, 12 percent for industrial, commercial, or governmental lands or facilities, and 11 percent for homes and gardens (Aspelin, 1997). Non-agricultural pesticides and miscellaneous agricultural chemicals are included in the data presented for sales, production, waste management, and enforcement and compliance. However, since they represent a relatively small part of the industry and cover a wide range of chemicals and production processes, these products are not covered in the Industrial Processes and Pollutant Outputs sections of this document.

Herbicides

Herbicides (in both value and quantity) are the largest class of pesticides used in the United States, as well as in the world. This class of pesticides, which accounts for approximately fifty percent of the value of aggregate world pesticide usage, is used to destroy or control a wide variety of weeds and other unwanted plants. Because of its demonstrated farm labor savings, nearly all the agricultural land in the United States is currently being treated with some type of herbicide. In recent years, approximately fifty percent of total United States pesticide consumption (by value) was herbicides (USITC, 1994).

Insecticides

Insecticides are the second largest pesticide category (by value) used in the United States and in the world. In the early 1990s, insecticides accounted for approximately twenty-nine percent of the total value of United States pesticide consumption. Historically, the category of synthetic organic insecticides has been divided into one of four major chemical groups:

- organochlorines (e.g., DDT and chlordane)
- organophosphates (e.g., parathion and diazinon)
- carbamates (e.g., carbaryl)
- pyrethroids (e.g., natural and synthetic)

Several compounds, discovered during the 1950s, found widespread use in agriculture because of their high toxicity to a variety of insects. However, the qualities that made these chemicals so desirable also led to their eventual removal from the market, as these products also proved harmful to humans and to the environment. Spurred in part by increased environmental concern, researchers developed a new series of less toxic synthetic compounds called pyrethroids. These compounds are based on the natural pyrethroids, which are found in such plants as the chrysanthemum (USITC, 1994).

Fungicides

In recent years, fungicides accounted for approximately ten percent of the value of total United States pesticide consumption. Fungicides are used today primarily to protect agricultural crops and seeds from various fungi; farmers previously used inorganic products, such as elemental sulfur and copper sulfate. Initially, synthetic products were commercially unsuccessful, because of their high manufacturing costs. By the 1940s, however, newer, less expensive products became commercially successful. Today, fungicides are manufactured from a variety of chemical classes. Commercially, the most important fungicides are halogenated compounds, the carbamates and dithiocarbamates, and organophosphates (USITC, 1994).

Other Pesticides

Although small in total quantity consumed, a number of other classes of pesticide products are on the market. Some of these pesticides are not covered by this Notebook.

- **Biological pesticides**, also known as biopesticides, include true biological agents, living or reproduced biological entities such as viruses or bacteria, and naturally occurring biochemicals such as plant growth regulators, hormones, and insect sexual attractants (pheromones) that function by modes of action other than innate toxicity. At the end of 1998, there were approximately 175 registered biopesticide active ingredients and 700 products. Generally, biological pesticides pose little or no risk to human health or the environment. Accordingly EPA generally requires much less data to register a biopesticide than to register a conventional pesticide (USEPA, 1999). To further facilitate the registration of biopesticides, in 1994, EPA established the Biopesticides and Pollution Prevention Division in the Office of Pesticide Programs.

- **Plant growth regulators** have been developed by many companies to improve crop production. Plant growth regulators are produced for a

R0074079

variety of purposes, including loosening ripened fruits for faster harvest; controlling the size and firmness of fruits; and regulating the size of a plant to increase branching. These products account for a small portion of world and United States usage. Future development will probably be directed toward selected crops for which the application of these specialty products is found to be the most cost effective (USITC, 1994).

- **Sex attractants** may be used to attract insects to traps or to confuse specific male insects, making it difficult to locate females for mating. Commercially available sexual attractants are synthetically produced compounds. Insect growth regulators, such as juvenile growth hormones, are synthetic compounds similar to the natural chemicals that regulate insect growth.

- **Genetically modified plants** are plants developed through the use of biotechnology. There are three types of plants that are relevant to pest control: herbicide-tolerant plants (which can tolerate certain types of herbicides), insect-resistant plants (which can withstand attacks by certain insects), and virus- and other pest-resistant plants (which are immune to some types of plant viruses and other plant pests). As of September 1994, several genetically modified plants had been commercialized and had elicited optimism that genetically modified plants would become an important new approach to controlling pests (USDA, 1995).

The environmental benefits of reduced use of chemical pesticides are also significant. Environmental side effects of traditional pesticides include the cost of providing alternative sources of drinking water, increased treatment costs for public and private water systems, lost boating and swimming opportunities, worker safety concerns, exposure to nearby residents, increased exposures for farm children, possible loss of biodiversity, pressure on threatened and endangered species, and damage to recreational and fishery resources (USDA, 1995).

Pesticide Formulations

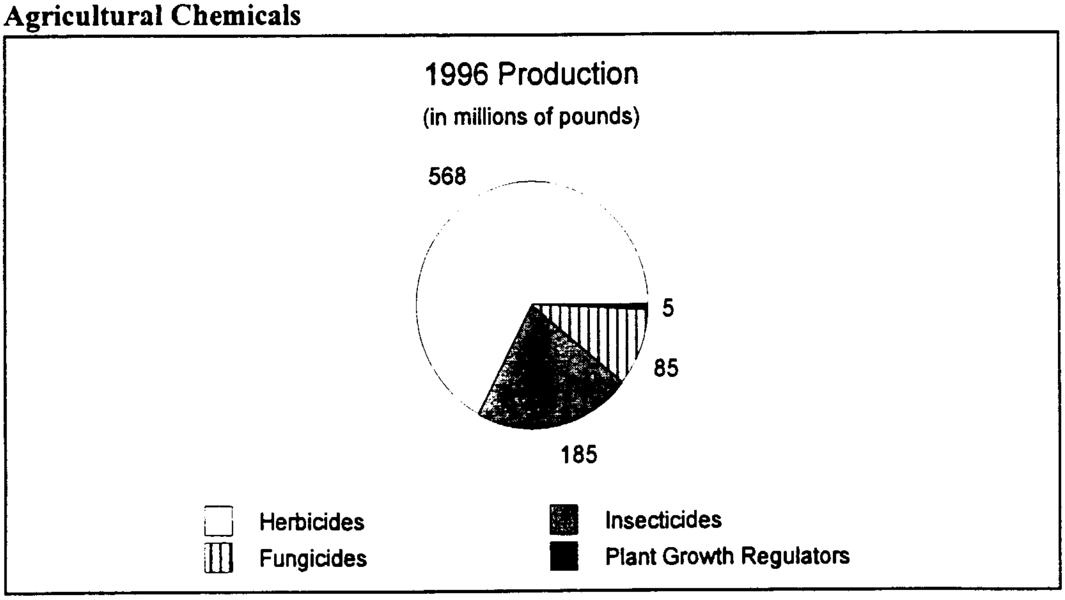
Pesticide formulations may exist in any of the three following physical states: liquid, dry, and pressurized gas. The liquid formulation may be applied directly in liquid form or propelled as an aerosol. Some common dry-based formulations are dusts, wettable powders, granules, treated seed, bait pellets, encapsulated, and cubes. Pressurized gas formulations are used primarily for soil fumigation (USEPA, 1996). Gaseous pesticides can be subjected to high pressures which often convert the formulation to a liquid which can be stored, transported and applied from gas cylinders.

Repackaging of pesticide formulations is common when materials are to be transferred from bulk storage to a smaller scale of packaging for use by a consumer. Products are typically repackaged in smaller containers and consumer-specific labeling is added (USEPA, 1996).

In 1995, roughly 79 percent of all pesticides were used on agricultural cropland. The remainder were used in private homes and gardens and on commercial and industrial property (Aspelin, 1997). Therefore, although non-agricultural pesticides are included in SIC code 2879 and thus the notebook. the specific packaging or formulating requirements of those products are not included. However, the sales, production, pollutant releases, and enforcement and compliance data reflect non-agricultural pesticides as well as agricultural pesticides.

The majority of pesticides were used on only a few major crops: cotton, corn, soybeans, and apples. The major pesticide chemicals used in United States agricultural crop production are atrazine, metolachlor, metam sodium, methyl bromide[1], and dichloropropene (Aspelin, 1997).

Figure 4: Product Distribution for SIC 2879, Pesticides and Miscellaneous Agricultural Chemicals



Source: American Crop Protection Association, as reported in Chemical and Engineering News, June 23, 1998.

[1] Production and importation of methyl bromide is currently being phased out. It will be reduced from 1991 levels and will be completely phased out in 2005.

R0074081

Establishment Reporting Under FIFRA Section 7

Information reported under section 7 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is another source of facility level data for the pesticides industry. All establishments that produce pesticides in the United States or that import pesticides into the United States are required to register and report their production volume to the EPA. These data differ from the Census of Manufacturers data presented above for the agricultural chemical industry as a whole. The Census of Manufacturers data only covers facilities that are manufacturing these products, while the FIFRA data system more broadly includes establishments that "produce" these products. The term. "produce" has been defined under FIFRA and 40 CFR Part 167 to mean "to manufacture, prepare, propagate, compound, or process any pesticide. including any pesticide produced pursuant to section 5 of FIFRA, any active ingredient, or device, or to package, repackage, label, relabel, or otherwise change the container of any pesticide or device." Repackaging or otherwise changing the container of any pesticide or device in bulk amounts constitutes pesticide production. Under FIFRA section 7, products are reported under one of four product types:

1) Technical material or active ingredient
2) End-use blend, formulation, or concentrate
3) Repackaged or relabeled product
4) Device

The total number of establishments, domestic and foreign, that reported to EPA under FIFRA section 7 are presented in Table 5. Although there are approximately twelve to thirteen thousand Active Registered Pesticide-Producing Establishments, table 5 below only lists establishments that reported actual production for the calender year 1996. The establishments that reported either zero production or who were non-reporters for calender year 1996 are not included in the establishment number totals in the table. The significant difference between the pesticide producing establishment counts as reported under section 7 (8,612) and the pesticide and agricultural chemical manufacturers n.e.c. reported by the Census (263) can be attributed to the section 7 broad inclusion of producers vs. the relatively narrow, Census inclusion of manufacturers. In addition, the Census of Manufacturers uses SIC code definitions which lump many pesticide active ingredient manufacturers into SIC codes that represent organic or inorganic chemicals. Establishments classified under the first product type, as well as some of the second, may include facilities classified under the chemical manufacturing SIC codes 286 or 281. Also, the Census only counts a facility in an SIC code if they report a product in that SIC code as their primary line of business. Therefore, facilities producing a variety of products might not be classified under all applicable SIC codes. For example, a facility which produces many different types of fertilizers as well as some pesticides might only be counted under the fertilizer SIC codes by the Census Bureau to avoid double counting of facilities.

Table 5: Establishment Counts Based on Product Type*

Type	Product	Total	Domestic	Foreign
1	Technical Material, Active Ingredient	555	410	145
2	End-Use Blend, Formulation, Concentrate	2,590	2,454	136
3	Repackaged or Relabeled Goods	5,267	5,243	24
4	Devices	200	166	34
	Total	8,612	8,273	339

Source: U.S.EPA, Enforcement, Planning, Targeting & Data Division,, FIFRA, section 7 Data System, United States EPA. 1996.

R0074083

II.B.2. Industry Size and Geographic Distribution

Table 6 lists the facility size distribution within the nitrogenous fertilizer, phosphatic fertilizer, fertilizer mixing, and pesticide and agrichemical formulating industries. For each industry code, the majority of facilities employ less than 50 people.

Table 6: Facility Size Distribution for the Fertilizer, Pesticide, and Agricultural Chemical Manufacturing Industry

	FERTILIZERS						PESTICIDES	
	Nitrogenous Fertilizers (SIC 2873)		Phosphatic Fertilizers (SIC 2874)		Fertilizers, Mixing only (SIC 2875)		Pesticides and other Agrichemicals (SIC 2879)*	
Employees per Facility	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities
1-9	60	39%	27	36%	205	51%	108	41%
10-49	47	31%	22	29%	166	41%	95	36%
50-249	43	28%	15	20%	30	8%	45	17%
250-499	1	1%	6	8%	0	0%	7	3%
500-2499	1	1%	5	7%	0	0%	8	3%
Total	152	100%	75	100%	401	100%	263*	100%

Source: 1992 Census of Manufacturers, Industry Series: Agricultural Chemicals, US Department of Commerce, Bureau of the Census, May 1995.

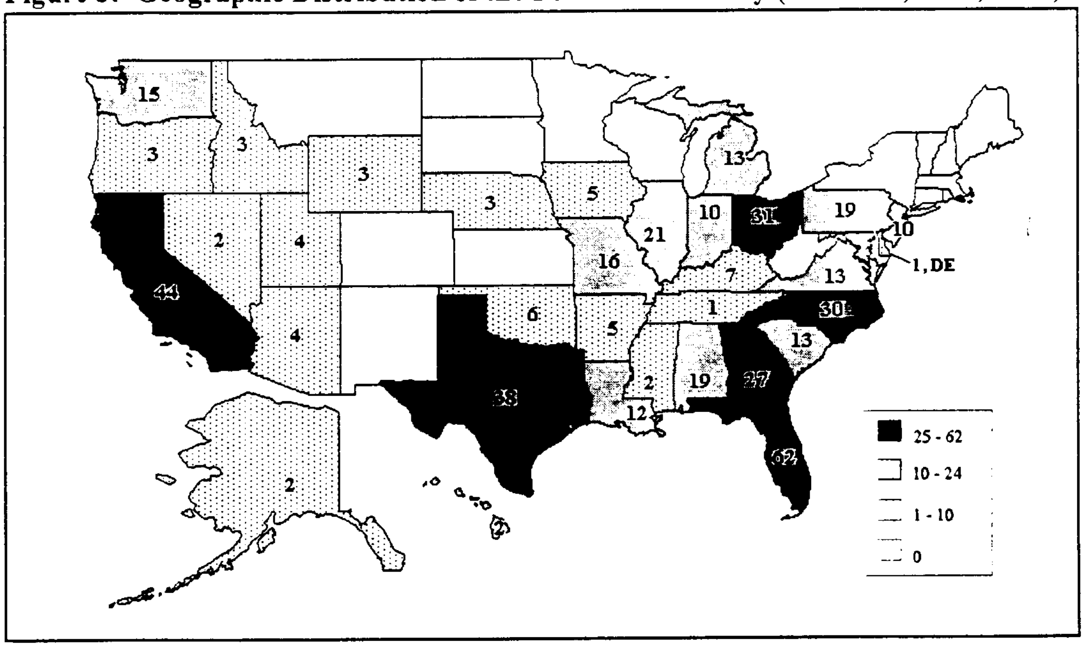
Note: 1992 Census of Manufacturers data are the most recent available. Changes in the number of facilities, location, and employment figures since 1992 are not reflected in these data.

* *United States EPA has identified over 8,600 registered pesticide producing establishments. The SIC code as it is defined by the OMB only includes 263 of those establishments.*

R0074084

Figure 5 shows the United States distribution of fertilizer manufacturing and mixing facilities. The geographic distribution of nitrogenous and phosphatic fertilizer manufacturers is determined by natural resources and demand. Seventy percent of synthetic ammonia plants in the United States are concentrated in Louisiana, Texas, Oklahoma, Iowa, and Nebraska due to abundant natural gas supplies. The majority of nitric acid plants are located in agricultural regions such as the Midwest, South Central, and Gulf States in order to accommodate the high volume of fertilizer usage. Florida has the largest phosphate rock supply in the United States, thus phosphoric acid manufacturing is concentrated primarily in Florida and spreads into the Southeast.

Figure 5: Geographic Distribution of the Fertilizer Industry (SIC 2873, 2874, 2875)



Source: 1992 Census of Manufacturers, Industry Series: Agricultural Chemicals, United States Department of Commerce, Bureau of the Census, May 1995.

R0074085

Table 7 further divides the geographic distribution of fertilizer manufacturing and mixing facilities. The top states in which the nitrogenous fertilizer, phosphatic fertilizer, and fertilizer mixing industries are concentrated are given along with their respective number of establishments. Florida's supply of phosphate rock causes a concentration of phosphatic and mixed fertilizer facilities, while nitrogenous fertilizer plants are often located near sources of raw materials.

Table 7: States with the Largest Number of Fertilizer Manufacturing Facilities

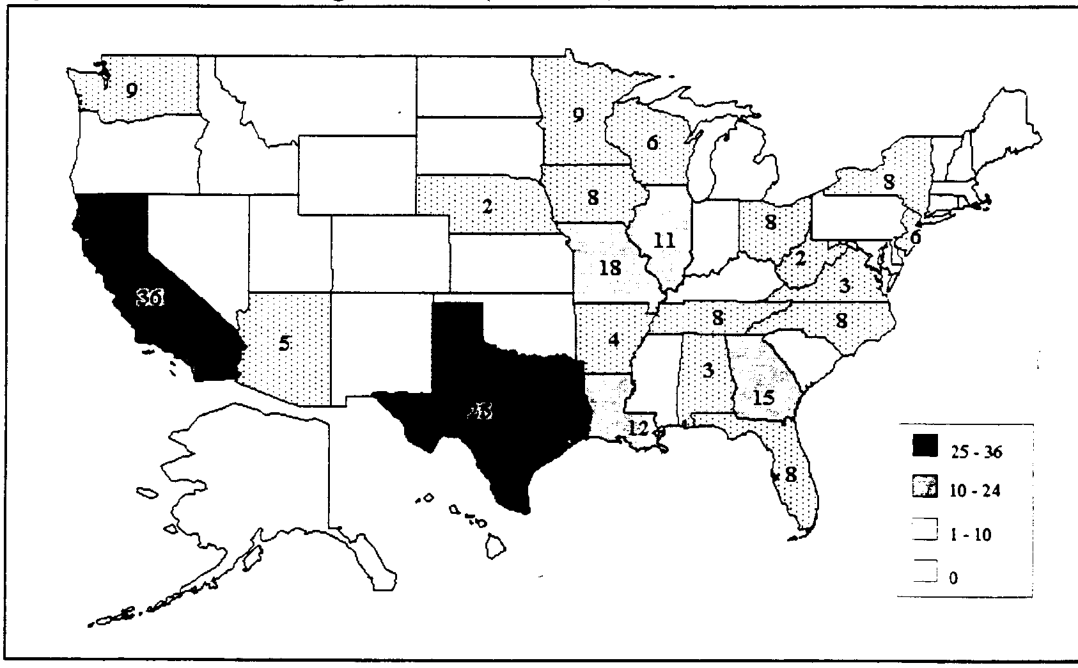
	Nitrogenous Fertilizers (SIC 2873)		**Phosphatic Fertilizers (SIC 2874)**		**Fertilizers, Mixing only (SIC 2875)**	
	Top States	Establish-ments	Top States	Establish-ments	Top States	Establish-ments
States in which industry is concentrated, based on number of establishments	California Texas Louisiana	17 12 8	Florida North Carolina	15 9	Florida Ohio Texas	42 31 26
% of total	24%		32%		25%	

Source: 1992 Census of Manufacturers, Industry Series: Agricultural Chemicals, US Department of Commerce, Bureau of the Census, May 1995.
Note: 1992 Census of Manufacturers data are the most recent available. Changes in the number of facilities, location, and employment figures since 1992 are not reflected in these data.

R0074086

Figure 6 shows the United States distribution of pesticide formulating and miscellaneous agrichemical formulating facilities. The distribution follows the general distribution of the petrochemical industry (coasts and Great Lakes) which the industry relies on for its raw materials, and the distribution of agricultural production in the United States (Midwest and Great Plains states).

Figure 6: Geographic Distribution of the Pesticide Formulating and Miscellaneous Agrichemical Formulating Facilities (SIC 2879)*



Source: 1992 Census of Manufacturers, Industry Series: Agricultural Chemicals, United States Department of Commerce, Bureau of the Census, May 1995.
* *United States EPA has identified over 8,000 establishments that could fall within this SIC code as it is defined by the OMB.*

R0074087

Table 8: Top United States Agricultural Chemical Companies

Rank	Company	1997 Sales (millions of dollars)	SIC Code(s) Reported
1	IMC Global - Northbrook, IL	2,981	2874, 2875, 2819, 1474, 1475
2	Zeneca Inc. - Wilmington, DE	2,822	2879, 2834,2899
3	Agrium United States Inc. - Spokane, WA	1,814	2873
4	CF Industries, Inc. - Lake Zurich, IL	1,383	2873, 2874
5	PCS Nitrogen Inc. - Memphis, TN	1,310	2873, 2874
6	Dowelanco (now named Dow AgriSciences) - Indianapolis, IN	1,288	2879
7	The Scotts Company - Marysville, OH	752	2873, 2874, 2879, 0139, 2499, 3524
8	Cargill Fertilizer - Riverview, FL	600	2874
9	ChemFirst Inc. - Jackson, MS	595	2873, 2865, 3567, 3312
10	La Roche Industries Inc. - Atlanta, GA	449	2873, 5191, 2812, 2869, 3291, 3569

Source: Dun & Bradstreet's Million Dollar Directory, 1997

Note: Not all sales can be attributed to the companies agricultural chemical operations.

Dun & Bradstreet's *Million Dollar Directory*, compiles financial data on United States companies including those operating within the Fertilizer, Pesticide, and Agricultural Chemical Industry. Dun & Bradstreet ranks United States companies, whether they are a parent company, subsidiary or division, by sales volume within their assigned 4-digit SIC code. Readers should note that: (1) companies are assigned a 4-digit SIC code that resembles their principal industry most closely; and (2) sales figures include total company sales, including subsidiaries and operations (possibly not related to agricultural chemicals). Additional sources of company specific financial information include Standard & Poor's *Stock Report Service, Ward's Business Directory of United States Public and Private Companies,* Moody's Manuals, and annual reports.

The Bureau of the Census publishes concentration ratios, which measure the degree of competition in a market. They compute the value of shipments percentage controlled by the top 4, 8, 20, and 50 companies in a given industry. Within the agricultural chemical industry, the phosphatic fertilizer industry had the highest concentration ratio for the top four companies in 1992, 62 percent. The pesticide and other agricultural chemicals, nitrogenous fertilizers, and fertilizer mixing industries' concentration ratios were 53, 48, and 19 percent respectively.

II.B.3. Economic Trends

The United States is a major producer and exporter of agricultural chemicals. It is the largest producer of phosphatic fertilizers and pesticides and the second largest producer of nitrogenous fertilizers in the world (USDOC, 1998).

Domestic Market Trends

The majority of important crops, such as corn and soybeans, are grown using fertilizers and pesticides. As a result, year-to-year changes in the domestic demand for agrichemicals reflect the level of planted acreage, which in turn is affected by grain prices and weather conditions. Increases in planted acreage of corn, feedgrains and other crops in recent years have resulted in increased demand and production of agrichemicals in the United States. Industry shipments of agricultural chemicals should show modest annual growth through the end of the decade (USDOC, 1998).

The Federal Agricultural Improvement and Reform Act of 1996 could have a major long-term impact on the agricultural chemical industry. This law gives farmers greater flexibility in making planting decisions and allows them to rely more on the marketplace as a guide for crop plantings. The bill eliminates the annual acreage set-aside program, thus potentially boosting the levels of crop acreage (USDOC, 1998).

Agricultural chemical production showed little change between 1995 and 1996. Total production was approximately 103 million pounds each year. However, experts claim that due to lower dosage requirements for pesticides, agrichemical demand is actually higher than it would appear. Pesticides saw a six percent rise in production from 1995 to 1996. Nitrogenous fertilizer production was up approximately seven percent, and phosphate production increased slightly except for its major product, diammonium phosphate. Prices for agricultural chemicals rose three percent from 1995 to 1996, while the number of production workers fell two percent (USDOC, 1998).

International Market Trends

The United States accounts for more than 50 percent of world trade in phosphatic fertilizers, with a two-thirds share of total trade in DAP (diammonium phosphate), the principal phosphatic fertilizer product.

Exports generally account for about half of total shipments for the United States phosphatic fertilizer industry, with about half of all exports going to China.

International markets, especially less developed nations in Asia and Latin America, hold greater market potential for the agrichemicals industry as population levels grow, income levels rise, and demands for better standards of living and diets increase the need for grain production. From the current level of about 5.8 billion, the world population is expected to increase by about 80 million each year between 1996 and 2000. Developing nations are becoming more sophisticated in agricultural practices, thus increasing their usage of fertilizers and pesticides to improve production (USDOC, 1998).

The United States has been a net exporter of pesticide chemicals, and this is expected to continue through the turn of the century. Exports of pesticides accounted for about 25 percent of United States pesticide production in 1994, according to The American Crop Protection Association. United States pesticide producers benefit from a highly developed chemical sector and strong demand from developing regions of the world. Nevertheless, export opportunities are being restrained by industry-wide globalization as producers are choosing to site facilities closer to end-use markets. In addition, regulatory reforms in Western Europe, such as the competitive access provider plan, are expected to limit prospects in that region, currently the largest destination for United States produced pesticides (USDOC, 1998).

International competition for the United States phosphatic fertilizer industry generally comes from countries with phosphate rock reserves and capacity to convert rock into phosphate chemicals. Diammonium phosphate imports are expected to account for most of the growth in world trade, thus giving the United States a promising outlook for this product. Morocco possesses at least 50 percent of the world's rock reserves and is the largest phosphate rock exporter. China and Russia are also major phosphate rock and fertilizer producers, with Russia also a leading exporter of phosphate chemicals. In the world pesticide markets, major competitors are companies based in Germany, France, and Switzerland.

The United States is a net importer of nitrogenous fertilizers. Trinidad and Tobago and Canada are the leading United States suppliers of nitrogen due to their low-cost supplies of natural gas.

Agricultural biotechnology is beginning to play a major role in agricultural pest control, spurred on by government pesticide restrictions, increased insect resistance to pesticides, and farmers' demand for productivity gains. Genetically engineered plants will be higher yielding, more resistant to disease and insects, and tolerant to herbicides. A number of companies have received approvals for the use of genetically engineered seeds, including corn and cotton, that are resistant to insects and herbicide tolerant. Commercial usage should increase rapidly over the next few years (USDOC, 1998).

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the Fertilizer, Pesticide, and Agricultural Chemical Industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of resource materials and contacts that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the by-products produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

The three most important nutrients for plant growth are nitrogen, phosphorous, and potassium. However, the production of the major potassium fertilizer salts, or potash as they are commonly known, is typically considered an inorganic chemical process (SIC 2819). Therefore, the discussion of fertilizer production in this notebook is restricted to nitrogenous and phosphatic mixtures. The fertilizer, pesticide, and agricultural chemical industry can be divided into Nitrogenous Fertilizers, Phosphatic Fertilizers, Fertilizers (Mixing-only), and the formulating and preparing of pesticides and other agricultural chemicals. A detailed description of the production processes for nitrogenous and phosphatic fertilizers is presented here, along with brief descriptions of the fertilizer mixing and pesticide formulating and preparing industry.

III.A. Nitrogenous Fertilizers

The major nitrogenous fertilizers include synthetic ammonia, ammonium nitrate, and urea. The various industrial processes used to manufacture these products are described, as well as the production process for nitric acid, an important intermediate in nitrogenous fertilizer production.

III.A.1. Synthetic Ammonia

Synthetic ammonia (NH_3) is produced by reacting hydrogen with nitrogen at a molar ratio of three to one. Nitrogen is obtained from the air, which is primarily comprised of nitrogen (78 percent) and oxygen (21 percent) (Lewis, 1993). Hydrogen is obtained from either the catalytic steam reforming of natural gas (methane) or naptha, or as the byproduct from the electrolysis of brine at chlorine plants. In the United States, about 98 percent of the hydrogen used to synthesize ammonia is produced by catalytic steam reforming of natural gas, and only 2 percent is obtained from chlorine plants (USEPA, 1993a).

Six process steps are required to produce synthetic ammonia using the catalytic steam reforming method:

1) natural gas desulfurization
2) catalytic steam reforming
3) carbon monoxide shift
4) carbon dioxide removal
5) methanation
6) ammonia synthesis.

The first, third, fourth, and fifth steps remove impurities such as sulfur, CO, CO_2 and water from the feedstock, hydrogen and synthesis gas streams. In the second step, hydrogen is manufactured and mixed with air (nitrogen). The sixth step produces anhydrous ammonia from the synthetic gas. An anhydrous compound is inorganic and does not contain water either adsorbed on its surface or combined as water of crystallization. While almost all ammonia plants use these basic process steps, details such as operating pressures, temperatures, and quantities of feedstock vary from plant to plant. Figure 7 shows a simplified process flow diagram of a typical ammonia plant (USEPA, 1993a).

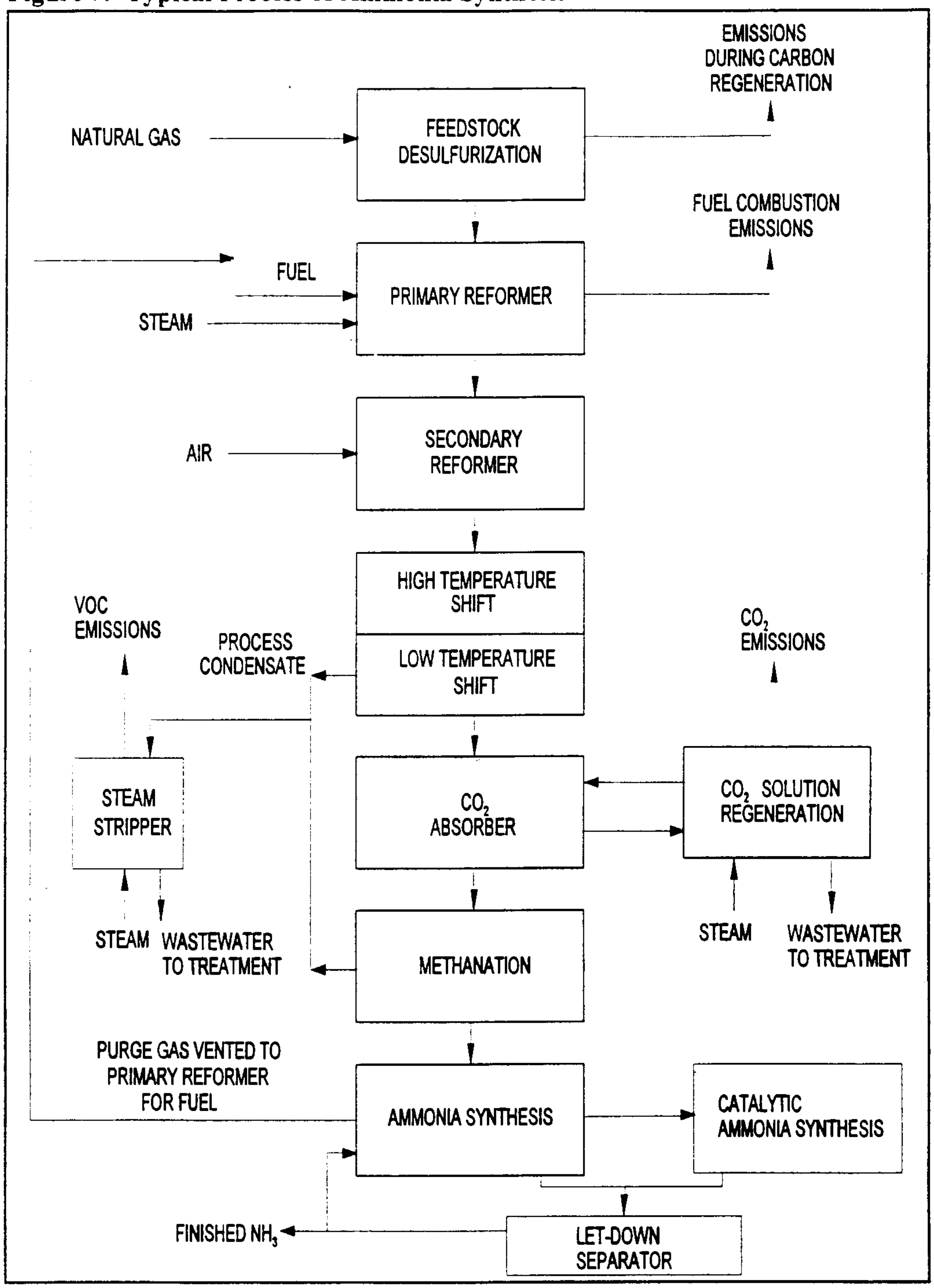
Natural gas desulfurization

In the natural gas desulfurization step, the sulfur content (primarily as H_2S) in natural gas feedstock is reduced to below 280 micrograms per cubic meter to prevent poisoning of the catalyst used in the catalytic steam reforming step. Desulfurization can be accomplished by passing the natural gas through a bed of either activated carbon or zinc oxide. In both systems, the hydrogen sulfide in the gas adsorbs to the surface of the activated carbon or zinc oxide medium and the desulfurized natural gas passes through.

Over 95 percent of the ammonia plants in the United States use activated carbon fortified with metallic oxide additives for feedstock desulfurization. After a certain amount of impurities adsorb to the activated carbon, its effectiveness is reduced and it must be regenerated by passing superheated steam through the carbon bed. The superheated steam strips out the sulfur impurities, is condensed, and sent to the wastewater treatment plant. One disadvantage of the activated carbon system is that some of the heavy hydrocarbons in the natural gas adsorb to the carbon, decreasing its effectiveness and lowering the heating value of the desulfurized gas.

The remaining five percent of plants use zinc oxide for desulfurization. The zinc oxide system is capable of absorbing up to 20 percent sulfur by weight

Figure 7: Typical Process of Ammonia Synthesis



Source: United States EPA, 1993a.

R0074094

(Hodge, 1994). Zinc oxide is replaced rather than regenerated, which lowers energy consumption and minimizes impact to the atmosphere. The higher molecular weight hydrocarbons are not removed; therefore, the heating value of the natural gas is not reduced. However, it is impractical and uneconomical to replace the zinc oxide beds so few plants use it (USEPA, 1993a).

Catalytic steam reforming

Next, the desulfurized natural gas is preheated by mixing with superheated steam. The mixture of steam and gas enters the primary reformer tubes which are filled with a nickel-based reforming catalyst, and the tubes are heated by natural gas or oil-fired burners. Approximately 70 percent of the methane (CH_4) is converted to hydrogen (H_2) and carbon dioxide (CO_2), according to the following reaction:

$$0.88CH_4 + 1.26air + 1.24\ H_2O \rightarrow 0.88\ CO_2 + N_2 + 3H_2$$

The remainder of the CH_4 is converted to H_2 and CO. This process gas is then sent to the secondary reformer, where it is mixed with compressed hot air at 540°C (1004°F). Sufficient air is added to produce a final synthesis gas having a hydrogen-to-nitrogen mole ratio of three to one. The gas leaving the secondary reformer (primarily hydrogen, nitrogen, CO, CO_2, and H_20) is then cooled to 360°C (680°F) in a waste heat boiler before being sent to the carbon monoxide shift (USEPA, 1993a).

Carbon monoxide shift

After cooling, the secondary reformer effluent gas enters a high temperature (350-400°C) CO shift converter which converts the CO to CO_2, followed by a low temperature (200-250°C) shift converter which continues to convert CO to CO_2 (Kroschwitz and Howe-Grant, 1992). The high temperature CO shift converter is filled with chromium oxide initiator and iron oxide catalyst. The following reaction takes place (USEPA, 1993a):

$$CO + H_2O \rightarrow CO_2 + H_2$$

The exit gas is then cooled in a heat exchanger before being sent to a low temperature shift converter for ammonia, amines, and methanol where CO continues to be converted to CO_2 by a copper oxide/zinc oxide catalyst (Kent, 1992). In some plants, the gas is first passed through a bed of zinc oxide to remove any residual sulfur contaminants that would poison the low temperature shift catalyst. In other plants, excess low temperature shift catalyst is added to ensure that the unit will operate as expected. Final shift gas from this converter is cooled from 210 to 110°C (410 to 230°F) and unreacted steam is condensed and separated from the gas in a knockout drum. The final shift gas then enters the bottom of the carbon dioxide absorption system. The condensed steam (process condensate) contains ammonium carbonate ($[(NH_4)_2 CO_3 \cdot H_2O]$) from the high temperature shift converter, methanol (CH_3OH) from the low temperature shift converter, and small amounts of sodium, iron, copper, zinc, aluminum and calcium. Process condensate is sent to the stripper to remove volatile gases such as ammonia, methanol, and carbon dioxide. Trace metals remaining in the process condensate are typically removed in an ion exchange unit (USEPA, 1993a).

Carbon dioxide removal

In this step, CO_2 in the final shift gas is removed. CO_2 removal can be done by using one of two methods: monoethanolamine ($C_2H_4NH_2OH$) scrubbing or hot potassium scrubbing. Approximately 80 percent of the ammonia plants use monoethanolamine (MEA) for removing CO_2. In this process, the CO_2 gas is passed upward through an adsorption tower countercurrent to a 15 percent to 30 percent solution of MEA in water fortified with corrosion inhibitors. After absorbing the CO_2, the amine-CO_2 solution is preheated and regenerated in a reactivating tower. The reacting tower removes CO_2 by steam stripping and then by heating. The CO_2 gas (98.5 percent CO_2) is either vented to the atmosphere or used for chemical feedstock in other parts of the plant complex. The regenerated MEA is pumped back to the absorber tower after being cooled in a heat exchanger and solution cooler (USEPA, 1993a).

Methanation

Carbon dioxide absorption is not 100 percent effective in removing CO_2 from the gas stream, and CO_2 can poison the synthesis converter. Therefore, residual CO_2 in the synthesis gas must be removed by catalytic methanation. In a reactor containing a nickel catalyst and at temperatures of 400 to 600°C (752 to 1112°F) and pressures up to 3,000 kPa (435 psia) methanation follows the following reaction steps:

$$CO_2 + H_2 \rightarrow CO + H_2O$$

$$CO + 3H_2 \rightarrow CH_4 + H_2O$$

$$CH_4 + 2H_2O \rightarrow CO_2 + 4H_2$$

Exit gas from the methanator is almost a pure three to one mole ratio of hydrogen to nitrogen (USEPA, 1993a).

Ammonia Synthesis

In the synthesis step, the hydrogen and nitrogen synthesis gas from the methanator is converted to ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

First, the gas is compressed to pressures ranging from 13,800 to 34,500 kPa (2000 to 5000 psia), mixed with recycled synthesis gas, and cooled to 0°C

(32°F). This results in a portion of the gas being converted to ammonia which is condensed and separated from the unconverted synthesis gas in a liquid-vapor separator and sent to a let-down separator. The unconverted synthesis gas is further compressed and heated to 180°C (356°F) before entering a synthesis converter containing an iron oxide catalyst. Ammonia gas exiting the synthesis converter is condensed and separated, then sent to the let-down separator. A small portion of the overhead gas is purged to prevent the buildup of inert gases such as argon in the circulating gas system. Ammonia in the let-down separator is flashed to atmospheric pressure (100 kPa (14.5 psia)) at -33°C (-27°F) to remove impurities from the make-up gas. The flash vapor is condensed in a let-down chiller where anhydrous ammonia is drawn off and stored at low temperature (USEPA, 1993a).

Storage and Transport
Ammonia is typically stored at ambient pressure and -33°C (-28°F) in large 20,000 ton tanks. Some tanks are built with a double wall to minimize leakage and insulate. If heat leaks into the tank and ammonia is vaporized, the vapors are typically captured, condensed, and returned to the tank. Ammonia is mostly transported by barge to key agricultural areas, but there is also a small system of interstate ammonia pipelines (Kent, 1992).

III.A.2. Nitric Acid

Nitric acid (HNO_3) is produced by two methods. The first method utilizes oxidation, condensation, and absorption of ammonia to produce a "weak" nitric acid. Weak nitric acid has a concentration ranging from 30 to 70 percent nitric acid. The second method combines dehydrating, bleaching, condensing, and absorption to produce "high strength" nitric acid from weak nitric acid. High strength nitric acid generally contains more than 90 percent nitric acid (USEPA, 1993a). The following text discusses each of these processes.

Weak Nitric Acid Production

Nearly all the weak nitric acid produced in the United States is manufactured by the high temperature catalytic oxidation of ammonia as shown schematically in Figure 8. This process typically consists of three steps:

1) ammonia oxidation
2) nitric oxide oxidation
3) absorption.

Each step corresponds to a distinct chemical reaction.

Ammonia Oxidation
During ammonia oxidation, a one to nine ammonia to air mixture is oxidized

at a temperature of 750 to 800°C (1380 to 1470°F) as it passes through a catalytic converter, according to the following reaction:

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

The most commonly used catalyst is made of gauze squares of fine wire constructed of 90 percent platinum and 10 percent rhodium. Under these conditions the oxidation of ammonia to nitric oxide (NO) proceeds in an exothermic reaction with 93 to 98 percent yield. Higher catalyst temperatures increase reaction selectivity toward nitric oxide (NO) production. Lower catalyst temperatures tend to be more selective toward nitrogen (N_2) and nitrous oxide (N_2O) (USEPA, 1993a). The nitric oxide then passes through a waste heat boiler and a platinum filter in order to recover the precious metal platinum (Kent, 1992).

Nitric Oxide Oxidation

The nitric oxide formed during the ammonia oxidation is further oxidized in another process step. The nitric oxide process stream is passed through a cooler/condenser and cooled to 38°C (100°F) or less at pressures up to 800 kPa (116 psia). The nitric oxide reacts noncatalytically with residual oxygen to form nitrogen dioxide and its liquid dimer, dinitrogen tetroxide:

$$2NO + O_2 \rightarrow 2NO_2 \rightarrow N_2O_4$$

(A dimer is a small polymer whose molecule is composed of two molecules of the same composition (Lewis, 1993).) This slow, homogeneous reaction is temperature and pressure dependent. Operating at low temperatures and high pressures promotes maximum production of NO_2 within a minimum reaction time (USEPA, 1993a).

Nitrogen dioxide absorption

The final step introduces the gaseous nitrogen dioxide/dimer mixture into an absorption process after being cooled. The mixture is pumped into the bottom of an absorption tower with trays, while liquid dinitrogen tetroxide (N_2O_4) is added at a higher point. Deionized water enters the top of the column. Both liquids flow countercurrent to the dioxide/dimer gas mixture. The exothermic reaction occurs as follows (USEPA, 1993a):

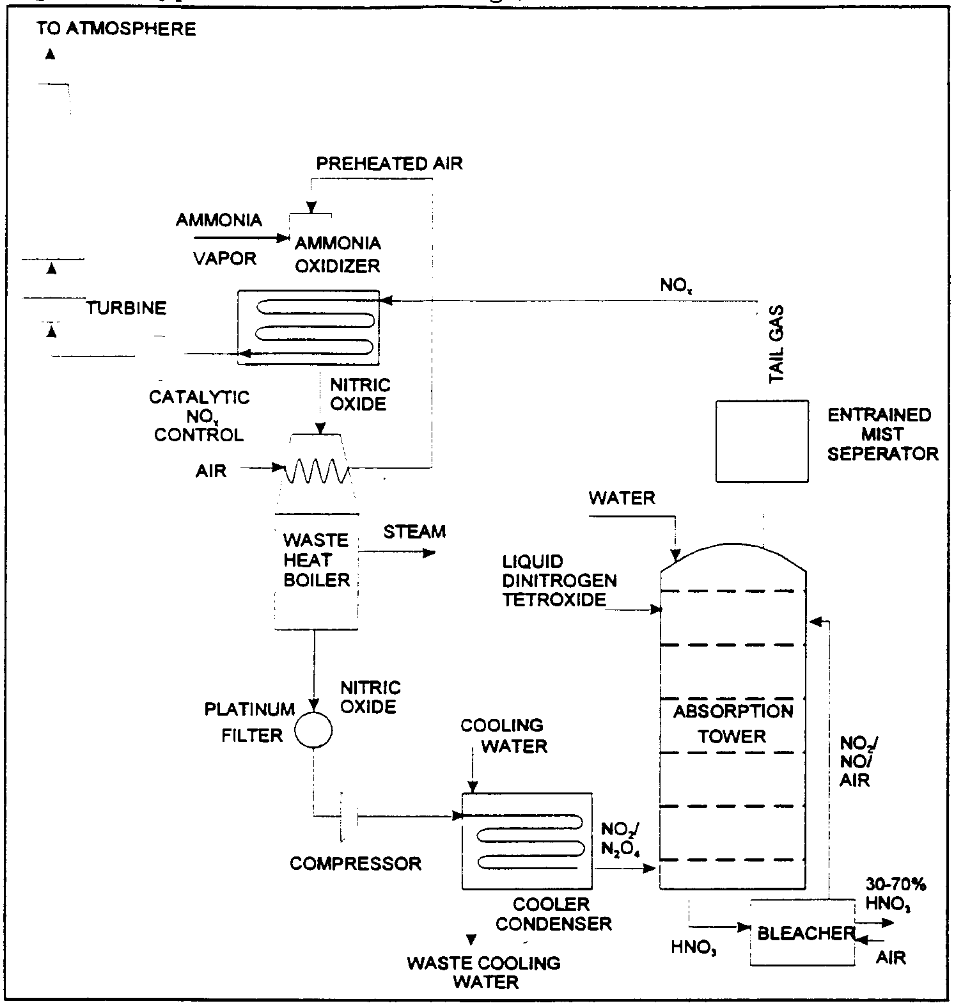
$$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$$

A secondary air stream is introduced into the column to re-oxidize the NO that is formed. This secondary air also removes NO_2 from the product acid. Oxidation of NO to NO_2 takes place in the free space between the trays, while absorption of NO_2 into the water occurs on the trays. An aqueous solution of 55 to 65 percent (typically) nitric acid is withdrawn from the bottom of the tower. The acid concentration can vary from 30 to 70 percent nitric acid depending upon the temperature, pressure, number of absorption stages, and concentration of nitrogen oxides entering the absorber (USEPA, 1993a).

There are two variations of the process described above to produce weak nitric acid: single-stage pressure process and dual-stage pressure process. In the past, nitric acid plants have been operated at a single pressure, ranging from atmospheric pressure to 1400 kPa (14.7 to 203 psia). However, since the oxidation of ammonia is favored by low pressures and the oxidation of nitric oxide and the absorption of nitrogen dioxide are favored by higher pressures, newer plants tend to operate a dual-stage pressure system, incorporating a compressor between the ammonia oxidizer and the condenser. The oxidation reaction is carried out at pressures from slightly negative to about 400 kPa (58 psia), and the absorption reactions are carried out at 800 to 1,400 kPa (116 to 203 psia) (USEPA, 1993a).

In the dual-stage pressure system, the nitric acid formed in the absorber (bottoms) is usually sent to an external bleacher where air is used to remove (bleach) any dissolved oxides of nitrogen (NO, NO_2, etc.). The bleacher gases are then compressed and again passed through the absorber. The absorber tail gas (distillate) is sent to an entrainment separator for acid mist removal. Next, the tail gas is reheated in the ammonia oxidation heat exchanger to approximately 200°C (392°F). The gas is then passed through catalytic reduction units for NO_x emissions control. The final step expands the gas in the power-recovery turbine. The thermal energy produced in this turbine can be used to drive the compressor.

Figure 8: Typical Process of Dual-Stage, Weak Nitric Acid Production



Source: United States EPA, 1993a.

High Strength Nitric Acid

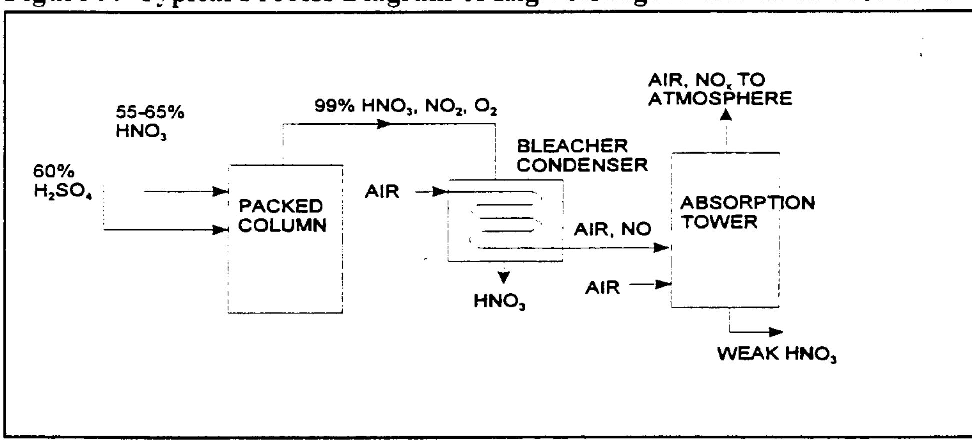
High strength nitric acid (98 to 99 percent concentration) can be obtained by concentrating weak nitric acid (30 to 70 percent concentration) using extractive distillation. Extractive distillation is distillation carried out in the presence of a dehydrating agent. Concentrated sulfuric acid (typically 60 percent sulfuric acid) is most commonly used for this purpose. The weak nitric acid cannot be concentrated by simple fractional distillation, in which acid is concentrated by removing water vapor in a column with trays or plates.

R0074100

The nitric acid concentration process consists of feeding strong sulfuric acid and 55 to 65 percent nitric acid into the top of a packed dehydrating column at approximately atmospheric pressure. The acid mixture flows downward and concentrated nitric acid leaves the top of the column as 99 percent vapor, containing a small amount of NO_2 and O_2 resulting from dissociation of nitric acid. The concentrated acid vapor then goes to a bleacher and a countercurrent condenser system to condense strong nitric acid and the separate out the oxygen and nitrogen oxide by-products. The bleacher uses air to strip nitrogen oxides out of the nitric acid and the countercurrent condenser system cools the vapor by flowing air through the vapor causing droplets to separate out.

These nitrogen oxide by-products then flow to an absorption column where the nitric oxide mixes with auxiliary air to form NO_2, which is recovered as weak nitric acid..Inert and unreacted gases are vented to the atmosphere from the top of the absorption column. Emissions from this process are relatively small compared to weak acid production (USEPA, 1993a). Figure 9 illustrates a typical high strength nitric acid production process.

Figure 9: Typical Process Diagram of High Strength Nitric Acid Production



Source: Adapted from United States EPA, 1993a.

III.A.3. Ammonium Nitrate and Urea

The manufacture steps for ammonium nitrate (NH_4NO_2) and urea ($CO(NH_2)_2$) are similar. In both cases, several major unit operations are involved, including:

1) solution formation
2) concentration
3) solids formation

R0074101

4) finishing
5) screening
6) coating
7) product bagging and/or bulk shipping.

These operations are shown schematically in Figure 10. Not all steps are always necessary depending on the end product desired. For example, plants producing ammonium nitrate or urea liquid solutions alone use only the solution formation, solution blending and bulk shipping operations. Plants producing a solid product may employ all of the operations.

Solution synthesis

Ammonium nitrate.

Ammonium nitrate plants produce an aqueous ammonium nitrate solution through the reaction of ammonia and nitric acid in a neutralizer where water is evaporated by the heat of the reaction as follows:

$$NH_3 + HNO_3 \rightarrow NH_4NO_3 + 26 \text{ kcal/g mol}$$

The temperature, pressure, and final concentration of the ammonium nitrate are interdependent. Higher temperatures and pressures can be used to produce a higher concentration of ammonium nitrate (Hodge, 1994); however, the temperature of the operation should be below 120°C (250°F) in order to prevent explosions. Up to 99.5 percent of the ammonia and nitric acid is typically converted to ammonium nitrate (Kent, 1992). Ammonium nitrate solution can then be used as an ingredient for nitrogen solution fertilizers or concentrated to a solid form.

Urea.

In the urea solution synthesis operation, ammonia (NH_3) and carbon dioxide (CO_2) are reacted to form ammonium carbamate ($NH_2CO_2NH_4$) as follows:

$$2NH_3 + CO_2 \rightarrow NH_2CO_2NH_4$$

Typical operating conditions include temperatures from 180 to 200°C (356 to 392°F), pressures from 14,000 to 25,000 kPa (140 to 250 psia), molar ratios of NH_3 to CO_2 from 3:1 to 4:1, and a retention time of twenty to thirty minutes. The ammonium carbamate is then dehydrated to yield 70 to 77 percent aqueous urea solution. This reaction follows: (USEPA, 1993a)

$$NH_2CO_2NH_4 \rightarrow NH_2CONH_2 + H_2O$$

Urea solution can be used as an ingredient of nitrogen solution fertilizers, or it can be concentrated further to produce solid urea.

Solids Concentration

Ammonium nitrate.

To produce a solid product, the aqueous ammonium nitrate solution is concentrated in an evaporator or concentrator. The resulting liquid "melt" contains about 95 to 99.8 percent ammonium nitrate at approximately 149°C (300°F). This melt is then used to make solid ammonium nitrate products (USEPA, 1993a).

Urea.

The three methods of concentrating the urea solution are vacuum concentration, crystallization, and atmospheric evaporation. The method chosen depends upon the level of biuret ($NH_2CONHCONH_2$) impurity allowable in the end product. Biuret can cause mottling in urea solutions, reducing the fertilizers effectiveness in foliar applications (Kent, 1992). Aqueous urea solution decomposes with heat to biuret and ammonia. Therefore, if only a low level of biuret impurity is allowed in the end product, the method with the least heat requirement will be chosen, such as crystallization and vacuum concentration (Kent, 1992). However, the simplest and most common method of solution concentration is atmospheric evaporation.

Solids Formation

Prilling and granulation are the most common processes used to produce solid ammonium nitrate and urea. Prills are round or needle-shaped artificially prepared aggregates of a material. To produce prills, concentrated melt is sprayed into the top of a prill tower. In the tower, melt droplets fall countercurrent to a rising air stream that cools and solidifies the falling droplets into prills. Prill density can be varied by using different concentrations of ammonium nitrate melt. Low density prills, in the range of 1.29 specific gravity, are formed from a 95 to 97.5 percent ammonium nitrate melt, and high density prills, in the range of 1.65 specific gravity, are formed from a 99.5 to 99.8 percent melt. Low density ammonium nitrate prills are used for making blasting agents because they are more porous than high density prills and will absorb oil. Most high density prills are used as fertilizers (USEPA, 1993a).

Granulated ammonium nitrate and urea are produced by spraying a concentrated melt (99.0 to 99.8 percent) onto small seed particles of ammonium nitrate or urea in a long rotating cylindrical drum. As the seed particles rotate in the drum, successive layers of the nitrogenous chemical are added to the particles, forming granules. Pan granulators operate on the same principle as drum granulators, except the solids are formed in a large, rotating circular pan. Pan granulators produce a solid product with physical characteristics similar to those of drum granules (USEPA, 1993a).

Although not widely used, additives such as magnesium nitrate or magnesium oxide may be injected directly into the melt stream. Additives can serve three purposes: to raise the crystalline transition temperature of the final solid product in order to retain its strength and density; to act as a desiccant, drawing water into the final product to reduce caking; and to allow solidification to occur at a low temperature by reducing the freezing point of molten ammonium nitrate. (Kent, 1992)

Solids Cooling

The temperature of the nitrogenous product exiting the solids formation process is approximately 66 to 124°C (150 to 255°F). To prevent deterioration and agglomeration, the product must be cooled before storage and shipping. Typically, rotary drums or fluidized beds are used to cool granules and prills leaving the solids formation process. Because low density prills have a high moisture content, they require drying in rotary drums or fluidized beds before cooling (USEPA, 1993a).

Solids Screening

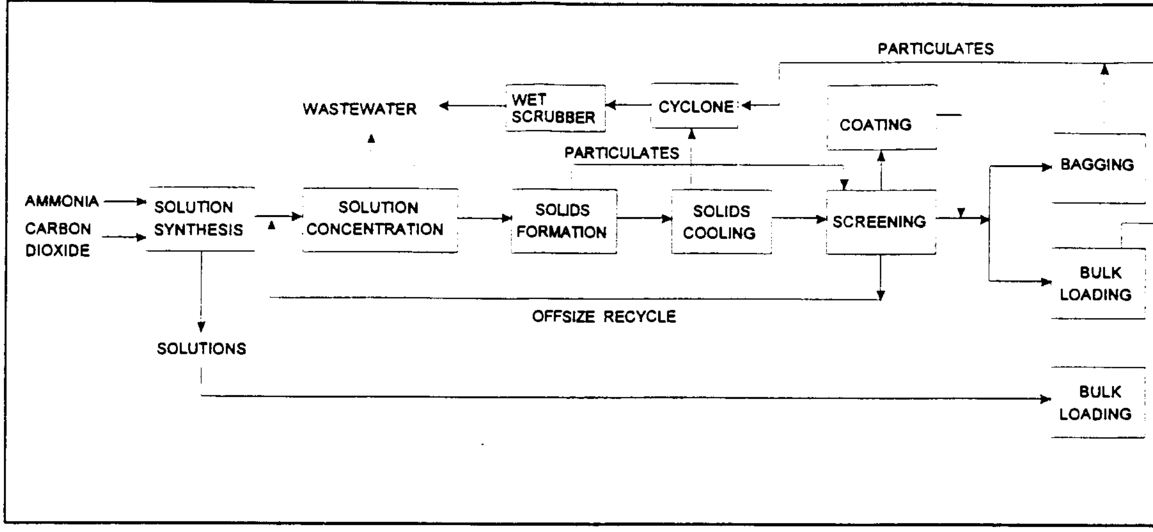
Since the solids are produced in a wide variety of sizes, they must be screened for consistently sized prills or granules. After cooling, off size prills are dissolved and recycled back to the solution concentration process. Granules are screened before cooling. Undersize particles are returned directly to the granulator and oversize granules may be either crushed and returned to the granulator or sent to the solution concentration process (USEPA, 1993a).

Solids Coating

Following screening, products can be coated in a rotary drum to prevent agglomeration during storage and shipment. The most common coating materials are clays and diatomaceous earth. However, the use of additives in the melt before solidification may preclude the use of coatings.

The solid product is stored and shipped in either bulk or bags. The majority of solid product is bulk shipped in trucks, enclosed railroad cars, or barges, and approximately ten percent of solid ammonium nitrate and urea produced in the United States is bagged (USEPA, 1993a).

Figure 10: Typical Process for Ammonium Nitrate and Urea Manufacturing



Source: United States EPA, 1993a.

III.B. Phosphatic Fertilizers

The primary products of the phosphatic fertilizers industry are phosphoric acid, ammonium phosphate, normal superphosphate, and triple superphosphate. Phosphoric acid is sold as is or is used as an intermediate in producing other phosphatic fertilizers. Monoammonium phosphate is favored for its high phosphorous content, while diammonium phosphate is favored for its high nitrogen content. Normal superphosphate has a relatively low concentration of phosphorous, however it is used in mixtures because of its low cost. Triple superphosphate provides a high concentration of phosphorous, more than 40% phosphorous pentoxide. The industrial processes for each of these products are described below.

III.B.1. Phosphoric Acid (Wet Process)

In a wet process phosphoric acid facility (shown schematically in Figure 11), phosphoric acid is produced by reacting sulfuric acid (H_2SO_4) with naturally occurring phosphate rock. The phosphate rock is mined, dried, crushed until 60 to 70 percent of the rock is less than 150 μm in diameter, and then continuously fed into the reactor along with sulfuric acid (UNEP, 1996). The reaction also combines calcium from the phosphate rock with sulfate, forming calcium sulfate ($CaSO_4$), commonly referred to as gypsum. Gypsum is separated from the reaction solution by filtration.

R0074105

Facilities in the United States generally use a dihydrate process that produces gypsum in the form of calcium sulfate with two molecules of water ($CaSO_4 \bullet 2H_2O$ or calcium sulfate dihydrate). Japanese phosphoric acid facilities use a hemihydrate process which produces calcium sulfate with a half molecule of water ($CaSO_4 \bullet \frac{1}{2} H_2O$). This one-step hemihydrate process has the advantage of producing wet process phosphoric acid with a higher phosphate pentoxide (P_2O_5) concentration and less impurities than the dihydrate process. Due to these advantages, some United States companies have recently converted to the hemihydrate process. However, since most wet process phosphoric acid is still produced by the dihydrate process, the hemihydrate process will not be discussed in detail here.

A simplified reaction for the dihydrate process is as follows:

$$Ca_3(PO_4)_2 + 3H_2SO_4 + 6H_2O - 2H_3PO_4 + 3[CaSO_4 \bullet 2H_2O]\downarrow$$

To make the strongest phosphoric acid possible and to decrease evaporation costs, a highly concentrated 93 percent sulfuric acid is normally used. Because the proper ratio of acid to rock in the reactor is critical, precise automatic process control equipment is employed in the regulation of these two feed streams (USEPA, 1993a).

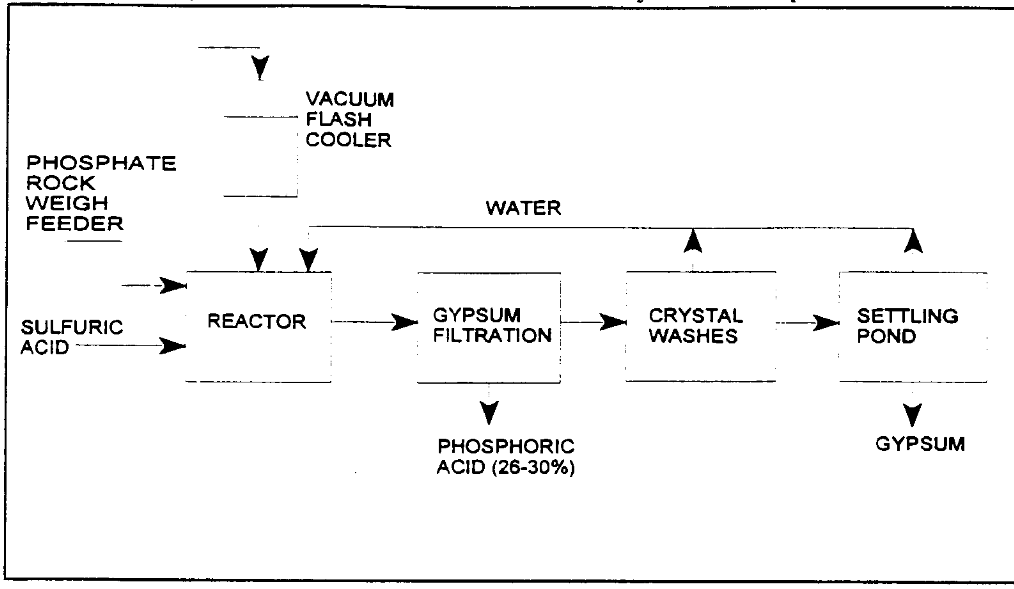
During the reaction, gypsum crystals are precipitated and separated from the acid by filtration. The separated crystals must be washed thoroughly to yield at least a 99 percent recovery of the filtered phosphoric acid. After washing, the slurried gypsum is pumped into a gypsum settling pond for storage. Water is siphoned off and recycled through a surge cooling pond to the phosphoric acid process. Depending on a variety of factors, such as average ambient temperature and annual rainfall, settling and cooling ponds may require between 0.25 and 1.0 acre for each ton of daily P_20_5 capacity (TFI, 1999).

Considerable heat is generated in the reactor when the sulfuric acid and phosphate rock react. In older plants, this heat was removed by blowing air over the hot slurry surface. Modern plants vacuum flash cool a portion of the slurry, and then recycle it back into the reactor.

Wet process phosphoric acid normally contains 26 to 30 percent P_2O_5. In most cases, the acid must be further concentrated to meet phosphate feed material specifications for fertilizer production. Depending on the types of fertilizer to be produced, phosphoric acid is usually concentrated to 40 to 55 percent P_2O_5 by using two or three vacuum evaporators (USEPA, 1993a). These evaporators operate with a forced circulation and generate a vacuum through vacuum pumps, steam ejectors, or an entraining condenser downstream of the evaporator. Figure 12 illustrates a vacuum evaporator.

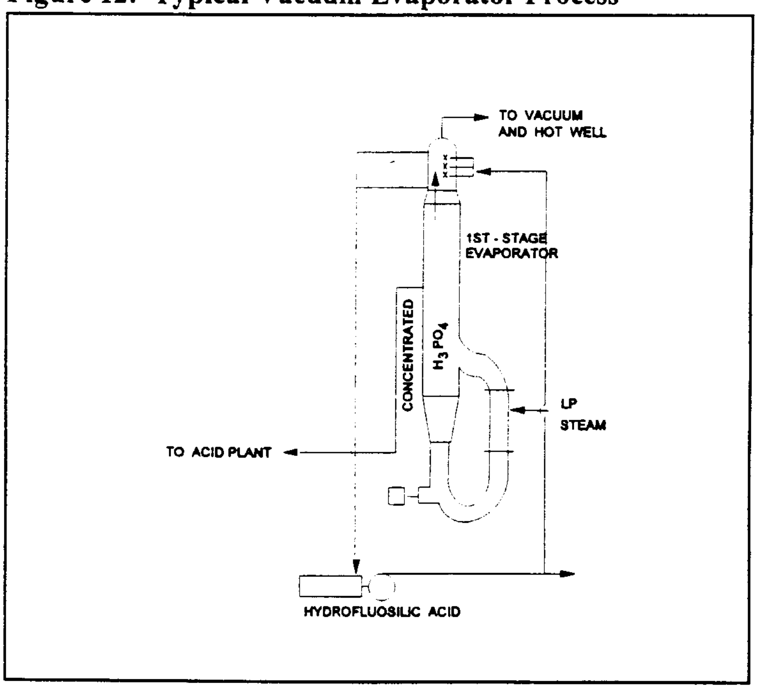
R0074106

Figure 11: Typical Process of a Wet Process Dihydrate Phosphoric Acid Plant



Source: Adapted from United States EPA, 1993a.

Figure 12: Typical Vacuum Evaporator Process



Source: United States EPA, 1993a

R0074107

III.B.2. Ammonium Phosphate

Diammonium phosphate (DAP) and monoammonium phosphate are the major types of ammonium phosphatic fertilizer. Ammonium phosphates are produced by reacting phosphoric acid with ammonia. The ammonium phosphate liquid slurry produced is then converted to solid granules. Approximately 95 percent of ammoniation-granulation plants in the United States use a rotary drum mixer developed and patented by the Tennessee Valley Authority (TVA).

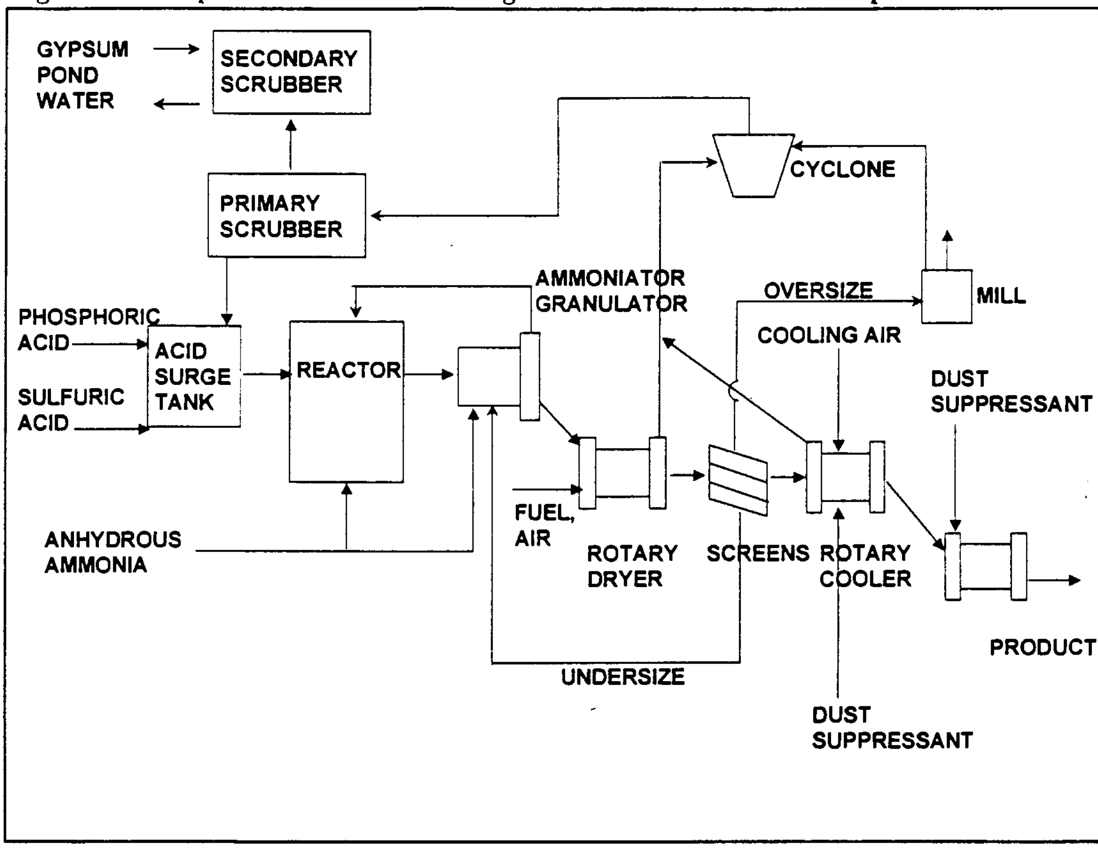
In the TVA DAP process, phosphoric acid is mixed in an acid surge tank with 93 percent sulfuric acid (H_2SO_4) and recycled acid from wet scrubbers. The mixed acids are then partially neutralized with liquid or gaseous anhydrous ammonia in a brick-lined acid reactor. All of the phosphoric acid and approximately 70 percent of the ammonia needed to complete the reaction are introduced into this vessel. A slurry of ammonium phosphate and 22 percent water are produced and sent through steam-traced lines to the ammoniator-granulator.

Slurry from the reactor is distributed in the rotary drum granulator, and the remaining ammonia (approximately 30 percent) is sparged under the slurry. The basic rotary drum granulator consists of an open-ended, slightly inclined rotary cylinder, with retaining rings at each end and a scraper or cutter mounted inside the drum shell. A rolling bed of dry material is maintained in the unit while the slurry is introduced through distributor pipes set lengthwise in the drum. Gravity forces the slurry to travel through the turning granulator to the lower end. Moist DAP granules are then discharged into a rotary dryer, where excess water is evaporated and the chemical reaction is accelerated to completion by the dryer heat. Dried granules are cooled and then sized on vibrating screens. The product ranges in granule diameter from one to four millimeters (mm). The oversized granules are crushed, mixed with the undersized, and recycled back to the ammoniator-granulator. Product-size DAP granules are allowed to cool, screened, bagged, and shipped. Before being exhausted to the atmosphere, particulate and ammonia rich off-gases from the granulator, cooler, and screening operations pass through cyclones and wet scrubbers (USEPA, 1993a).

TVA developed two minor modifications in their DAP process to produce Monoammonium Phosphate (MAP). In one, the phosphoric acid is ammoniated to an ammonia to phosphoric acid ratio of only 0.6 in the preneutralizer and then 1.0 in the granulator. This compares to a ratio of about 1.4 for DAP. With the second modification, the ammonium to phosphoric acid ratio is brought to 1.4 in the preneutralizer, then additional phosphoric acid is added in the granulator to bring the ratio back to 1.0. The second method is preferred by industry because higher temperatures may be used to dry the MAP, increasing production rates (Kent, 1992).

A schematic diagram of the ammonium phosphate process flow diagram is shown in Figure 13.

Figure 13: Simplified Process Flow Diagram of Diammnonium Phosphate Production



Source: U.S.EPA, 1993a and TFI, 1999

III.B.3. Normal Superphosphate

Normal superphosphates (NSP) are prepared by reacting ground phosphate rock with 65 to 75 percent sulfuric acid to produce a solid fertilizer material. NSP is most often used as a high-phosphate additive in the production of granular fertilizers. It can also be granulated for sale as granulated superphosphate or granular mixed fertilizer.

There are two primary types of sulfuric acid used in superphosphate manufacture: virgin and spent acid. Virgin acid is produced from elemental sulfur, pyrites, and industrial gases and is relatively pure. Spent acid is a

R0074109

recycled waste product from various industries that use large quantities of sulfuric acid. Problems encountered with using spent acid include unusual color, unfamiliar odor, and toxicity. An important factor in the production of normal superphosphates is the amount of iron and aluminum in the phosphate rock. Aluminum (as Al_2O_3) and iron (as Fe_2O_3) above five percent imparts an extreme stickiness to the superphosphate and makes it difficult to handle (USEPA, 1993a).

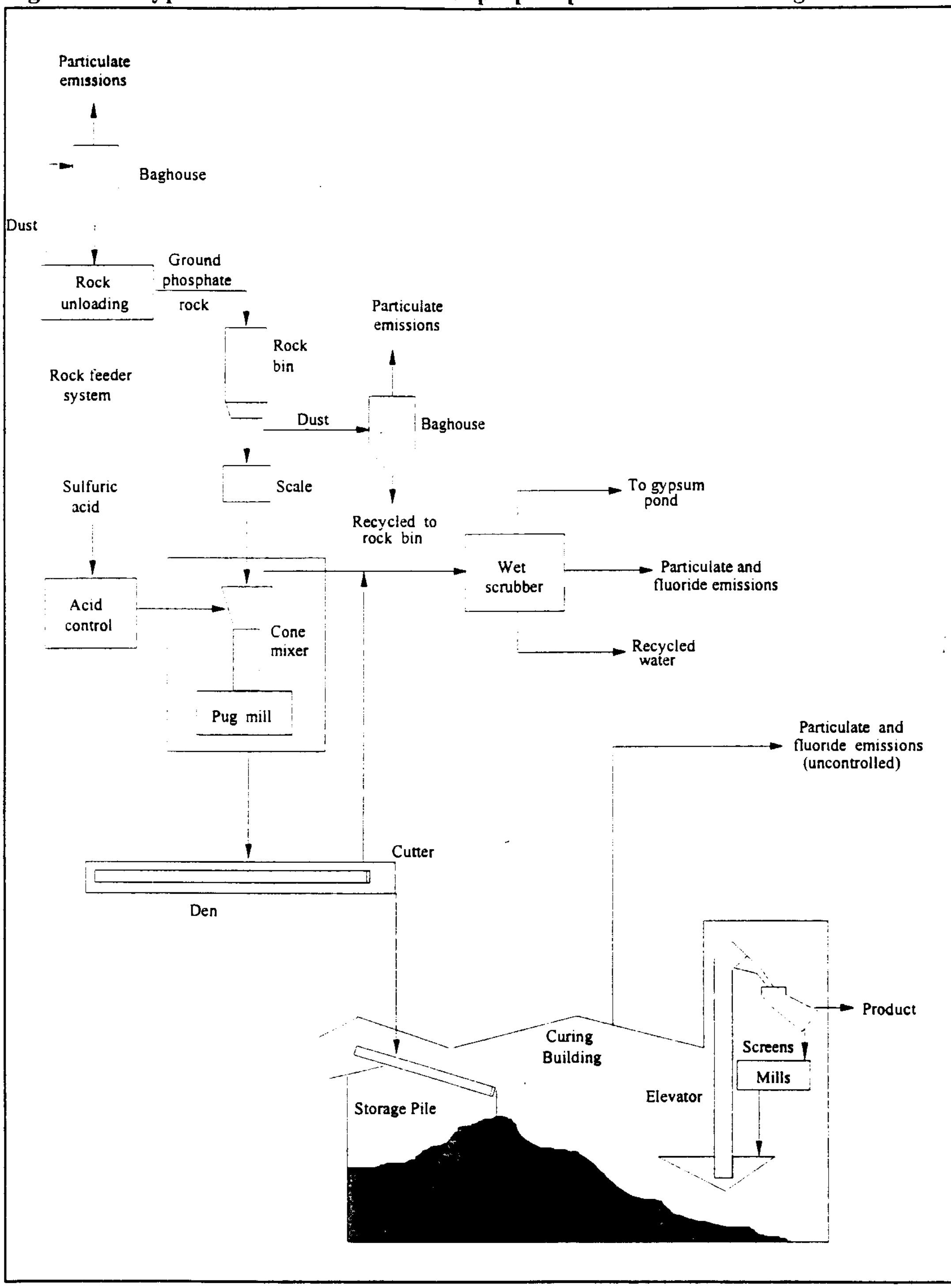
A generalized process diagram of normal superphosphate production is shown in Figure 14. Ground phosphate rock is weighed and mixed with sulfuric acid (H_2SO_4) and held in an enclosed area for about 30 minutes until the reaction is partially completed. The mixing may be done in a cone mixer, which relies on an inputted swirling motion of the acid to mix the rock and acid, a pug mill, which operates with one or two mixing shafts, or a pan mixer, which agitates the solution. The reaction is (AWMA, 1992):

$$Ca_{10}(PO_4)_6F_2CaCO_3 + 11H_2SO_4 \rightarrow 6H_3PO_4 + 11CaSO_4{*}nH_2O + 2HF + CO_2 + H_2O$$

The mixture is then transferred, using an enclosed conveyer known as the den, through the cutter which breaks up clumps, and finally to a storage pile for curing. Off-gases from the reactor are typically treated in a wet scrubber. Particulates throughout the process are controlled with cyclones and baghouses (USEPA, 1993a).

To produce granulated normal superphosphate, cured superphosphate is fed through a clod breaker and sent to a rotary drum granulator where steam, water, and acid may be added to aid in granulation. Material is processed through a rotary drum granulator, a rotary dryer, and a rotary cooler, and is then screened to specification similar to the process used for ammonium nitrate and urea. Finally, it is stored in bagged or bulk form prior to being sold (USEPA, 1993a).

Figure 14: Typical Process for Normal Superphosphate Manufacturing



Source: United States EPA, 1993a.

R0074111

III.B.4. Triple Superphosphate

Triple superphosphate provides a high concentration of phosphorous. Two processes have been used to produce triple superphosphate: run-of-the-pile (ROP-TSP) and granular (GTSP). GTSP yields larger, more uniform particles with improved storage and handling properties than ROP-TSP. At this time, no facilities in the United States are producing ROP-TSP, so only the GTSP process is described here.

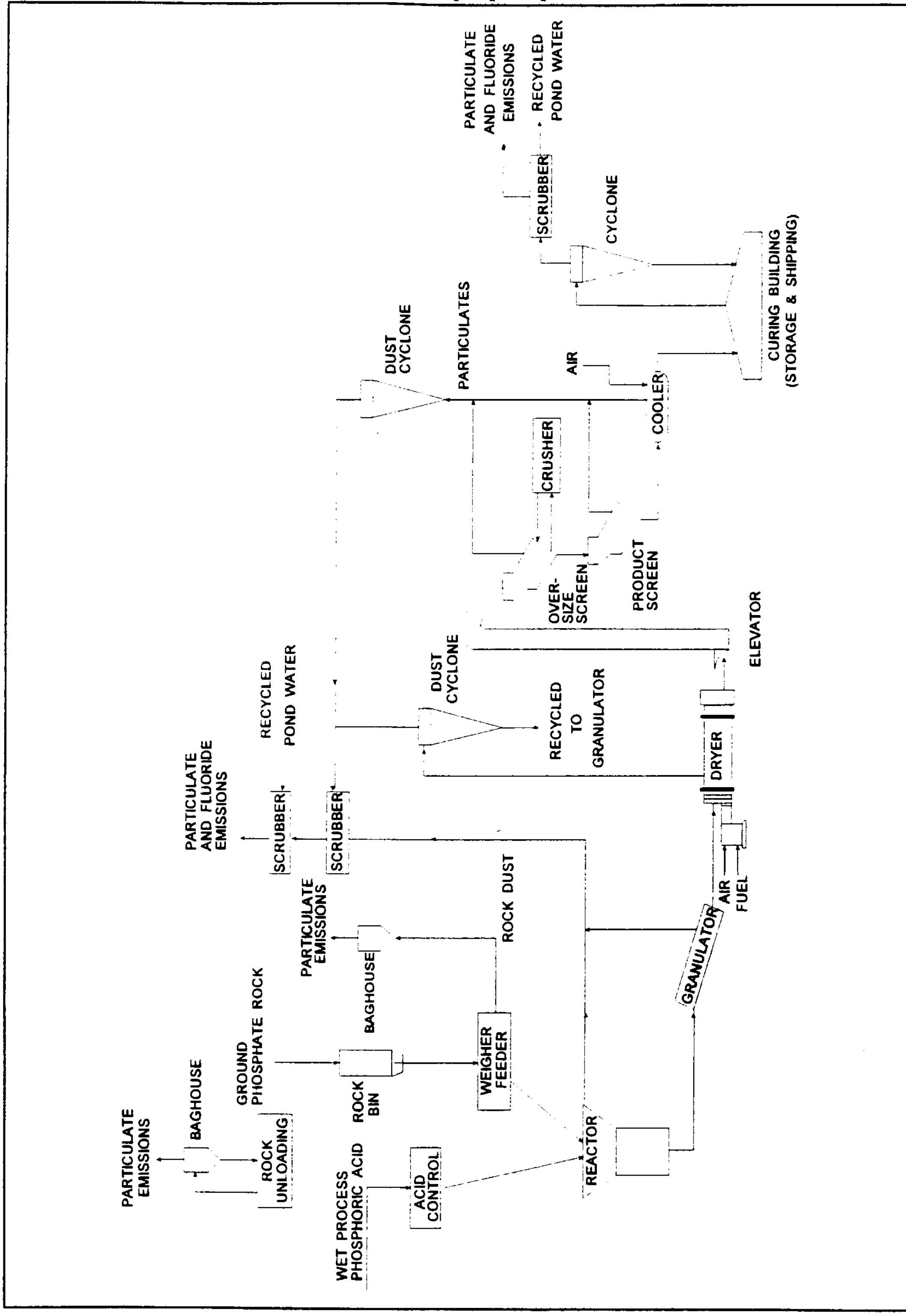
Most GTSP material is made with the Dorr-Oliver slurry granulation process, illustrated in Figure 15. This process is similar to that for normal superphosphates with the major exception being that phosphoric acid is used instead of sulfuric acid. In this process, ground phosphate rock or limestone is reacted with phosphoric acid in one or two reactors in series (USEPA, 1993a). The reaction is:

$$Ca_5F(PO_4)_3 + 7H_3PO_4 + 5H_2O \rightarrow 5Ca(H_2PO_4)_2{\bullet}H_2O + HF$$

(Hodge, 1994) The phosphoric acid used in this process has a relatively low concentration (40 percent P_2O_5). The lower strength acid maintains the slurry in a fluid state during a mixing period of one to two hours. A small sidestream of slurry is continuously removed and distributed onto dried, recycled fines in a granulator, where it coats the granule surfaces and builds up its size.

Granules are then dried in a rotary dryer, elevated and passed through screens to eliminate oversize and undersize granules. Oversize granules are crushed and sent back to the first screen, while undersize ones are sent into the emission control systems. The granules within the size range of the product are then cooled and stored in a curing pile where the reaction is completed. Particulates from the rock handling, drying, screening, cooling, and storing processes are typically controlled with cyclones and bag houses and off-gases from the reactor, granulator, and cyclones and baghouses are typically treated with wet scrubbers (USEPA, 1993a).

Figure 15: Typical Process for Triple Superphosphate



Source: United States EPA, 1993a

R0074113

III.C. Fertilizer Mixing

A significant part of the fertilizer industry only purchases fertilizer materials in bulk from fertilizer manufacturing facilities and mixes them to sell as a fertilizer formulation. Fertilizer mixing facilities use many different materials in their blends. The most common granular fertilizer materials are listed in Table 9.

Table 9: Fertilizer Materials Used in Bulk Blends

	Typical Grade $N\text{-}P_2O_5\text{-}K_2O$	Percent of fertilizer plants using this material
Ammonium nitrate	31-0-0	41%
Urea	46-0-0	66%
Ammonium sulfate	21-0-0	22%
Diammonium phosphate (DAP)	18-46-0	95%
Monoammonium phosphate (MAP)	11-52-0	11%
Triple Superphosphate	0-46-0	78%
Normal superphosphate	0-20-0	4%
Potassium chloride	0-0-60	94%

Source: "Retail Marketing of Fertilizers in the United States," by Hargett, Norman and Ralph Pay, 1980.

DAP is favored for fertilizer mixing because of its ease in storage and handling, convenient low nitrogen and high phosphorous content, and compatibility with almost any other material. Granular triple superphosphate is also very popular, but is incompatible with urea, a common nitrogen source. Therefore, TSP is commonly used in no-nitrogen blends necessary for legumes. Ammonium sulfate has the lowest nitrogen content of the major nitrogen sources, however its production cost is quite low. Potassium chloride is the only major potassium source used in fertilizer blending. Additional materials may also be added to the blends, such as micronutrients and pesticides (Nielson, 1987).

R0074114

Inert ingredients may also be added to fertilizer mixtures to improve the consistency or ease of application. Inert ingredients include sands, clays, and water.

Fertilizer mixing plants consist of five primary phases:

1. mixing and storing
2. moving materials to mixers
3. proportioning of materials
4. mixing, and
5. moving the finished blend to holding bins or transport containers

Fertilizer materials may be mixed as bulk blends or formed into granulations by a variety of processes. Bulk blending is a dry process, where different fertilizers are combined. Materials are typically received by rail cars and transferred through elevators to storage areas. Front-end loaders then carry the materials to weighing hoppers which feed into the mixers. There are two types of mixers most commonly used: the horizontal axis rotary drum mixer and the inclined axis rotary drum mixer. The inclined axis mixer is similar to a cement mixer in design and appearance. Ribbon-type bulk-blend mixers are also used in some plants. A ribbon-type mixer has an axial shaft with mixing spokes radiating out of the shaft in a configuration which forces the blend to flow in a ribbon-like pattern through the mixture (Nielson, 1987).

After preparation and initial bulk blending of materials, granulation may be employed in order to form larger fertilizer particles with multi-nutrient compositions. Granulation of mixed fertilizers may be accomplished by steam granulation, slurry granulation, melt, or compaction granulation.

Steam granulation is primarily used in Europe and Australia. The process results in little chemical reaction in order to maintain the P_2O_5 content of the fertilizer. Plasticity and agglomeration of the fertilizer materials is promoted by the injection of steam into rotating pans, rotary drums, or pug mills. The particles are then dried with heated air in a rotary drum dryer and cooled in a rotary drum cooler. In some cases, particles may be coated with chalk or clay to prevent caking (Hoffmeister, 1993).

Slurry granulation is more commonly used in the United States The process involves a chemical reaction of the feed ingredients. In slurry granulation, one of the feed ingredients is prepared as a slurry and reacted with the others in a preneutralizer. The slurry is then fed to a granulator such as the ammoniator-granulator developed by the TVA. Fertilizer producers in the United States found that higher concentrations of acid could be fed to this preneutralizer-granulator process than to a granulator alone, thus increasing the grades of fertilizers and making the TVA process popular in the United States (Hoffmeister, 1993).

Another granulation process similar to slurry granulation is melt granulation. The slurry feed is replaced by a hot, concentrated, almost anhydrous melt of feed fertilizer, typically ammonium phosphate, prepared in a pipe reactor. The hot melt provides the plasticity necessary for granulation. The granules cool first in the granulator and then in the cooler, eliminating the need for a dryer.

Compaction granulation is based on the fact that most materials are semiplastic and when subjected to high pressures, the materials will compact, deform, and it is possible to roll them out into flat, stable sheets. These sheets are then cracked, forming granule-size chips which are most stable and less prone to caking than other granulations. This process has been successful for many fertilizer mixtures, particularly those including potassium chloride and ammonium phosphates and superphosphates. Ammonium sulfate, however, has limited crystal plasticity, making it unsuitable for compaction granulation (Hoffmeister, 1993).

The mixtures are then typically bagged in woven polypropylene bags for strength and resistance, with liner bags to prevent leaks. The bags are either clamped, tied, heat sealed, or sewn, sewing being the cheapest and most common method (Nielson, 1987).

III.D. Pesticide Formulating Processes

Pesticide formulation involves the process of mixing, blending, or diluting one or more pesticide active ingredients (AIs) and inert ingredients to obtain a product used for additional processing or an end-use (retail) product. Formulation does not involve an intended chemical reaction (i.e., chemical synthesis). AIs are produced at separate facilities not included in this notebook. Pesticide formulations take many forms: water-based liquid; organic solvent-based liquid; dry products in granular, powder, and solid forms; pressurized gases; and aerosols. The formulations can be in a concentrated form requiring dilution before application, or they can be ready to apply. The packaging of the formulated pesticide product depends on the type of formulation. Liquids generally are packaged into jugs, cans, or drums; dry formulations generally are packaged into bags, boxes, drums, or jugs; pressurized gases are packaged into cylinders; and aerosols are packaged into aerosol cans.

Formulating, packaging, and repackaging is performed in a variety of ways, ranging from very sophisticated and automated formulating and packaging lines to completely manual lines. Descriptions of liquid formulating and packaging, dry formulating and packaging, aerosol packaging, pressurized gas formulating and packaging, and repackaging operations are provided below.

III.D.1. Liquid Formulating and Packaging

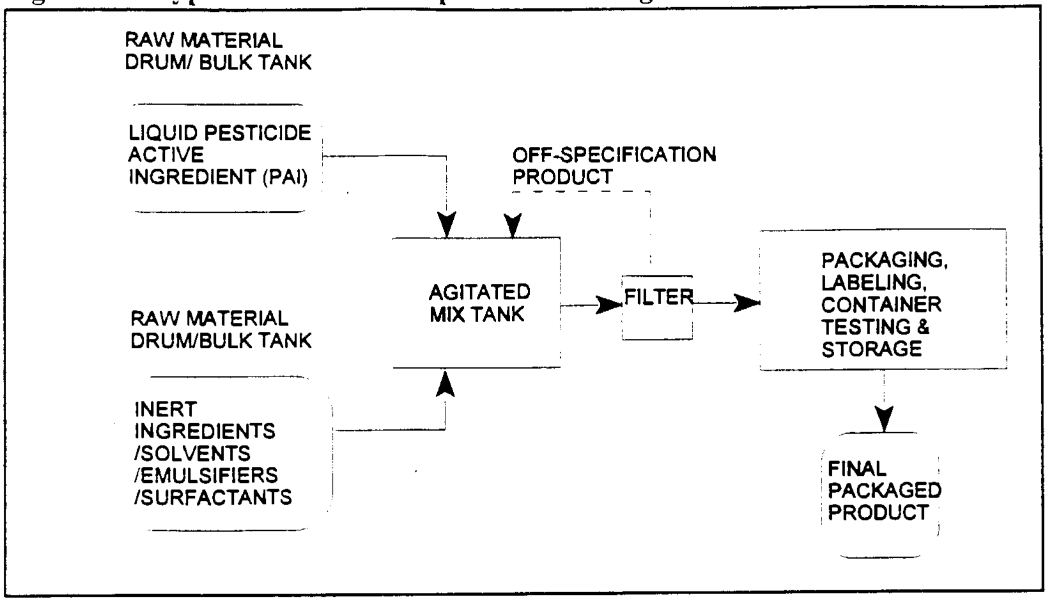
Liquid formulations contain mixtures of several raw materials, including AIs, inert ingredients such as base solvents, emulsifiers, or surfactants. The solvent must be able to dissolve the AIs and other ingredients. It may be water or an organic chemical, such as isopropyl alcohol or petroleum distillate. In some cases, the formulation is an emulsion and contains both water and an organic solvent. Solid materials, such as powders or granules, may also be used as part of a liquid formulation by dissolving or emulsifying the dry materials to form a liquid or suspension. The formulated product may be in a concentrated form requiring dilution before application, or may be ready to apply.

Typical liquid formulating lines consist of storage tanks or containers to hold active and inert raw materials and a mixing tank for formulating the pesticide product. A storage tank may also be used on the formulating line to hold the formulated pesticide product, prior to a packaging step. Facilities may receive their raw materials in bulk and store them in bulk storage tanks, or they may receive the raw materials in smaller quantities, such as 55-gallon drums, 50-pound bags, or 250-gallon minibulk refillable containers or "totes." These raw materials are either piped to the formulation vessel from bulk storage tanks or added directly to the vessel from drums, bags, or minibulks. Typically, water or the base solvent is added to the formulation vessel in bulk quantities (USEPA, 1996). A typical liquid formulating line is shown in Figure 16.

The formulating line may also include piping and pumps for moving the raw material from the storage tanks to the mixing tank, and for moving formulated pesticide product to the packaging line. Other items that may be part of the line are premixing tanks, stirrers, heaters, bottle washers, and air pollution control equipment. Some lines may also have refrigeration units for formulation and storage equipment, scales, and other equipment.

Many liquid formulations are packaged by simply transferring the final product into containers. Small quantities of product are often manually packaged by gravity feeding the product directly from the formulation tank into the product container. For larger quantities, the process is often automated. Formulated product is transferred to the packaging line through pipes or hoses, or is received from a separate formulating facility and placed in a filler tank. A conveyor belt is used to carry product containers, such as jugs, bottles, cans, or drums, through the filling unit, where nozzles dispense the appropriate volume of product. The belt then carries the containers to a capper, which may be automated or manual, and to a labeling unit. Finally, the containers are packed into shipping cases (USEPA, 1996).

Figure 16: Typical Process for Liquid Formulating



Source: United States EPA, 1996

III.D.2. Dry Formulating and Packaging

Dry formulations also contain active and inert ingredients. The final product may be in many different forms, such as powders, dusts, granules, blocks, solid objects impregnated with pesticide (e.g., flea collars), pesticides formed into a solid shape (e.g., pressed tablets), microencapsulated dusts or granules (AI coated with a polymeric membrane to prevent premature degradation), or encapsulated water soluble packaging. They are formulated in various ways, including:

- mixing powdered or granular AIs with dry inert carriers;
- spraying or mixing a liquid active ingredient onto a dry carrier;
- soaking or using pressure and heat to force active ingredients into a solid matrix;
- mixing active ingredients with a monomer and allowing the mixture to polymerize into a solid; and
- drying or hardening an active ingredient solution into a solid form.

These dry pesticide products may be designed to be applied in solid form or dissolved or emulsified in water or solvent prior to application (USEPA, 1996).

Because there are many types of dry pesticide products, dry pesticide formulating lines can vary considerably. In general, though, dry formulating

R0074118

lines have tanks or containers to hold the active ingredients and inert raw materials, and may include mixing tanks, ribbon blenders, extruding equipment, high pressure and temperature tanks for impregnating solids with active ingredient, vacuums or other types of drying equipment, tanks or bins for storage of the formulated pesticide product, pelletizers, presses, milling equipment, sieves, and sifters (USEPA, 1996).

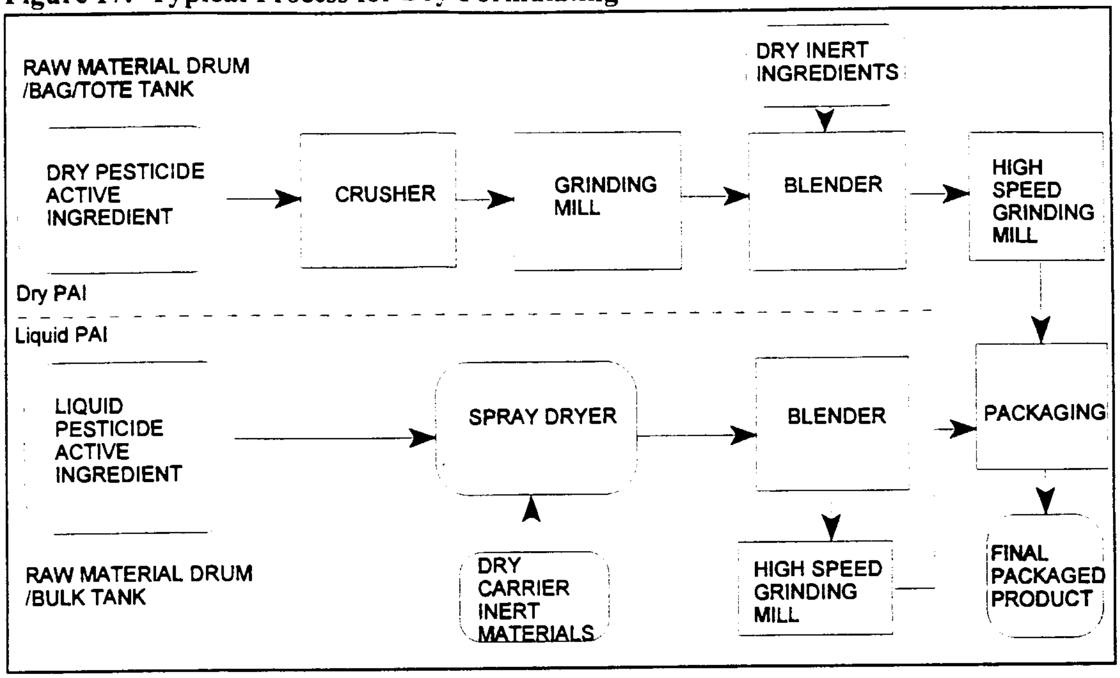
Raw materials for dry pesticide products may be liquid or solid. Liquid raw materials may be stored in rail tank cars, tank trucks, minibulks, drums, or bottles. Dry raw materials may be stored in silos, rail cars, tank trucks, minibulks, metal drums, fiber drums, bags, or boxes. Liquid raw materials may be pumped, poured or sprayed into formulation vessels, while dry raw materials are frequently transferred to formulation equipment by screw conveyors (consisting of a helix mounted on a shaft and turning in a trough), elevators, or by pouring.

Dry formulating lines may also include piping and pumps to move raw materials from storage tanks to the formulation equipment, and to move formulated pesticide product to the packaging equipment. Other items that may be included in the dry pesticide product line are premixing tanks, tanks for storing formulated product prior to packaging, stirrers, heaters, refrigeration units on formulation and storage equipment, scales, and air pollution control equipment (e.g., cyclones, filters, or baghouses) (USEPA, 1996).

Dry pesticide products may be packaged into rail tank cars, tank trucks, totes, and minibulks, but are typically packaged into bags, boxes, and drums. As with many liquid formulations, dry formulations are packaged by simply transferring the final product into boxes, drums, jugs, or bags. Small quantities or bags are typically packaged manually using a gravity feed from the formulating unit into the containers or bags. Larger quantities may be packaged on an automated line, similar to liquid packaging lines.

Figure 17 illustrates a dry pesticide formulation line.

Figure 17: Typical Process for Dry Formulating



Source: United States EPA, 1996

III.D.3. Aerosol Packaging

Some pesticide products (typically water-based or solvent-based liquids) are packaged as aerosols, which can be applied to surfaces or dispersed in the air. The product is placed in spray cans that are put under pressure and a propellant is added, which forces the product out of the can in an aerosol spray. An aerosol packaging line typically includes a filler, a capper, a propellant injector, and a United States Department of Transportation (DOT) test bath. In the filler, formulated pesticide product is dispensed into empty aerosol cans, in much the same way as the liquid packaging lines fill containers. The cans are then sent to the capper, where a cap with a nozzle is placed on the can. The can enters a separate room, where the propellent is injected into the can, a vacuum is pulled, and the cap is crimped to make the can airtight. In order to comply with DOT regulations on the transport of pressurized containers, each can must then be tested for leaks and rupturing in a DOT test bath. Test baths indicate leaks by the appearance of bubbles at the point of leakage on the cylinder. The aerosol packaging line may also include a can washer to remove residue from can exteriors prior to entering the test bath (to reduce contaminant buildup in the bath), a dryer to dry can exteriors, and machinery to package aerosol cans into boxes for shipment (USEPA, 1996).

R0074120

III.D.4. Pressurized Gas Formulating and Packaging

Some pesticide products are formulated and packaged as pressurized gases, primarily for the purpose of soil fumigation. Soil fumigation is used where the nematodic and fungal populations in soil prohibit successful seed planting. Volatile general toxicants, such as low molecular weight halogenated compounds, are typically injected into the soil before planting, but are also occasionally used once plants have reached maturity (Kent, 1992).

The active and inert ingredients are received as liquid, pressurized liquids, or gases, and are stored in tanks, tank trucks, rail cars, or minibulk storage containers. Liquid ingredients are placed in a holding tank prior to formulation. Formulating and packaging operations for these products usually occurs in one step in a closed-loop system. The ingredients are metered by weight through pressurized transfer lines into DOT-approved steel application cylinders. Other equipment that may be included in a pressurized gas line include pump and piping, and heating and refrigerating units to maintain gas pressures and temperatures in storage (USEPA, 1996).

The cylinders may be refilled at a later date, after they have been tested to ensure that they are still capable of containing pressurized fluids. DOT requires hydrostatic pressure testing, as well as visual examination of the cylinder (USEPA, 1996).

III.D.5. Repackaging

Repackaging operations are similar to packaging operations, except the "raw material" is an already formulated product that has been packaged for sale. Repackagers often purchase formulated pesticide products, transfer the product to new containers with customer-specific labeling, and sell them to distributors (USEPA, 1996).

A separate type of repackaging, called refilling, is usually performed by agrichemical facilities that transfer pesticide products from bulk storage tanks into minibulks. These refillable containers are typically constructed of plastic and typically have capacities ranging from 100 to 500 gallons. Minibulks may be owned by the refilling establishment, the pesticide registrant, or by the end user. Production lines usually consist of a bulk storage tank, a minibulk tank into which the product is repackaged, and any interconnecting hoses or piping. The bulk storage tanks may be dedicated by product and clustered together in a diked area. The products are dispensed to the minibulks by the use of manual system or a computer-regulated system of pumps and meters (USEPA, 1996).

III.E. Raw Material Inputs and Pollution Outputs

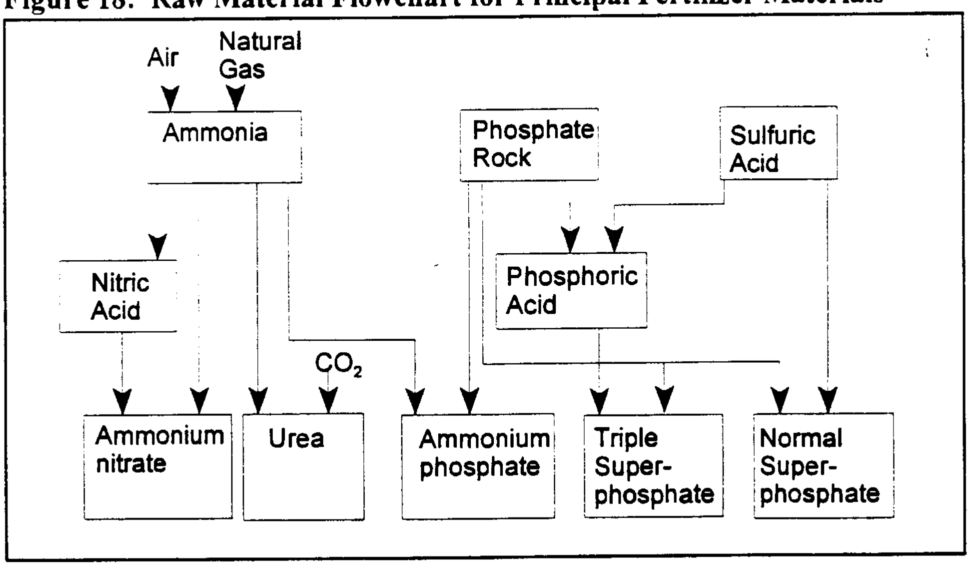
Raw material inputs and pollution outputs of fertilizer products and pesticide products differ considerably, and, therefore, are discussed separately below. The pollution outputs are discussed both specifically by product as well as generally by process since there are some similarities in the fertilizer and pesticide production processes and pollutant outputs.

III.E.1. Fertilizers

The primary raw materials for fertilizer manufacturing are phosphate rock, natural gas, sulfuric acid, and carbon dioxide. These materials are combined by several methods and in different proportions to produce a variety of fertilizer products, as described in section III.

Figure 18 summarizes the fertilizer material inputs for the principal fertilizer products.

Figure 18: Raw Material Flowchart for Principal Fertilizer Materials



Source: Adapted from Manual on Fertilizer Statistics, Food and Agriculture Organization of the United Nations, Rome 1991.

Because the basic fertilizer nutrients are found in many natural and manmade materials, raw materials for fertilizers can also be derived from sources other than the virgin materials described above. Common sources of fertilizer ingredients are sewerage treatment sludges and certain industrial wastes. Although these waste-derived fertilizers may contain essentially the same

R0074122

nutrients as fertilizers derived from virgin materials, they also may contain additional constituents that were present in the waste material and which may not be beneficial, or are potentially harmful to crops, human health, or the environment. Such constituents may enter the food chain or groundwater and could become concentrated in the soil after repeated use. Lead, cadmium and arsenic are some of the more common fertilizer ingredients that could be harmful if sufficient quantities are present. It should be noted, however, that fertilizers derived from virgin materials also have the potential to contain harmful levels of these constituents if significant quantities are naturally present in the raw materials.

One waste material input which has received some attention recently is cement kiln dust (CKD). Although there has been a considerable amount of research conducted on CKD use as a fertilizer, existing applications of CKD for this purpose have been mostly anecdotal, and there is only limited evidence that commercial CKD use as a fertilizer is growing significantly (USEPA, 1993b).

Like agricultural lime, CKD is alkaline and contains a number of essential plant nutrients. Because of these parallel characteristics, CKD has been used as an agricultural soil amendment. CKD possesses significant fertilizer potential, particularly because of its high potassium content. Soil scientists have also suggested that other key plant nutrients contained in CKD, such as calcium, phosphorous, and zinc, might be beneficial in some fertilizer applications. However, some concern has been raised over hazardous wastes in CKD (USEPA, 1993b).

Coal combustion by-products are also receiving attention for their potential agricultural benefits., including alleviating soil trace elemental deficiencies, modifying soil pH, and increasing levels of Ca and S, infiltration rates, depth of rooting, and drought tolerance. Flue gas desulfurization residues, which contain gypsum, have the potential to improve water use efficiency, product quality, and productivity of soil-crop systems. The short term benefits of coal combustion by-products usage has been demonstrated, however, long term effects have not been documented. Future hazards and benefits are yet to be determined (Korcak, 1995). Electric-arc furnace dust is also used as a fertilizer ingredient since it contains a number of trace elements required by plants, including zinc.

Pollution outputs are summarized in terms of air emission, wastewater, and residual wastes.

Air Emissions

Synthetic Ammonia

Air pollutants from the manufacture of synthetic anhydrous ammonia are emitted primarily from four process steps:

- regeneration of the desulfurization bed,
- heating of the catalytic steam,
- regeneration of carbon dioxide scrubbing solution,
- steam stripping of process condensate.

More than 95 percent of the ammonia plants in the United States use activated carbon fortified with metallic oxide additives for feedstock desulfurization. Vented regeneration steam contains sulfur oxides (SO_x) and hydrogen sulfide (H_2S), depending on the amount of oxygen in the steam. Regeneration may also emit hydrocarbons and carbon monoxide (CO). The reformer, heated with natural gas or fuel oil, may emit combustion products such as NO_x, CO, SO_x, hydrocarbons, and particulates (USEPA, 1993a).

Carbon dioxide (CO_2) is removed from the synthesis gas by scrubbing with monoethanolamine ($C_2H_4NH_2OH$) or hot potassium carbonate solution. Regeneration of this CO_2 scrubbing solution with steam produces emissions of water, NH_3, CO, CO_2 and monoethanolamine (USEPA, 1993a).

Cooling the synthesis gas after low temperature shift conversion forms a condensate containing NH_3, CO_2, methanol (CH_3OH), and trace metals. Condensate steam strippers are used to remove NH_3 and methanol from the water, and steam from this may be vented to the atmosphere, emitting NH_3, CO_2, and methanol (USEPA, 1993a).

Nitric Acid

Emissions from nitric acid manufacturing consist primarily of NO and NO_2 (which account for visible emissions), and trace amounts of HNO_3 mist and NH_3. The major source of nitrogen oxides is the tail gas from the acid absorption tower. In general, the quantity of nitrogen oxides (NO_x) emissions is directly related to the kinetics of the nitric acid formation reaction and absorption tower design. NO_x emissions can increase when there is:

- insufficient air supply to the oxidizer and absorber,
- low pressure, especially in the absorber,
- high temperatures in the cooler/condenser and absorber,
- production of an excessively high-strength product acid,
- operation at high throughput rates,
- faulty equipment such as compressors or pumps which lead to lower pressures, leaks, and reduced plant efficiency (USEPA, 1993a).

Comparatively small amounts of nitrogen oxides are also lost from acid concentrating plants. These losses (mostly NO_2) are from the condenser system, but the emissions are small enough to be controlled easily by absorbers.

Acid mist emissions do not occur from the tail gas of a properly operated plant. The small amounts that may be present in the absorber exit gas streams are typically removed by a separator or collector prior to entering the catalytic reduction unit or expander.

The acid production system and storage tanks can be a significant source of visible NOx emissions at nitric acid plants. Emissions from acid storage tanks are most likely to occur during tank filling (USEPA, 1993a).

Ammonium Nitrate

The primary air emissions from ammonium nitrate production plants are particulate matter (ammonium nitrate and coating materials), ammonia and nitric acid. Ammonia and nitric acid are emitted primarily from solution formation and granulators. Particulate matter (largely as ammonium nitrate) can be emitted from most of the process operations (USEPA, 1993a).

The emission sources in solution formation and concentration processes are neutralizers and evaporators, emitting nitric acid and ammonia. The vapor stream off the top of the neutralization reactor is primarily steam with some ammonia and NH_4NO_3 particulates present. Specific plant operating characteristics, however, make these emissions vary depending upon use of excess ammonia or acid in the neutralizer. Particulate emissions from these operations tend to be smaller in size than those from solids production and handling processes and generally are recycled back to the process (USEPA, 1993a).

Emissions from solids formation processes are ammonium nitrate particulate matter and ammonia. The sources of primary importance are prill towers (for high density and low density prills) and granulators (rotary drum and pan). Emissions from prill towers result from carryover of fine particles and fume by the prill cooling air flowing through the tower. These fine particles are from microprill formation, attrition of prills colliding with the tower or one another, and rapid transition of the ammonia nitrate between crystal states (USEPA, 1993a).

Microprill formation resulting from partially plugged orifices of melt spray devices can increase fine dust loading and emissions. Certain designs (spinning buckets) and practices (vibration of spray plates) help reduce plugged orifices and thus microprill formation. High ambient air temperatures can cause increased emissions because of entrainment as a result of higher air flow required to cool prills and because of increased fume formation at the higher temperatures (USEPA, 1993a).

Emissions from screening operations are generated by the attrition of the

R0074125

ammonium nitrate solids against the screens and against one another. Almost all screening operations used in the ammonium nitrate manufacturing industry are enclosed or have a cover over the uppermost screen. Emissions are ducted from the process for recovery or reuse (USEPA, 1993a).

Bagging and bulk loading operations are also a source of particulate emissions. Dust is emitted from each type of bagging process during final filling when dust laden air is displaced from the bag by the ammonium nitrate. The potential for emissions during bagging is greater for coated than for uncoated material. It is expected that emissions from bagging operations are primarily the kaolin, talc or diatomaceous earth coating matter. About 90 percent of solid ammonium nitrate produced domestically is bulk loaded. While particulate emissions from bulk loading are not generally controlled, visible emissions are within typical state regulatory requirements (below 20 percent opacity) (USEPA, 1993a).

Urea

Emissions from urea manufacture are mainly ammonia and particulate matter. Formaldehyde and methanol, hazardous air pollutants, may be emitted if additives are used. Formalin™, used as a formaldehyde additive, may contain up to 15 percent methanol. Ammonia is emitted during the solution synthesis and solids production processes. Particulate matter is emitted during all urea processes (USEPA, 1993a).

In the synthesis process, some emission control is inherent in the recycle process where carbamate gases and/or liquids are recovered and recycled. Typical emission sources from the solution synthesis process are noncondensable vent streams from ammonium carbamate decomposers and separators. Emissions from synthesis processes are generally combined with emissions from the solution concentration process and are vented through a common stack. Combined particulate emissions from urea synthesis and concentration operations are small compared to particulate emissions from a typical solids-producing urea plant. The synthesis and concentration operations are usually uncontrolled except for recycle provisions to recover ammonia (USEPA, 1993a).

Uncontrolled emission rates from prill towers may be affected by the following factors:

- product grade being produced
- air flow rate through the tower
- type of tower bed
- ambient temperature and humidity (USEPA, 1993a)

The total of mass emissions per unit is usually lower for feed grade prill production than for agricultural grade prills, due to lower airflows. Uncontrolled particulate emission rates for fluidized bed prill towers are higher than those for nonfluidized bed prill towers making agricultural grade prills, and are approximately equal to those for nonfluidized bed feed grade prills (USEPA, 1993a).

Ambient air conditions can affect prill tower emissions. Available data indicate that colder temperatures promote the formation of smaller particles in the prill tower exhaust. Since smaller particles are more difficult to remove, the efficiency of prill tower control devices tends to decrease with ambient temperatures. This can lead to higher emission levels for prill towers operated during cold weather. Ambient humidity can also affect prill tower emissions. Air flow rates must be increased with high humidity, and higher air flow rates usually cause higher emissions (USEPA, 1993a).

In the solids screening process, dust is generated by abrasion of urea particles and the vibration of the screening mechanisms. Therefore, almost all screening operations used in the urea manufacturing industry are enclosed or are covered over the uppermost screen. Emissions attributable to coating include entrained clay dust from loading, inplant transfer, and leaks from the seals of the coater (USEPA, 1993a).

Phosphoric Acid

Gaseous fluorides such as silicon tetrafluoride (SiF_4) and hydrogen fluoride (HF) can be major emissions from wet process acid production. Phosphate rock contains 3.5 to 4.0 percent fluorine. Part of the fluorine from the rock is precipitated with the gypsum, another part is leached out with the phosphoric acid product, and the remaining portion is vaporized in the reactor or evaporator. The relative quantities of fluorides in the filter acid and gypsum depend on the type of rock and the operating conditions. Final disposition of the volatilized fluoride depends on the design and operation of the plant (USEPA, 1993a).

The reactor in which phosphate rock is reacted with sulfuric acid is the main source of emissions. Fluoride emissions accompany the air used to cool the reactor slurry. Vacuum flash cooling has replaced the air cooling method to a large extent, since emissions are minimized in the closed system.

Acid concentration by evaporation is another source of fluoride emissions. Approximately 20 to 40 percent of the fluorine originally present in the rock vaporizes in this operation. Particulate matter containing fluorides can be emitted directly from process equipment. About three to six percent of the particulates can be fluorides, as measured at one facility (USEPA, 1993a).

Ammonium Phosphates

The major sources of air emissions from the production of ammonium phosphatic fertilizers include the reactor, the ammoniator-granulator, the dryer and cooler, product sizing and material transfer, and the gypsum pond.

The reactor and ammoniator-granulator produce emissions of gaseous ammonia, gaseous fluorides such as hydrogen fluoride (HF) and silicon tetrafluoride (SiF_4), and particulate ammonium phosphates. These two exhaust streams are generally combined and passed through primary and secondary scrubbers (USEPA, 1993a).

Exhaust gases from the dryer and cooler also contain ammonia, fluorides and particulates, and these streams are commonly combined and passed through cyclones and primary and secondary scrubbers. Particulate emissions and low levels of ammonia and fluorides from product sizing and material transfer operations are controlled the same way (USEPA, 1993a).

Normal Superphosphates

Sources of emissions at a normal superphosphate plant include rock unloading and feeding, mixing operations (in the reactor), storage (in the curing building), and fertilizer handling operations. Rock unloading, handling and feeding generate particulate emissions of phosphate rock dust. The mixer, den and curing building emit gases in the form of silicon tetrafluoride (SiF_4), hydrogen fluoride (HF) and particulates composed of fluoride and phosphate material (USEPA, 1993a).

Triple Superphosphates

Emissions of fluorine compounds and dust particles occur during the production of granulated triple superphosphate. Silicon tetrafluoride (SiF_4) and hydrogen fluoride (HF) are released by the acidulation reaction and they evolve from the reactors, den, granulator, and dryer. Evolution of fluoride is essentially finished in the dryer and there is little fluoride evolved from the storage pile in the curing building (USEPA, 1993a).

Sources of particulate emissions include the reactor, granulator, dryer, screens, cooler, mills, and transfer conveyors. Additional emissions of particulate result from the unloading, grinding, storage, and transfer of ground phosphate rock. Facilities may also use limestone, which is received in granulated form and does not require additional milling (USEPA, 1993a).

Wastewater

Wastewater from the fertilizer industry can be classified into four groups:

- process effluents resulting from contact with gas, liquids, or solids
- dedicated effluents which may be separated for use in one process or for recycling at a controlled rate
- effluents from general services such as cleaning or pretreatment
- occasional effluents such as leaks or spills

R0074128

A number of process wastewater streams from the nitrogenous fertilizer industry have been identified. Frequently these wastewaters contain high levels of nitrogenous compounds such as ammonia, nitrates, and organic nitrogen. In ammonia production, wastewater is generated from process condensate stripping. Ammonium nitrate manufacturing produces process wastewater in the neutralization process, the evaporation unit, and air cooling equipment. The vacuum condenser in urea plants is a source of wastewater. Most scrubbing operations are also a source of wastewater. Nitric acid production generates relatively little wastewater since there is no process wastewater source. Steam generated in nitrogenous fertilizer processing may contain dissolved and suspended solids, alkalinity, and hardness (USEPA, 1974).

The most common methods for removing nitrogenous compounds include:

- Biological nitrification/denitrification
- Air or steam stripping
- Ion exchange
- Breakpoint chlorination (Water Environment Federation, 1994).

The major source of wastewater from any phosphatic fertilizer manufacturing process is referred to as "pond water." Phosphoric acid production creates large quantities of pond water for cooling of the process, concentration of the product and for processing and storage of the gypsum byproduct. Gypsum slurry water is decanted from the top of the gypsum stacks and sent to the cooling pond through collection ditches (USEPA, 1993a). Through evaporation and recycling, contaminant concentrations in pond water can reach several grams per liter of phosphates and fluoride. Additional elemental contaminants in pond water which originate in phosphate rock are arsenic, cadmium, uranium, vanadium, and radium (USEPA, 1974).

The most common industry treatment for removing phosphorous is lime neutralization and settling.

Occasional wastewater is generated in any fertilizer production facility by leaks, spills, cleaning, maintenance, and laboratory tests. Cleaning of cooling and pollution control systems also produces process wastewater. Cooling water may contain ammonia, sulfate, chloride, phosphate, chromate, and dissolved solids which become concentrated through evaporation (USEPA, 1974). The laundry of workers' clothing is another source of wastewater originating outside the actual process.

Solid/Hazardous/Residual Wastes

One of the largest solid wastes in the fertilizer industry is phosphogypsum which is produced during phosphoric acid production. Approximately 1.5

tons of phosphogypsum is produced per ton of phosphate rock fed, or 5 tons per ton of phosphoric acid produced (expressed as P_2O_5). Gypsum (calcium sulphate dihydrate) is a mineral which also occurs in nature. Phosphogypsum is produced by the reaction of phosphate rock with sulphuric acid during the process of producing phosphoric acid. The term "phosphogypsum" is used to specify the particular gypsum arising from the acidulation of phosphate rock, because it contains trace amounts of many of the mineral impurities that accompany phosphate rock. One of these impurities is radium, the parent of radon. Other trace impurities found in phosphogypsum include arsenic, nickel, cadmium, lead, aluminum, fluoride, and phosphoric acid. Mainly because of the radium content, the EPA restricts use of phosphogypsum and stipulates that no phosphogypsum with radium over ten pCi/g can be removed from the stacks adjacent to the agricultural chemical plants (UNEP, 1996).

The use of waste phosphogypsum for other purposes has been widely encouraged, but economic and/or quality problems and/or the demand for the resulting products frequently inhibit or prevent this. These problems relate not only to the impurities in the gypsum, but also to its relatively high moisture content. Plasterboard, plaster, and cement are the main possibilities. It is also possible to recycle phosphogypsum in sulphuric acid production. The ready availability of natural gypsum and the high cost of gypsum-based sulphuric acid, as well as the presence of trace contaminants, are the main obstacles to its use (Miller, 1995). However, in countries where gypsum and other sulphurous raw materials are scarce, phosphogypsum has been successfully used for these purposes (UNEP, 1996).

Dumping gypsum on land is not possible everywhere because the material settles and dries slowly and requires an adequate land area and certain climatic and soil conditions where the stack is situated. Gypsum stacks are being increasingly regulated in terms of lining and cap systems to prevent contaminated leaching or runoff (UNEP, 1996).

All phosphate ores contain traces of radioactive elements and a number of metals. During processing, these are partitioned between beneficiation process wastes, the waste from the further processing into intermediate and finished fertilizer production, and some end up in the final product (UNEP, 1996).

Cadmium is a heavy metal which accumulates in living systems and can become toxic above certain limits. The quantity of cadmium contained in a phosphatic fertilizer depends on the source of the rock or waste material from which it was made. The cadmium content of phosphate rocks varies from almost zero to over 300 mg/kg P_2O_5. The acidulation of phosphate rock partitions the cadmium between the fertilizer product and the by-products, mainly the phosphogypsum arising from phosphoric acid production (UNEP, 1996).

The fertilizer industry has for some decades tried to develop cadmium separation processes. Processes studied so far have shown serious limitations and problems, with regard to safety, cost, energy consumption or environmental concerns. Currently available processes are expensive and are not economically viable except for phosphates destined for human or animal consumption, which have a greater added value. A process developed for removing cadmium from phosphoric acid, which is used in the production of many phosphatic fertilizers (except normal superphosphate), has shown promise on a laboratory scale, but needs further testing before being used on an industrial scale (UNEP, 1996).

Off-specification product, spills, and dusts collected in emission control systems are potential sources of residual wastes. Products are occasionally suspended or canceled, leaving stockpiles of residual product. Other possible sources of solid wastes are spent catalysts, spent containers, wastewater treatment sludges, and spent filters. Many of these wastes are transported off-site for disposal. However, with good housekeeping techniques and dedicated systems, some of these wastes may be recycled back into the process instead of being wasted.

Catalysts used in the steam reforming process need to be replaced every two to six years. Spent catalysts contain oxides of hexavalent chromium, zinc, iron, and nickel. They are typically returned to the manufacturer or other metal recovery companies for recycling and reclamation of valuable materials (UNEP, 1996).

III.E.2. Pesticide Formulating, Packaging, and Repackaging

As listed below, input raw materials include the pesticide concentrates from pesticide manufacturing plants as well as diluents and other chemical additives used in the formulating process:

- **Active Ingredients**
  Organic/inorganic pesticides: insecticides, herbicides, fungicides, and others. *(See Table 10.)*

- **Formulation and preparation materials**
  Dry formulations:
    organic flours, sulfur, silicon oxide, lime, gypsum, talc, pyrophyllite, bentonites, kaolins, attapulgite, and volcanic ash.

  Liquid formulations:
    Solvents: xylenes, kerosenes, methyl isobutyl ketone, amyl acetate, and chlorinated solvents.

Propellants: carbon dioxide and nitrogen.
Others: wetting and dispersing agents, masking agents, deodorants, and emulsifiers (USEPA, 1990).

In addition to pesticide materials, some facilities listed under SIC code 2879 produce fertilizer/pesticide blends. A variety of nitrogenous, phosphatic, and mixed fertilizers may be inputted into bulk blending tanks to produce these combinations.

Table 10: Approximate Quantities of Most Commonly Used Conventional Pesticides in United States Agricultural Crop Production

Chemical	1995 Consumption (Million pounds active ingredient)	Chemical	1995 Consumption (Million pounds active ingredient)
Atrazine	68-73	Chlorpyrifos	9-13
Metolachlor	59-64	Chlorothalonil	8-12
Metam Sodium	449-54	Copper Hydroxide	7-11
Methyl Bromide	39-46	Propanil	6-10
Dichloropropene	38-43	Dicamba	6-10
2,4-D	31-36	Terbufos	6-9
Glyphosate	25-30	Mancozeb	6-9
Cyanazine	24-29	Fluometuron	5-9
Pendimethalin	23-28	MSMA	4-8
Trifluralin	23-28	Bentazone	4-8
Acetochlor	22-27	Parathion	4-7
Alachlor	19-24	Sodium Chlorate	4-6
EPTC	9-13		

Source: Pesticide Industry Sales and Usage, 1994 and 1995 Market Estimates, EPA, August 1997.

Air Emissions

Air emissions can be generated throughout the pesticide formulating and packaging processes, mostly when fine particulates of pesticide dust become suspended in air while the materials are being moved, processed, or stored. Most dust or granule blending mills are equipped with vacuum systems, cyclones, and wet scrubbers to collect fugitive dust. Some vacuum systems are dedicated to certain processes to facilitate reuse of the dust. Other systems are used to collect dust from a number of areas (USEPA, 1990). Dust generated by pesticide formulation processes contain AIs which may be toxic to humans and the environment. Thus, they are important to contain.

Volatile organic compound (VOC) emissions such as xylene may also arise when solvent-based liquid formulations are produced. VOC emissions may also be generated during equipment cleaning with solvents.

Wastewater

Process wastewater is defined in 40 CFR 122.2 as "any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, byproduct, intermediate product, finished product, or waste product." Wastewater from the pesticide formulating industry is typically due to cleaning of equipment and related process areas and not the actual formulating processes (USEPA, 1996).

Cleaning and decontaminating blending and liquid pesticide mixing and storage equipment generates pesticide-contaminated wastewater or solvent, depending upon whether the equipment is used to formulate water or solvent-based pesticides. Decontamination is performed between batches of different types of formulations to prevent cross contamination of the subsequent batch. Decontamination is also performed prior to taking the equipment out of service for maintenance. The decontamination is commonly performed using high pressure water hoses equipped with spray nozzles, portable steam generators, or by running a batch of solvent through the formulating equipment (USEPA, 1990).

Active ingredient containers, such as 55-gallon drums, are often decontaminated by triple rinsing. The decontamination is usually performed using a high pressure water hose equipped with a spray nozzle or a portable steam jenny. The containers can then be sold or given to commercial recycling firms, depending on label directions (USEPA, 1990).

Floor, wall, and equipment exterior washing is typically performed using water hoses equipped with spray nozzles. It may also involve the use of mops and squeegees. Wastewater is also generated by clean-up of spills and leaks.

Wastewater from these operations typically contains AIs, solvents, and wetting agents (USEPA, 1990). Other sources of wastewater include:

- Pollution control scrubber water
- Department of Transportation leak test water
- Safety equipment wash water
- Laboratory equipment wash water

- Shower water
- Laundry water
- Fire protection test water
- Contaminated precipitation runoff (USEPA, 1996)

Solid/Hazardous/Residual Wastes

Residual wastes include containers and container liners potentially contaminated with pesticides, as well as off-spec product, dust collected from emission control equipment, and product spills. Contaminated laboratory equipment and protective workers clothing are other potential solid waste sources (USEPA, 1990).

Decontamination of the solid-based pesticide blending mills may generate solid diluent contaminated with pesticides. The diluent typically consists of clay for dust mills and sand for granule mills (USEPA, 1990).

In case of pesticide products which have been suspended or canceled, there may be existing stocks of these products remaining. EPA may allow the use of existing stocks or prohibit such use. State environmental agencies occasionally collect unusable pesticides.

Procedures for pesticide management have been proposed by EPA, as authorized under section 19 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). For more details, refer to section VI.C on pending and proposed regulatory requirements.

Table 11: Summary of Potential Pollution Outputs for the Agricultural Chemical Industry

Process	Air Emissions	Process Wastewater	Residual Waste
Nitric Acid Absorption Tower	NO, NO_2, HNO_3 in tailgas	NA	Spent tower materials, trays
Solution Formulation and Granulation	NH_3, HNO_3 particulates	Condensed steam with NH_4NO_3 and NH_3	NA
Solids Formation	Particulates, NO_x, SiF_4, HF	NA	Dusts
Regeneration of Desulfurization and Filter Beds	Hydrocarbons, CO, NH_3, CO_2	Condensed steam, NH_3, CO_2	Spent bed material
Screening	Dust	NA	Mixed undersized captured dusts, used screens
Wet Process Phosphoric Acid Production	SiF_4, HF	Pond water	Gypsum
Unloading of materials into blending tanks	Dust/particulates released in transfer	NA	Leftover raw material containers
Open processing and storage equipment	VOC's	NA	NA
Equipment and facility cleaning	NA	Washwater, waste solvent	Waste sands and clays, used mops/ squeegees/etc.
Laboratory procedures	VOC's and dusts released	Washwater, lab testing water	Off-spec product used for testing/analysis
Spills and runoff	Dust/particulates released by spill	Contaminated rainfall/runoff	Contaminated solid product
Pollution control systems	NA	Contaminated scrubber water	Spent filter material

Source: Guide to Pollution Prevention, The Pesticide Formulating Industry, Center for Environmental Research Information, United States EPA, Washington D.C., 1990.

R0074135

III.F. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of Toxic Release Inventory (TRI) chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1995-1998 and are meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention or compliance assistance activities.

While the quantities reported for 1995 and 1996 are estimates of quantities already managed, the quantities listed by facilities for 1997 and 1998 are projections only. The PPA requires these projections to encourage facilities to consider future source reduction, not to establish any mandatory limits. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Fertilizers

Table 12 shows that the TRI reporting fertilizer manufacturing and mixing facilities managed about 566 million pounds of production related wastes (total quantity of TRI chemicals in the waste from routine production operations in column B) in 1996. From the yearly data presented in column B, the total quantity of production related TRI wastes decreased between 1995 and 1996. Production related wastes are projected to increase in 1997 and 1998. Note that the affects of production increases and decreases on the quantities of wastes generated are not evaluated here.

In 1996, about 84 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns C, D, and E, respectively. Most of these on-site managed wastes were recycled on-site. There is a negligible amount (<1%) of wastes being transferred off-site for recycling, energy recovery, or treatment. The remaining portion of the production related wastes (12 percent in 1995 and 16 percent in 1996), shown in column I, is either released to the environment through direct discharges to air, land, water, and underground injection, or is transferred off-site for disposal.

Table 12: Source Reduction and Recycling Activity for the Fertilizer Industry as Reported within TRI

A	B	On-Site			Off-Site			I
		C	D	E	F	G	H	
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	% Released and Disposed[c] Off-site
1995	719	76%	8%	4%	0%	0%	0%	12%
1996	566	77%	1%	6%	0%	0%	0%	16%
1997	606	77%	1%	7%	0%	0%	0%	15%
1998	617	78%	1%	7%	0%	0%	0%	14%

Source: *1996 Toxics Release Inventory Database.*

[a] Within this industry sector, non-production related waste < 1% of production related wastes for 1996.

[b] Total TRI transfers and releases as reported in section 5 and 6 of Form R as a percentage of production related wastes.

[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

Pesticides and Miscellaneous Agricultural Chemicals

Table 13 shows that the TRI reporting pesticide and miscellaneous agricultural chemicals facilities managed about 252 million pounds of production related wastes (total quantity of TRI chemicals in the waste from routine production operations in column B) in 1996. From the yearly data presented in column B, the total quantity of production related TRI wastes increased between 1995 and 1996. Production related wastes were projected to continue to increase in 1997 and 1998. Note that the affects of production increases and decreases on the quantities of wastes generated are not evaluated here.

In 1996, about 95 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns C, D, and E, respectively. Most of these on-site managed wastes were recycled on-site. A small portion of the remaining wastes (4% in 1996) are transferred off-site for recycling, energy recovery, or treatment. The remaining one percent of the production related wastes, shown in column I, is either released to the environment through direct discharges to air, land, water, and underground injection, or is transferred off-site for disposal.

Table 13: Source Reduction and Recycling Activity for the Pesticide and Miscellaneous Agricultural Chemicals Industry as Reported within TRI

A	B	On-Site			Off-Site			I
		C	D	E	F	G	H	
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	% Released and Disposed[c] Off-site
1995	245	85%	0%	10%	2%	1%	1%	2%
1996	252	84%	0%	11%	2%	1%	1%	1%
1997	266	84%	0%	11%	1%	1%	2%	1%
1998	279	85%	0%	11%	1%	1%	1%	1%

Source: 1996 Toxics Release Inventory Database.

[a] Within this industry sector, non-production related waste < 1% of production related wastes for 1996.

[b] Total TRI transfers and releases as reported in section 5 and 6 of Form R as a percentage of production related wastes.

[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

R0074138

THIS PAGE WAS INTENTIONALLY LEFT BLANK

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry in correlation with other industries. The best source of comparative pollutant release information is the Toxic Release Inventory (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20 through 39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1996) TRI reporting year (which includes over 600 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries. TRI data provide the type, amount and media receptor of each chemical released or transferred.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1996 Toxic Release Inventory Public Data Release, reported onsite releases of toxic chemicals to the environment decreased by 5 percent (111.6 million pounds) between 1995 and 1996 (not including chemicals added and removed from the TRI chemical list during this period). Reported releases dropped by 48 percent between 1988 and 1996. Reported transfers of TRI chemicals to off-site locations increased by 5 percent (14.3 million pounds) between 1995 and 1996. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

Certain limitations exist regarding TRI data. Within some sectors, (e.g. dry cleaning, printing and transportation equipment cleaning) the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. For these sectors, release information from other sources has been included. In addition, many facilities report TRI more under than one SIC code reflecting the multiple operations carried out onsite whether or not the operation is the facilities primary area of business as reported to the U.S. Census Bureau. Reported chemicals are limited to the approximately 600 TRI chemicals. A portion of the emissions from agricultural chemical facilities, therefore, are not captured by TRI. Also, reported releases and transfers may or may not all be associated with the industrial operations described in this notebook.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) code, a statistical classification standard used for all establishment-based federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are on-site discharges of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, vents, ducts, or pipes. Fugitive emissions include equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Releases due to runoff, including storm water runoff, are also reportable to TRI.

Releases to Land -- occur within the boundaries of the reporting facility. Releases to land include disposal of toxic chemicals in landfills, land treatment/application farming, surface impoundments, and other disposal on land (such as spills, leaks, or waste piles).

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal. Wastes containing TRI chemicals are injected into either Class I wells or Class V wells. Class I wells are used to inject liquid hazardous wastes or dispose of industrial and municipal wastewaters beneath the lowermost underground source of drinking water. Class V wells are generally used to inject non-hazardous fluid into or above an underground source of drinking water. TRI reporting does not currently distinguish between these two types of wells, although there are important differences in environmental impact between these two methods of injection.

TRANSFERS -- are transfers of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. Chemicals reported to TRI as transferred are sent to off-site facilities for the purpose of recycling, energy recovery, treatment, or disposal. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, the reported quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewater transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment or removal of a chemical from the wastewater depends on the nature of the chemical, as well as the treatment methods present at the POTW. Not all TRI chemicals can be treated or removed by a POTW. Some chemicals, such as metals, may be removed but not destroyed and may be disposed of in landfills or discharged to receiving waters.

Transfers to Recycling -- are wastes sent off-site for the purposes of regenerating or recovery by a variety of recycling methods, including solvent recovery, metals recovery, and acid regeneration. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site to be treated through a variety of methods, including neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal, generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Fertilizer, Pesticide, and Agricultural Chemical Industry

This section summarizes the TRI data of fertilizer manufacturing and mixing facilities reporting SIC codes 2873, 2874, or 2875 as their primary SIC code and of pesticide and miscellaneous agricultural chemicals formulating facilities reporting SIC code 2879 as their primary SIC code.

According to the 1995 Toxics Release Inventory (TRI) data, 190 fertilizer and pesticide facilities reporting SIC 2873, 2874, 2875, or 2879 released (to the air, water, or land) and transferred (shipped off-site or discharged to sewers) a total of 106 million pounds of toxic chemicals during calendar year 1996. This represents approximately 2 percent of the 5.6 billion pounds of releases and transfers from all manufacturers (SICs 20-39) reporting to TRI that year. The top two chemicals released by weight are ammonia and phosphoric acid (both from fertilizer manufacturing). These two account for about 89 percent (82 million pounds) of the industry's total releases. Xylene, methanol, and ethylbenzene are the three top chemicals transferred by weight (all from pesticide formulating). These three account for about 71 percent (9 million pounds) of the total TRI chemicals transferred by the industries. The variability in facilities' TRI chemical profiles may be attributed to the variety of processes and products in the industries. Eighty-seven percent of the 243 different chemicals reported were reported by fewer than 10 facilities.

Fertilizers (SIC 2873, 2874, 2875)

According to 1996 TRI data, fertilizer manufacturing and mixing facilities released and transferred approximately 93 million pounds of pollutants during calendar year 1996. One hundred and ninety facilities reported TRI emissions for 46 chemicals. Only 13 of the 46 chemicals (28 percent) were reported (as releases and/or transfers) by ten or more facilities, evidence of the diversity of the industry. Fertilizer facilities released an average of 481,000 pounds per facility and transferred an average of 8.000 pounds per facility. The high release per facility values are, in a large part, a result of significant releases for ammonia and phosphoric acid from seventy or more facilities.

Releases

Table 14 presents the number and weights of chemicals released by fertilizer manufacturing and mixing facilities reporting SIC 2873, 2874, and 2875 in 1996. The total quantity of releases was 91.3 million pounds or 98 percent of the total weight of chemicals reported to TRI by the fertilizer industry (i.e., releases and transfers). The top chemical released by this industry is ammonia, accounting for 54 percent of the total releases. Phosphoric acid is the next largest release at 35 percent of the total. Fifty-eight percent of all TRI releases in the fertilizer industry were air emissions, 53 percent as point source and 5 percent as fugitive. Ammonia accounts for 91 percent of air releases. The majority of the other releases were land disposed (32 percent) with phosphoric acid accounting for 99 percent of land disposals. The remaining nine percent was released as water discharges or underground injections.

Transfers

Table 15 presents the number and weights of chemicals transferred off-site by fertilizer manufacturing and mixing facilities reporting SIC 2873, 2874, or 2875 in 1996. The total amount of transfers was about 1.5 million pounds or only two percent of the total amount of chemicals reported to TRI by the fertilizer industry (i.e., releases and transfers). Transfers to recycling facilities accounted for the largest amount, 51 percent of the total transfers. The next greatest percentage went for disposal and the rest to treatment facilities. No energy recovery transfers were reported for this industry. Copper compounds, phosphoric acid, and zinc compounds represented the largest transfers (primarily to recycling), as 60 percent of the total transfers. Ammonia only accounted for 4 percent of the transfers compared to 54 percent of releases.

Pesticides and Miscellaneous Agricultural Chemicals (SIC 2879)

According to 1996 TRI data, pesticide formulating facilities released and transferred approximately 13 million pounds of pollutants during calendar year 1996. One hundred and ninety-three facilities reported TRI emissions for 197 chemicals in 1996. Only 18 (9 percent) of these chemicals were reported by ten or more facilities, evidence of the particularly diverse nature of the industry. Pesticide formulating facilities released an average of 10,000 pounds of pollutants per facility and transferred an average of 59,000 pounds per facility. The high average transfer per facility is due mostly to high average xylene, ethylbenzene, and methanol transfers.

Releases

Table 16 presents the number and weights of chemicals released by pesticide and miscellaneous agricultural chemicals formulating facilities reporting SIC 2879 in 1996. The total amount of releases was 2.0 million pounds or 15 percent of the total quantity of TRI chemicals reported by the pesticide and miscellaneous agricultural chemicals industry (i.e., releases and transfers). This is substantially less than the 98 percent of reported chemicals released by the fertilizer industry. The top two chemicals released by this industry are methanol (23 percent of releases) and dichloromethane (13 percent of releases).

About 69 percent (1.4 million pounds) of all the chemicals released by the pesticide industry were released to air in the form of point source emissions (50 percent) and fugitive air releases (19 percent). Air releases were primarily comprised of dichloromethane, carbon disulfide, and methyl isobutyl ketone. Approximately 29 percent of the releases were by underground injection, and the remaining releases were to water (2 percent) and land disposal (1 percent). The relatively large number of chemicals reported to TRI under SIC 2879 compared to the fertilizer industry illustrates the variety of chemical formulations produced by the pesticide industry.

Transfers

Table 17 presents the number and weights of chemical transfers by the pesticide and miscellaneous agricultural chemicals formulating facilities reporting SIC 2879 in 1996. The total amount of transfers off-site was 11.3 million pounds or 85 percent of the total amount of chemicals reported to TRI by the pesticide industry (i.e., releases and transfers). Xylene, methanol, and ethylbenzene accounted for 58, 12, and 10 percent, respectively, of the chemical TRI transfers. Transfers to recycling facilities accounted for the largest quantity (51 percent) although only eight facilities reported recycling transfers. Xylene accounted for 84 percent of all recycling transfers. Energy recovery and treatment accounted for 23 and 31 percent respectively. The remainder of transfers consisted of off-site disposals.

Table 14: 1996 TRI Releases for Agricultural Chemicals Facilities (SICs 2873,2874,2875) by Number of Facilities Reporting (Releases reported in pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Ammonia	106	4,590,371	43,967,432	427,065	539,900	78,814	49,603,582	467.958
Phosphoric Acid	72	1,452	8.631	2,939,394	0	29,071,310	32,020,787	444.733
Zinc Compounds	56	3,946	2,969	7,817	65	4,023	18,820	336
Manganese Compounds	43	5,292	1,696	1,500	0	500	8,988	209
Nitrate Compounds	42	1,529	261,250	3,108,211	971,850	125,960	4,468,800	106.400
Copper Compounds	37	1,477	525	1,443	60	528	4,033	109
Sulfuric Acid (1994 and after "Acid Aerosols" Only)	32	3,237	1,435,613	5	15,000	25,587	1,479,442	46.233
Nitric Acid	30	22,388	17,418	10	0	7,655	47,471	1,582
Chlorine	30	5,345	25,787	7,818	0	0	38,950	1,298
Methanol	20	38,447	3,068,775	63,362	20	185	3,170,789	158,539
Formaldehyde	13	730	20,874	10	220	5	21,839	1,680
Chromium Compounds	11	251	0	536	90	1,430	2,307	210
Nickel Compounds	10	255	250	795	270	565	2,135	214
Copper	8	5	10	0	0	0	15	2
Zinc (Fume or Dust)	8	5	8	0	0	0	13	2
Lead Compounds	7	17	270	510	0	0	797	114
Hydrogen Fluoride	7	15,325	13,820	15	0	3,309	32,469	4,638
Diethanolamine	6	5	7,907	31,470	0	0	39,382	6,564
2,4-D	5	21	251	0	0	0	272	54
Manganese	5	5	10	0	0	0	15	3
Diazinon	4	0	2	0	0	0	2	1
Benfluralin	4	445	258	0	0	0	703	176
Atrazine	3	140	0	0	0	0	140	47
Trifluralin	2	239	0	0	0	0	239	120
Chromium	2	400	0	0	0	0	400	200
Cadmium Compounds	1	.	.	.	.	.	.	.
Cobalt Compounds	1	.	.	.	.	.	.	.
Diisocyanates	1	10	70	0	0	0	80	80
Certain Glycol Ethers	1	0	0	0	0	0	0	0
Carbaryl	1	5	5	0	0	0	10	10
N-butyl Alcohol	1	5	0	0	0	0	5	5
Quintozene	1	0	0	0	0	0	0	[illegible]
Mecoprop	1	10	250	0	0	0	260	[illegible]
Methoxone	1	5	250	0	0	0	255	255
Ethylene Glycol	1	750	0	13,000	0	250	14,000	14,000
Methyl Isobutyl Ketone	1	73,325	16,241	0	0	0	89,566	89,566
Dicofol	1	250	0	.	0	0	250	250
2,4-DP	1	7	250	0	0	0	257	257
Asbestos (Friable)	1	0	0	0	0	0	0	0
Dicamba	1	12	250	0	0	0	262	262
Nickel	1	400	0	0	0	0	400	400
Vanadium (Fume or Dust)	1	.	.	.	.	.	.	.
Hydrochloric Acid (1995 and after "Acid Aerosols" Only)	1	0	0	0	260,000	0	260,000	260,000
Thiophanate-methyl	1	0	0	0	0	0	0	0
Pendimethalin	1	0	0	0	0	0	0	0
Oxyfluorfen	1	0	0	0	0	0	0	0
	190**	4,766,111	48,851,072	6,603,991	1,787,475	29,320,121	91,327,740	480.672

** Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

R0074146

Table 15: 1996 TRI Transfers for Agricultural Chemicals Facilities (SICs 2873,2874,2875) by Number and Facilities Reporting (Transfers reported in pounds/year)

Chemical Name	# Reporting Chemical	Potw Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery Transfers	Total Transfers	Avg Transfer Per Facility
Ammonia	106	51600	.	.	11477	.	63077	595
Phosphoric Acid	72	0	289528	.	418	.	289946	4,027
Zinc Compounds	56	5	1060	179327	45834	.	226226	4,040
Manganese Compounds	43	0	1000	.	3834	.	4834	112
Nitrate Compounds	42	95000	.	14657	750	.	110407	2,629
Copper Compounds	37	0	11861	384419	11000	.	407280	11,008
Sulfuric Acid (1994 and after "Acid Aerosols" Only)	32	0	.	.	.	.	0	0
Nitric Acid	30	0	250	.	.	.	250	8
Chlorine	30	25	.	.	.	.	25	1
Methanol	20	1542	.	.	.	.	1542	77
Formaldehyde	13	250	.	.	.	.	250	19
Chromium Compounds	11	0	14207	63230	.	.	77437	7,040
Nickel Compounds	10	0	.	81600	20000	.	101600	10,160
Copper	8	0	.	14657	.	.	14657	1,832
Zinc (Fume or Dust)	8	0	505	14657	5	.	15167	1,896
Lead Compounds	7	0	10	.	.	.	10	1
Hydrogen Fluoride	7	0	.	.	.	.	0	0
Diethanolamine	6	19940	.	.	20000	.	39940	6,657
2,4-D	5	0	.	.	4613	.	4613	923
Manganese	5	0	.	.	.	.	0	0
Diazinon	4	0	.	.	4608	.	4608	1,152
Benfluralin	4	0	.	.	1250	.	1250	313
Atrazine	3	0	.	.	107880	.	107880	35,960
Trifluralin	2	0	.	.	.	.	0	0
Chromium	2	0	.	14657	.	.	14657	7,329
Cadmium Compounds	1	.	.	.	.	.	.	.
Cobalt Compounds	1	.	.	.	.	.	.	
Diisocyanates	1	0	.	.	.	.	0	0
Certain Glycol Ethers	1	0	.	.	.	.	0	0
Carbaryl	1	0	.	.	591	.	591	591
N-butyl Alcohol	1	0	.	.	.	.	0	0
Quintozene	1	0	.	.	4358	.	4358	4,358
Mecoprop	1	0	.	.	250	.	250	250
Methoxone	1	0	.	.	250	.	250	250
Ethylene Glycol	1	0	.	185	.	.	185	185
Methyl Isobutyl Ketone	1	0	.	.	.	.	0	0
Dicofol	1	0	250	.	.	.	250	250
2,4-DP	1	0	.	.	250	.	250	250
Asbestos (Friable)	1	0	19300	.	.	.	19300	19,300
Dicamba	1	0	.	.	250	.	250	250
Nickel	1	0	.	14657	.	.	14657	14,657
Vanadium (Fume or Dust)	1	.	.	.	.	.	.	.
Hydrochloric Acid (1995 and after "Acid Aerosols" Only)	1	0	.	.	.	.	0	0
Thiophanate-methyl	1	0	.	.	4358	.	4358	4,358
Pendimethalin	1	0	.	.	4358	.	4358	4,358
Oxyfluorfen	1	0	.	.	4358	.	4358	4,358
	190**	168,362	337,971	782,046	250,692	0	1,539,071	8,100

** Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

R0074147

Table 16: 1996 TRI Releases for Agricultural Chemicals Facilities (SIC 2879) by Number of Facilities Reporting (Releases reported in pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
1,2,4-trimethylbenzene	24	5310	3185	0	0	0	8495	354
Xylene (Mixed Isomers)	24	24494	16327	0	17760	0	58581	2,441
Ethylene Glycol	22	7856	819	2521	2290	7922	21408	973
Naphthalene	21	4536	3402	17	0	20	7975	380
Malathion	17	571	280	10	0	0	861	51
Diazinon	17	21	227	10	0	0	258	15
Ammonia	14	20529	36889	4908	2300	360	64986	4,642
2,4-D	13	1926	1535	5	0	255	3721	286
Carbaryl	12	1005	9005	10	0	2500	12520	1,043
Methanol	12	12434	35850	8217	400300	51	456852	38,071
N-butyl Alcohol	12	1498	1668	0	0	0	3166	264
Captan	12	519	12106	5	5	0	12635	1,053
Quintozene	11	1050	561	0	0	0	1611	146
Trifluralin	11	1304	2578	87	0	0	3969	361
Chlorothalonil	11	622	1005	0	0	1670	3297	300
2,4-d 2-ethylhexyl Ester	11	2160	1065	5	0	0	3230	294
Ethylbenzene	10	1065	421	0	0	0	1486	149
Atrazine	10	4000	2430	5	1	0	6436	644
Copper Compounds	9	547	188	11	0	5	751	83
Zinc Compounds	9	2299	2307	0	0	0	4606	512
Dimethylamine	9	3547	7560	0	250	0	11357	1,262
Arsenic Compounds	8	267	1089	14	0	0	1370	171
Certain Glycol Ethers	8	10501	250	0	0	0	10751	1,344
Lindane	8	255	255	5	0	250	765	96
Bromomethane	8	9398	63421	0	0	0	72819	9,102
Chloropicrin	8	2240	5835	0	0	0	8075	1,009
Cumene	8	108	78	0	0	0	186	23
Permethrin	8	976	509	0	0	0	1485	186
Dicamba	7	348	324	132	59200	0	60004	8,572
Piperonyl Butoxide	6	35	6	0	0	0	41	7
Dimethoate	6	225	260	10	0	0	495	83
Mecoprop	6	510	920	0	0	255	1685	281
Toluene	6	11676	27350	39	536	71	39672	6,612
Thiram	6	510	1000	0	0	0	1510	252
Methyl Parathion	6	716	312	0	0	0	1028	171
Diuron	6	261	1250	8	0	0	1519	253
Prometryn	6	250	268	0	0	0	518	86
Chlorine	6	6020	2455	0	5	0	8480	1,413
Manganese Compounds	5	6657	75	0	0	0	6732	1,346
Nitrate Compounds	5	5	6	22000	0	0	22011	4,402
1,1,1-trichloroethane	5	1729	7400	0	0	0	9129	1,826
Carbon Disulfide	5	6817	112994	0	5	0	119816	23,963
Methoxone	5	265	510	250	0	250	1275	255
Metham Sodium	5	1266	258	1	0	2	1527	305
N-methyl-2-pyrrolidone	5	310	10	5	750	5	1080	216
Carbofuran	5	22	274	1	0	0	297	59
Bromoxynil Octanoate	5	270	251	0	0	0	521	104
Maneb	5	0	0	0	0	0	0	0
Cyanazine	5	285	1625	0	0	0	1910	382
Formaldehyde	4	3020	8018	1083	0	5	12126	3,032
Chloromethane	4	7434	82165	0	0	9	89608	22,402
Dichloromethane	4	12585	256135	100	0	23	268843	67,211
O-xylene	4	5602	35250	5	0	5	40862	10,216
Methyl Isobutyl Ketone	4	105310	58755	5	0	5	164075	41,019
Simazine	4	1005	1005	5	0	0	2015	504
Hydrochloric Acid (1995 **and after** "Acid Aerosols" Only)	4	3698	48257	0	0	56	52011	13,003
Phosphoric Acid	4	438	0	0	0	0	438	110
Sulfuric Acid (1994 and after "Acid Aerosols" Only)	4	1009	1	0	0	15	1025	256
Metribuzin	4	2	1010	5	0	0	1017	254
Acephate	4	255	1250	0	0	0	1505	376
Chromium Compounds	3	250	88	3	0	0	341	114
Chlorodifluoromethane	3	11406	2441	0	0	0	13847	4,616
Maleic Anhydride	3	1079	2385	5	0	0	3469	1,156
M-xylene	3	508	250	0	0	0	758	253
Dicofol	3	210	0	0	0	0	210	70
Aldicarb	3	21	1205	0	0	5	1231	410
Linuron	3	5	5	5	0	0	15	5
Ethyl Dipropylthiocarbamate	3	6706	619	2	29	0	7356	2,452
Paraquat Dichloride	3	500	500	0	0	0	1000	333

R0074148

Table 16: 1996 TRI Releases for Agricultural Chemicals Facilities (SIC 2879) by Number of Facilities Reporting (Releases reported in pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Propachlor	3	0	0	0	0	0	0	0
Fluometuron	3	260	512	0	0	0	772	257
Dimethylamine Dicamba	3	580	5	0	0	5	590	197
Carboxin	3	8	0	0	0	0	8	3
Copper	3	0	5	0	0	0	5	2
Ethoprop	3	250	615	0	0	0	865	288
Thiophanate-methyl	3	70	9	0	0	0	79	26
Pendimethalin	3	970	260	22	0	140	1392	464
Hexazinone	3	17	283	0	0	0	300	100
Ethylenebisdithiocarbamic Acid, Salts and Esters	2	1057	57	0	0	0	1114	557
Trichlorfon	2	.	.	.	.	.	.	.
Parathion	2	.	.	.	.	.	.	.
Dichlorvos	2	0	0	0	0	0	0	0
S.s.s-tributyltrithiophosphate	2	1325	473	2	0	8	1808	904
2,4-db	2	470	250	0	0	0	720	360
1,4-dichlorobenzene	2	340	1371	0	0	0	1711	856
1,2-dichloroethane	2	6300	57000	33	0	250	63583	31,792
Chlorobenzene	2	320	0	0	0	0	320	160
Phenol	2	533	0	1	0	0	534	267
Diethanolamine	2	255	255	0	0	0	510	255
2,4-dp	2	250	5	0	0	5	260	130
Naled	2	0	50	0	0	0	50	25
Hydrazine	2	201	12	0	0	0	213	107
1,3-dichloropropylene	2	2301	120	0	0	0	2421	1,211
Propanil	2	250	2627	0	0	0	2877	1,439
Ametryn	2	255	298	5	0	0	558	279
Cycloate	2	0	49	1	2	0	52	26
Bromoxynil	2	5	10	0	0	0	15	8
2,4-d Butoxyethyl Ester	2	262	401	0	0	0	663	332
Sodium Dicamba	2	5	750	0	0	0	755	378
Dipotassium Endothall	2	39	4	0	0	0	43	22
Molinate	2	315	271	1	0	0	587	294
Chlorpyrifos Methyl	2	5	5	0	0	0	10	5
Zinc (Fume or Dust)	2	250	0	.	0	0	250	125
Nitric Acid	2	4000	398	5	0	280	4683	2,342
Resmethrin	2	1	0	0	0	0	1	1
Desmedipham	2	15	0	0	0	0	15	8
Thiophanate Ethyl	2	.	.	.	.	.	.	.
Thiobencarb	2	530	281	0	0	0	811	406
Thiodicarb	2	250	1000	0	0	250	1500	750
Propiconazole	2	5	5	0	0	0	10	5
Cyfluthrin	2	3	13	0	0	350	366	183
Fomesafen	2	255	250	0	0	0	505	253
Quizalofop-ethyl	2	1	0	.	0	0	1	1
Lactofen	2	847	29	0	0	0	876	438
Bifenthrin	2	6	1	0	0	0	7	4
Myclobutanil	2	.	.	.	.	.	.	.
Antimony Compounds	1	0	2	0	0	0	2	2
Chlorophenols	1	250	250	0	73400	0	73900	73,900
Cyanide Compounds	1	15	41	5	0	5	66	66
Diisocyanates	1	.	.	.	.	.	.	.
Lead Compounds	1	130	139	0	0	0	269	269
Carbon Tetrachloride	1	66	41000	0	5	0	41071	41,071
Formic Acid	1	810	700	29	0	0	1539	1,539
Isopropyl Alcohol (Manufacturing, Strong-acid Process Only, No Supplies)	1	0	15	0	0	0	15	15
N,n-dimethylformamide	1	1	38	0	0	0	39	39
Methoxychlor	1	5	5	0	0	0	10	10
Vinyl Chloride	1	552	644	0	0	0	1196	1,196
Tert-butyl Alcohol	1	20	121	0	0	0	141	141
2-methyllactonitrile	1	0	180	0	0	0	180	180
Triphenyltin Hydroxide	1	.	.	.	.	.	.	.
Hexachlorocyclopentadiene	1	5	5	0	250	0	260	260
Dicyclopentadiene	1	141	562	0	0	0	703	703
Dimethyl Sulfate	1	.	.	.	.	.	.	.
Methyl Ethyl Ketone	1	32	240	0	0	0	272	272
Dichloran	1	.	.	.	.	.	.	.
P-xylene	1	5	5	0	0	0	10	10
1,3-butadiene	1	77	1200	0	0	0	1277	1,277
Cyclohexanol	1	0	18	0	0	0	18	18

Table 16: 1996 TRI Releases for Agricultural Chemicals Facilities (SIC 2879) by Number of Facilities Reporting (Releases reported in pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
N-hexane	1	2910	5560	0	0	0	8470	8.470
Pyridine	1	4836	5617	0	0	0	10453	10.453
Propoxur	1	.	.	.	.	.	.	.
Di(2-ethylhexyl) Phthalate	1	10	25	0	0	0	35	35
Hexachlorobenzene	1	5	0	0	0	0	5	5
1,2,4-trichlorobenzene	1	8000	750	0	750	0	9500	9.500
2,4-dichlorophenol	1	2630	250	0	15390	0	18270	18.270
Triethylamine	1	3298	101	0	0	0	3399	3,399
Hydroquinone	1	250	5	0	0	0	255	255
Folpet	1	0	5	0	0	0	5	5
Merphos	1	200	0	0	0	0	200	200
Oxydemeton Methyl	1	.	.	.	.	.	.	.
Bromacil	1	6	0	0	0	0	6	6
Methyl Isothiocyanate	1	0	0	0	0	0	0	0
Perchloromethyl Mercaptan	1	0	510	0	0	0	510	510
Methyl Isocyanate	1	0	0	0	0	0	0	0
Pebulate	1	250	250	0	.	0	500	500
Benfluralin	1	.	.	.	.	.	.	.
Nitrapyrin	1	.	.	.	.	.	.	.
Triallate	1	250	250	0	0	0	500	500
Dodine	1	5	5	0	0	0	10	10
Dimethyl Chlorothiophosphate	1	0	0	0	0	0	0	0
Temephos	1	.	.	.	.	.	.	.
Terbacil	1	.	.	.	.	.	.	.
Hydrogen Fluoride	1	0	0	0	0	0	0	0
Bromine	1	0	0	0	0	0	0	0
Mevinphos	1	0	0	0	0	0	0	0
Phosphine	1	0	1076	0	0	0	1076	1,076
Creosote	1	15	25	0	0	0	40	40
Zineb	1	.	.	.	.	.	.	.
Fenbutatin Oxide	1	.	.	.	.	.	.	.
Alachlor	1	2100	0	0	0	0	2100	2,100
Benomyl	1	.	.	.	.	.	.	.
Oryzalin	1	.	.	.	.	.	.	.
Oxydiazon	1	5	250	0	0	0	255	255
Aluminum Phosphide	1	.	.	.	.	.	.	.
Bendiocarb	1	.	.	.	.	.	.	.
Pronamide	1	5	250	0	0	0	255	255
Toluene Diisocyanate (Mixed Isomers)	1	.	.	.	.	.	.	.
Propetamphos	1	5	5	0	0	250	260	260
Amitraz	1	.	.	.	.	.	.	.
Tebuthiuron	1	0	5	0	0	0	5	5
Diflubenzuron	1	.	.	.	.	.	.	.
Sulprofos	1	.	.	.	.	.	.	.
Dinocap	1	.	.	.	.	.	.	.
Fenpropathrin	1	.	.	.	.	.	.	.
Profenofos	1	.	.	.	.	.	.	.
Oxyfluorfen	1	.	.	.	.	.	.	.
Triadimefon	1	.	.	.	.	.	.	.
Vinclozolin	1	.	.	.	.	.	.	.
Fenvalerate	1	1	0	0	0	0	1	1
Dimethipin	1	.	.	.	.	.	.	.
Triclopyr Triethylammonium Salt	1	0	6	0	0	0	6	6
Fenarimol	1	.	.	.	.	.	.	.
Acifluorfen, Sodium Salt	1	0	0	2	0	5	7	7
Chlorsulfuron	1	0	1	.	0	0	1	1
Fluvalinate	1	.	.	.	.	.	.	.
Chlorimuron Ethyl	1	0	1	.	0	0	1	1
Tribenuron Methyl	1	0	1	.	0	0	1	1
	193**	369,954	995,519	39,600	573,228	15,287	1,993,588	10,329

** Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

R0074150

Table 17: 1996 TRI Transfers for Agricultural Chemicals Facilities (SIC 2879) by Number and Facilities Reporting (Transfers reported in pounds/year)

Chemical Name	# Reporting Chemical	Potw Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery Transfers	Total Transfers	Avg Transfer Per Facility
1,2,4-trimethylbenzene	24	5	475	.	43314	.	43794	1,825
Xylene (Mixed Isomers)	24	9	2599	4851510	731777	1020414	6606309	275,263
Ethylene Glycol	22	463	3600	16070	11478	.	31611	1,437
Naphthalene	21	0	823	.	6962	45	7830	373
Malathion	17	0	.	.	1207	.	1207	71
Diazinon	17	0	.	.	3370	.	3370	198
Ammonia	14	25397	.	.	47248	.	72645	5,189
2,4-d	13	263	6017	.	8700	.	14980	1,152
Carbaryl	12	5	2750	.	61666	.	64421	5,368
Methanol	12	4367	5	.	126038	1186991	1317401	109,783
N-butyl Alcohol	12	5	584	.	4150	.	4739	395
Captan	12	0	2191	.	2081	.	4272	356
Quintozene	11	4	.	.	392714	221410	614128	55,830
Trifluralin	11	5	2278	.	9772	.	12055	1,096
Chlorothalonil	11	255	2005	.	1518	.	3778	343
2,4-d 2-ethylhexyl Ester	11	5	2077	.	23721	.	25803	2,346
Ethylbenzene	10	0	231	807182	150224	214836	1172473	117,247
Atrazine	10	73	5673	.	28161	.	33907	3,391
Copper Compounds	9	0	9267	754	1500	.	11521	1,280
Zinc Compounds	9	5	260	2730	.	.	2995	333
Dimethylamine	9	5	.	.	520	.	525	58
Arsenic Compounds	8	10	100655	.	231855	.	332520	41,565
Certain Glycol Ethers	8	57107	.	.	1132	.	58239	7,280
Lindane	8	0	276	.	1388	.	1664	208
Bromomethane	8	0	.	.	.	.	0	0
Chloropicrin	8	0	.	.	.	.	0	0
Cumene	8	0	5	.	1453	.	1458	182
Permethrin	8	0	1250	.	1617	.	2867	358
Dicamba	7	5	.	.	125	.	130	19
Piperonyl Butoxide	6	0	.	.	2082	.	2082	347
Dimethoate	6	0	.	.	3091	.	3091	515
Mecoprop	6	5	3896	.	2497	.	6398	1,066
Toluene	6	0	.	.	2171	.	2171	362
Thiram	6	2	533	.	38081	.	38616	6,436
Methyl Parathion	6	0	360	.	2120	.	2480	413
Diuron	6	250	.	.	380	.	630	105
Prometryn	6	12	250	.	6580	.	6842	1,140
Chlorine	6	6319	.	.	.	.	6319	1,053
Manganese Compounds	5	5	5	21	6309	.	6340	1,268
Nitrate Compounds	5	5	5	.	.	.	10	2
1,1,1-trichloroethane	5	0	.	.	22147	.	22147	4,429
Carbon Disulfide	5	0	.	.	.	.	0	0
Methoxone	5	5	4778	.	941	.	5724	1,145
Metham Sodium	5	1	15862	.	4603	557	21023	4,205
N-methyl-2-pyrrolidone	5	0	1770	.	8041	.	9811	1,962
Carbofuran	5	0	.	.	17525	.	17525	3,505
Bromoxynil Octanoate	5	0	16605	.	1448	.	18053	3,611
Maneb	5	0	250	.	1108	.	1358	272
Cyanazine	5	62	755	.	13905	.	14722	2,944
Formaldehyde	4	0	1200	.	29000	.	30200	7,550
Chloromethane	4	0	26	.	.	.	26	7
Dichloromethane	4	0	.	19277	3555	.	22832	5,708
O-xylene	4	0	.	.	1310	.	1310	328
Methyl Isobutyl Ketone	4	940	.	.	1630	.	2570	643
Simazine	4	5	1255	.	250	.	1510	378
Hydrochloric Acid (1995 and after "Acid Aerosols" Only)	4	0	.	.	.	.	0	0
Phosphoric Acid	4	0	25549	.	.	.	25549	6,387
Sulfuric Acid (1994 and after "Acid Aerosols" Only)	4	0	.	.	.	.	0	0
Metribuzin	4	0	.	.	13213	.	13213	3,303
Acephate	4	250	.	.	15800	.	16050	4,013
Chromium Compounds	3	1	11257	.	155	.	11413	3,804
Chlorodifluoromethane	3	0	.	.	.	.	0	0
Maleic Anhydride	3	0	.	.	.	.	0	0
M-xylene	3	0	.	.	410	.	410	137
Dicofol	3	0	.	.	250	.	250	83
Aldicarb	3	0	.	.	32289	.	32289	10,763
Linuron	3	0	.	.	.	.	0	0
Ethyl Dipropylthiocarbamate	3	5	590	.	9610	.	10205	3,402

R0074151

Table 17: 1996 TRI Transfers for Agricultural Chemicals Facilities (SIC 2879) by Number and Facilities Reporting (Transfers reported in pounds/year)

Chemical Name	# Reporting Chemical	Potw Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery Transfers	Total Transfers	Avg Transfer Per Facility
Paraquat Dichloride	3	32	5	.	250	.	287	96
Propachlor	3	15	.	.	6490	.	6505	2,168
Fluometuron	3	235	1505	.	13785	.	15525	5,175
Dimethylamine Dicamba	3	0	255	.	.	.	255	85
Carboxin	3	2	384	.	390	.	776	259
Copper	3	0	.	.	.	.	0	0
Ethoprop	3	0	250	.	1105	.	1355	452
Thiophanate-methyl	3	0	1167	.	.	.	1167	389
Pendimethalin	3	0	.	.	.	.	0	0
Hexazinone	3	250	250	.	250	.	750	250
Ethylenebisdithiocarbamic Acid, Salts and Esters	2	0	.	.	12830	.	12830	6,415
Trichlorfon	2	0	.	.	.	.	0	0
Parathion	2	.	.	.	.	.	.	.
Dichlorvos	2	0	.	.	145	104	249	125
S,s,s-tributyltrithiophosphate	2	0	.	.	116	.	116	58
2,4-db	2	0	.	.	792	.	792	396
1,4-dichlorobenzene	2	0	.	.	1365	.	1365	683
1,2-dichloroethane	2	0	.	.	.	.	0	0
Chlorobenzene	2	0	.	.	1700	.	1700	850
Phenol	2	0	.	.	.	.	0	0
Diethanolamine	2	5	51	.	5	.	61	31
2,4-dp	2	0	39	.	3	.	42	21
Naled	2	5	.	.	3176	.	3181	1,591
Hydrazine	2	0	.	.	.	.	0	0
1,3-dichloropropylene	2	0	.	.	51325	.	51325	25,663
Propanil	2	0	.	.	1744	.	1744	872
Ametryn	2	0	.	.	9700	.	9700	4,850
Cycloate	2	0	28	.	1006	.	1034	517
Bromoxynil	2	0	1388	.	8	.	1396	698
2,4-d Butoxyethyl Ester	2	0	.	.	3256	.	3256	1,628
Sodium Dicamba	2	750	.	.	.	.	750	375
Dipotassium Endothall	2	0	.	.	250	.	250	125
Molinate	2	0	4405	.	1256	21	5682	2,841
Chlorpyrifos Methyl	2	0	.	.	500	.	500	250
Zinc (Fume or Dust)	2	0	.	.	.	.	0	0
Nitric Acid	2	0	.	.	.	.	0	0
Resmethrin	2	0	.	.	600	.	600	300
Desmedipham	2	0	.	.	492	.	492	246
Thiophanate Ethyl	2	.	.	.	.	.	.	.
Thiobencarb	2	0	4930	.	.	.	4930	2,465
Thiodicarb	2	5	250	.	18411	.	18666	9,333
Propiconazole	2	0	1332	.	.	.	1332	666
Cyfluthrin	2	0	.	.	1019	.	1019	510
Fomesafen	2	0	2501	.	5	.	2506	1,253
Quizalofop-ethyl	2	0	.	.	.	.	0	0
Lactofen	2	0	250	.	3069	.	3319	1,660
Bifenthrin	2	0	.	.	48	.	48	24
Myclobutanil	2	.	.	.	.	.	.	.
Antimony Compounds	1	0	132	.	.	.	132	132
Chlorophenols	1	0	2290	.	1198	670	4158	4,158
Cyanide Compounds	1	0	.	.	4	.	4	4
Diisocyanates	1	.	.	.	.	.	.	.
Lead Compounds	1	0	.	65000	.	.	65000	65,000
Carbon Tetrachloride	1	0	.	.	.	.	0	0
Formic Acid	1	0	830	.	2800	.	3630	3,630
Isopropyl Alcohol (Manufacturing, Strong-acid Process Only, No Supplies)	1	0	.	.	.	529	529	529
N,n-dimethylformamide	1	250	54765	.	4055	2331	61401	61,401
Methoxychlor	1	.	.	.	500	.	500	500
Vinyl Chloride	1	0	.	.	.	.	0	0
Tert-butyl Alcohol	1	0	.	.	416	.	416	416
2-methyllactonitrile	1	0	.	.	.	.	0	0
Triphenyltin Hydroxide	1	.	.	.	.	.	.	.
Hexachlorocyclopentadiene	1	0	.	.	3735	800	4535	4,535
Dicyclopentadiene	1	0	.	.	.	.	0	0
Dimethyl Sulfate	1	0	.	.	.	.	0	0
Methyl Ethyl Ketone	1	0	.	.	814	.	814	814
Dichloran	1	.	.	.	.	.	.	.
P-xylene	1	0	.	.	250	.	250	250

R0074152

Table 17: 1996 TRI Transfers for Agricultural Chemicals Facilities (SIC 2879) by Number and Facilities Reporting (Transfers reported in pounds/year)

Chemical Name	# Reporting Chemical	Potw Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery Transfers	Total Transfers	Avg Transfer Per Facility
1,3-butadiene	1	0	.	.	.	.	0	0
Cyclohexanol	1	0	.	.	35289	.	35289	35,289
N-hexane	1	0	.	.	20740	56	20796	20,796
Pyridine	1	8506	.	.	.	.	8506	8,506
Propoxur	1	.	.	.	.	.	.	.
Di(2-ethylhexyl) Phthalate	1	2	.	.	1033	.	1035	1,035
Hexachlorobenzene	1	0	.	.	3849	2215	6064	6,064
1,2,4-trichlorobenzene	1	0	.	.	7920	890	8810	8,810
2,4-dichlorophenol	1	0	.	.	.	.	0	0
Triethylamine	1	0	.	.	61668	2568	64236	64,236
Hydroquinone	1	250	.	.	.	.	250	250
Folpet	1	0	.	.	.	.	0	0
Merphos	1	0	.	.	.	.	0	0
Oxydemeton Methyl	1	.	.	.	.	.	.	.
Bromacil	1	0	.	.	868	.	868	868
Methyl Isothiocyanate	1	0	.	.	.	.	0	0
Perchloromethyl Mercaptan	1	0	.	.	.	.	0	0
Methyl Isocyanate	1	0	.	.	.	.	0	0
Pebulate	1	0	500	.	250	.	750	750
Benfluralin	1	.	.	.	.	.	.	.
Nitrapyrin	1	.	.	.	.	.	.	.
Triallate	1	0	509	.	676	.	1185	1,185
Dodine	1	0	.	.	500	.	500	500
Dimethyl Chlorothiophosphate	1	0	.	.	.	.	0	0
Temephos	1	.	.	.	.	.	.	.
Terbacil	1	.	.	.	.	.	.	.
Hydrogen Fluoride	1	0	.	.	.	.	0	0
Bromine	1	750	.	.	.	.	750	750
Mevinphos	1	0	.	.	.	.	0	0
Phosphine	1	0	.	.	.	.	0	0
Creosote	1	5	.	.	602	.	607	607
Zineb	1	.	.	.	.	.	.	.
Fenbutatin Oxide	1	.	.	.	.	.	.	.
Alachlor	1	0	.	.	8600	.	8600	8,600
Benomyl	1	.	.	.	.	.	.	.
Oryzalin	1	.	.	.	.	.	.	.
Oxydiazon	1	0	.	.	250	.	250	250
Aluminum Phosphide	1	.	.	.	.	.	.	.
Bendiocarb	1	.	.	.	.	.	.	.
Pronamide	1	0	.	.	500	.	500	500
Toluene Diisocyanate (Mixed Isomers)	1	.	.	.	.	.	.	.
Propetamphos	1	0	1000	.	.	.	1000	1,000
Amitraz	1	.	.	.	.	.	.	.
Tebuthiuron	1	0	.	.	937	.	937	937
Diflubenzuron	1	.	.	.	.	.	.	.
Sulprofos	1	0	.	.	.	.	0	0
Dinocap	1	.	.	.	.	.	.	.
Fenpropathrin	1	.	.	.	.	.	.	.
Profenofos	1	.	.	.	.	.	.	.
Oxyfluorfen	1	.	.	.	.	.	.	.
Triadimefon	1	0	.	.	.	.	0	0
Vinclozolin	1	.	.	.	.	.	.	.
Fenvalerate	1	0	.	.	3994	.	3994	3,994
Dimethipin	1	.	.	.	.	.	.	.
Triclopyr Triethylammonium Salt	1	0	.	.	82	.	82	82
Fenarimol	1	.	.	.	.	.	.	.
Acifluorfen, Sodium Salt	1	0	.	.	.	.	0	0
Chlorsulfuron	1	0	.	.	9807	.	9807	9,807
Fluvalinate	1	.	.	.	.	.	.	.
Chlorimuron Ethyl	1	0	.	.	36604	.	36604	36,604
Tribenuron Methyl	1	0	.	.	17387	.	17387	17,387
	193**	106,917	306,983	5,762,544	2,494,611	2,654,437	11,325,492	58,681

** Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

R0074153

Top 10 TRI Releasing Agricultural Chemical Companies

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for the agricultural chemical industries are listed below in Tables 18,19, 20, and 21. Facilities that have reported the primary SIC codes covered under this notebook appear on Table 18 for fertilizers and Table 20 for pesticides and miscellaneous agricultural chemicals. Tables 19 and 21 contain additional facilities that have reported the SIC codes covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Table 18: Top 10 TRI Releasing Fertilizer Manufacturing and Mixing Facilities (SIC 2873, 2874, 2875)*

Rank	Facility	Total TRI Releases in Pounds
1	PCS Phosphate Co., Inc. - Aurora, NC	13,202,617
2	CF Ind. Inc. - Donaldsonville, LA	5,823,740
3	Unocal Agricultural Products - Kenai, AK	4,715,420
4	Terra Nitrogen - Catoosa, OK	4,147,000
5	PCS Nitrogen Fertilizer LP - Millington, TN	3,957,624
6	IMC Nitrogen Co. - East Dubuque, IL	3,954,025
7	IMC-Agrico - Uncle Sam, LA	3,570,548
8	Triad Chemical - Donaldsonville, LA	3,478,835
9	IMC-Agrico - Mulberry, FL	3,161,160
10	Farmland Ind. Inc. - Enid, OK	2,804,790
	Total	**45,615,759**

Source: *US Toxics Release Inventory Database, 1996.*
*Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Table 19: Top 10 TRI Releasing Facilities Reporting Fertilizer Manufacturing and Mixing SIC Codes *

Rank	Facility	SIC Codes Reported in TRI	Total TRI Releases in Pounds
1	PCS Phosphate Co. Inc. - Geismar, LA	2873, 2874, 2819	23,192,580
2	PCS Phosphate Co. Inc. - Aurora, NC	2874	13,202,617
3	IMC Agrico Co. - St. James, LA	2873, 2874, 2819	12,794,917
4	Du Pont - Beaumont, TX	2822, 2865, 2869, 2873	10,880,836
5	Rubicon Inc. - Geismar, LA	2865, 2869, 2873	8,327,597
6	Monsanto Co. - Luling, LA	2879, 2834, 2873, 2869, 2819	7,742,540
7	Coastal Chemical Co. - Cheyenne, WY	2813, 2819, 2869, 2873, 2899	7,674,410
8	PCS Phosphate - White Springs, FL	2874, 2819	6,961,770
9	Vicksburg Chemical Co. - Vicksburg, MS	2819, 2873, 2812	6,139,460
10	CF Ind. Inc. - Donaldsonville, LA	2873	5,823,740
	Total		**102,740,467**

Source: *US Toxics Release Inventory Database, 1996.*
* Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Table 20: Top 10 TRI Releasing Pesticide and Miscellaneous Agricultural Chemicals Facilities (SIC 2879)*

Rank	Facility	Total TRI Releases in Pounds
1	BASF Corp. - Beaumont, TX	649,472
2	Rhone-Poulenc Ag. Co. - Woodbine, GA	242,293
3	American Cyanamid Co. - Palmyra, MO	227,942
4	Zeneca Inc. - Perry, OH	178,291
5	Farmland Ind. Inc. - Saint Joseph, MO	162,037
6	Zeneca Inc. - Pasadena, TX	149,968
7	Bayer Corp. - Kansas City, MO	45,881
8	Trical Inc. - Hollister, CA	32,447
9	FMC Corp. - Institute, WV	22,195
10	McLaughlin Gormley King Co. - Chaska, MN	21,611
	Total	**1,732,137**

Source: *US Toxics Release Inventory Database, 1996.*
* Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Table 21: Top 10 TRI Releasing Facilities Reporting Pesticide and Miscellaneous Agricultural Chemicals SIC Codes *

Rank	Facility	SIC Codes Reported in TRI	Total TRI Releases in Pounds
1	Monsanto Co. - Luling, LA	2879, 2834, 2873, 2869, 2819	7,742,540
2	Monsanto - Alvin, TX	2869, 2819, 2841, 2879	7,718,029
3	Uniroyal Chemical Co. - Geismar, LA	2822, 2869, 2879	2,936,127
4	Du Pont - La Porte, TX	2819, 2869, 2879	2,633,242
5	Dow Chemical USA - Midland, MI	2800, 2819, 2821, 2834, 2869, 2879	1,523,414
6	Novartis Crop Protection Inc. - St. Gabriel, LA	2819, 2865, 2869, 2879	1,488,589
7	Tippecanoe Laboratories - Shadeland, IN	2834, 2879	1,206,435
8	Clinton Laboratories - Clinton, IN	2833, 2879	1,158,105
9	Ciba Specialty Chemicals Corp. - McIntosh, AL	2879, 2821, 2865, 3069	1,067,347
10	Du Pont - Belle, WV	2821, 2869, 2879	795,378
	Total		**28,269,206**

Source: *US Toxics Release Inventory Database, 1996.*
* Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1995 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reduction over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult these sources for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the Hazardous Substances Data Bank (HSDB) and the Integrated Risk Information System (IRIS), both accessed via TOXNET.[2] The discussions of toxicity describe the range of possible adverse health effects that have been found to be associated with exposure to these chemicals. These adverse effects may or may not occur at the levels released to the environment. Individuals interested in a more detailed picture of the chemical concentrations associated with these adverse effects should consult a toxicologist or the toxicity literature for the chemical to obtain more information. The effects listed below must be taken in context of these exposure assumptions that are explained more fully within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766.

[2] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and usage, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

Ammonia[3] *(CAS: 7664-41-7)*

Sources. Ammonia is the primary nitrogen source for all nitrogenous fertilizers and ammonium phosphatic fertilizers.

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that ammonia is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a colorless gas at atmospheric pressure, but is shipped as a liquefied compressed gas. It is soluble to about 34 percent in water and has a boiling point of -28 degrees F. Ammonia is corrosive and has a pungent odor.

Phosphoric Acid (CAS: 7664-38-2)

Sources. Phosphoric acid is the primary phosphorous source used for phosphatic fertilizers.

Toxicity. Phosphoric acid is toxic by ingestion and inhalation, and is an irritant to skin and eyes. The toxicity of phosphoric acid is related to its corrosivity as an acid, with ulceration of membranes and tissues with which it comes in contact. Because it is a source of phosphorous, an essential element for aquatic plant growth, phosphoric acid may contribute to eutrophication of standing or slow-moving surface water, particularly in phosphorous-limited waters such as the Great Lakes.

[3] The reporting standards for ammonia were changed in 1995. Ammonium sulfate is deleted from the list and threshold and release determinations for aqueous ammonia are limited to 10 percent of the total ammonia present in solution. This change will reduce the amount of ammonia reported to TRI. Complete details of the revisions can be found in 40 CFR Part 372.

Carcinogenicity. There is currently no evidence to suggest that phosphoric acid is carcinogenic.

Environmental Fate. The acidity of phosphoric acid may be reduced readily by natural water hardness minerals. The phosphate will persist until used by plants as a nutrient.

Physical Properties. Phosphoric acid is a thick, colorless, and odorless crystalline solid, often used in an aqueous solution. Its boiling point is 415° F and it is soluble in water.

Nitrate compounds

Sources. Many different nitrate compounds are formed during nitrogenous fertilizer production.

Toxicity. Nitrate compounds that are soluble in water release nitrate ions which can cause both human health and environmental effects. Human infants exposed to aqueous solutions of nitrate ion can develop a condition in which the blood's ability to carry oxygen is reduced. This reduced supply of oxygen can lead to damaged organs and death. Because it is a source of nitrogen, an essential element for aquatic plant growth, nitrate ion may contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters, such as the Chesapeake Bay.

Carcinogenicity. There is currently no evidence to suggest that nitrate compounds are carcinogenic.

Environmental Fate. Nitrogen in nitrate is the form of nitrogen most available to plants. In the environment, nitrate ion is taken up by plants and becomes part of the natural nitrogen cycle. Excess nitrate can stimulate primary production in plants and can produce changes in the dominant species of plants, leading to cultural eutrophication and ultimately to deterioration of water quality.

Methanol (CAS: 67-56-1)

Sources. Methanol is generated in ammonia production. It is also used as a solvent and for equipment cleaning in pesticide formulations.

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed one mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that methanol is carcinogenic.

Environmental Fate. Methanol is highly volatile and flammable. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microorganisms in soils and surface waters.

Physical Properties. Methanol is a colorless liquid with a characteristic pungent odor. It is miscible with water, and its boiling point is 147°F.

Sulfuric Acid (CAS: 7664-93-9)

Sources. Sulfuric acid is a raw material of most fertilizer products.

Toxicity. Concentrated sulfuric acid is corrosive. In its aerosol form, sulfuric acid has been implicated in causing and exacerbating a variety of respiratory ailments.

Ecologically, accidental releases of solution forms of sulfuric acid may adversely affect aquatic life by inducing a transient lowering of the pH (i.e., increasing the acidity) of surface waters. In addition, sulfuric acid in its aerosol form is also a component of acid rain. Acid rain can cause serious damage to crops and forests.

Carcinogenicity. There is currently no evidence to suggest that sulfuric acid is carcinogenic.

Environmental Fate. Releases of sulfuric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Sulfuric acid is an oily, odorless liquid which can be colorless to dark-brown. It is miscible, and its boiling point is 554°F.

Sulfuric acid reacts violently with water with evolution of heat and is corrosive to metals. Pure sulfuric acid is a solid below 51 °F.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures only about 236 of the facilities in the Fertilizer, Pesticide, and Agricultural Chemical Industry. However, it allows for a comparison across years and industry sectors. Reported chemicals are limited to the approximately 600 TRI chemicals. A portion of the emissions from agricultural chemical facilities, therefore, are not captured by TRI. The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many chemical manufacturing and formulating sources.

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Table 22 summarizes annual releases (from the industries for which a Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Table 22: Air Pollutant Releases by Industry Sector (tons/year)

Industry Sector	CO	NO_2	PM10	PT	SO_2	VOC
Metal Mining	4,951	49,252	21,732	9,478	1,202	119,761
Non-Fuel, Non-Metal Mining	31,008	21,660	44,305	16,433	9,183	138,684
Textiles	8,164	33,053	1,819	38,505	26,326	7,113
Lumber and Wood Products	139,175	45,533	30,818	18,461	95,228	74,028
Wood Furniture and Fixtures	3,659	3,267	2,950	3,042	84,036	5,895
Pulp and Paper	584,817	365,901	37,869	535,712	177,937	107,676
Printing	8,847	3,629	539	1,772	88,788	1,291
Inorganic Chemicals	242,834	93,763	6,984	150,971	52,973	34,885
Plastic Resins and Man-made Fibers	15,022	36,424	2,027	65,875	71,416	7,580
Pharmaceuticals	6,389	17,091	1,623	24,506	31,645	4,733
Organic Chemicals	112,999	177,094	13,245	129,144	162,488	17,765
Agricultural Chemicals	12,906	38,102	4,733	14,426	62,848	8,312
Petroleum Refining	299,546	334,795	25,271	592,117	292,167	36,421
Rubber and Plastic	2,463	10,977	3,391	24,366	110,739	6,302
Stone, Clay, Glass and Concrete	92,463	335,290	58,398	290,017	21,092	198,404
Iron and Steel	982,410	158,020	36,973	241,436	67,682	85,608
Metal Castings	115,269	10,435	14,667	4,881	17,301	21,554
Nonferrous Metals	311,733	31,121	12,545	303,599	7,882	23,811
Fabricated Metal Products	7,135	11,729	2,811	17,535	108,228	5,043
Electronics and Computers	27,702	7,223	1,230	8,568	46,444	3,464
Motor Vehicle Assembly	19,700	31,127	3,900	29,766	125,755	6,212
Aerospace	4,261	5,705	890	757	3,705	10,804
Shipbuilding and Repair	109	866	762	2,862	4,345	707
Ground Transportation	153,631	594,672	2,338	9,555	101,775	5,542
Water Transportation	179	476	676	712	3,514	3,775
Air Transportation	1,244	960	133	147	1,815	144
Fossil Fuel Electric Power	399,585	5,661,468	221,787	13,477,367	42,726	719,644
Dry Cleaning	145	781	10	725	7,920	40

Source: United States EPA Office of Air and Radiation, AIRS Database, 1997.

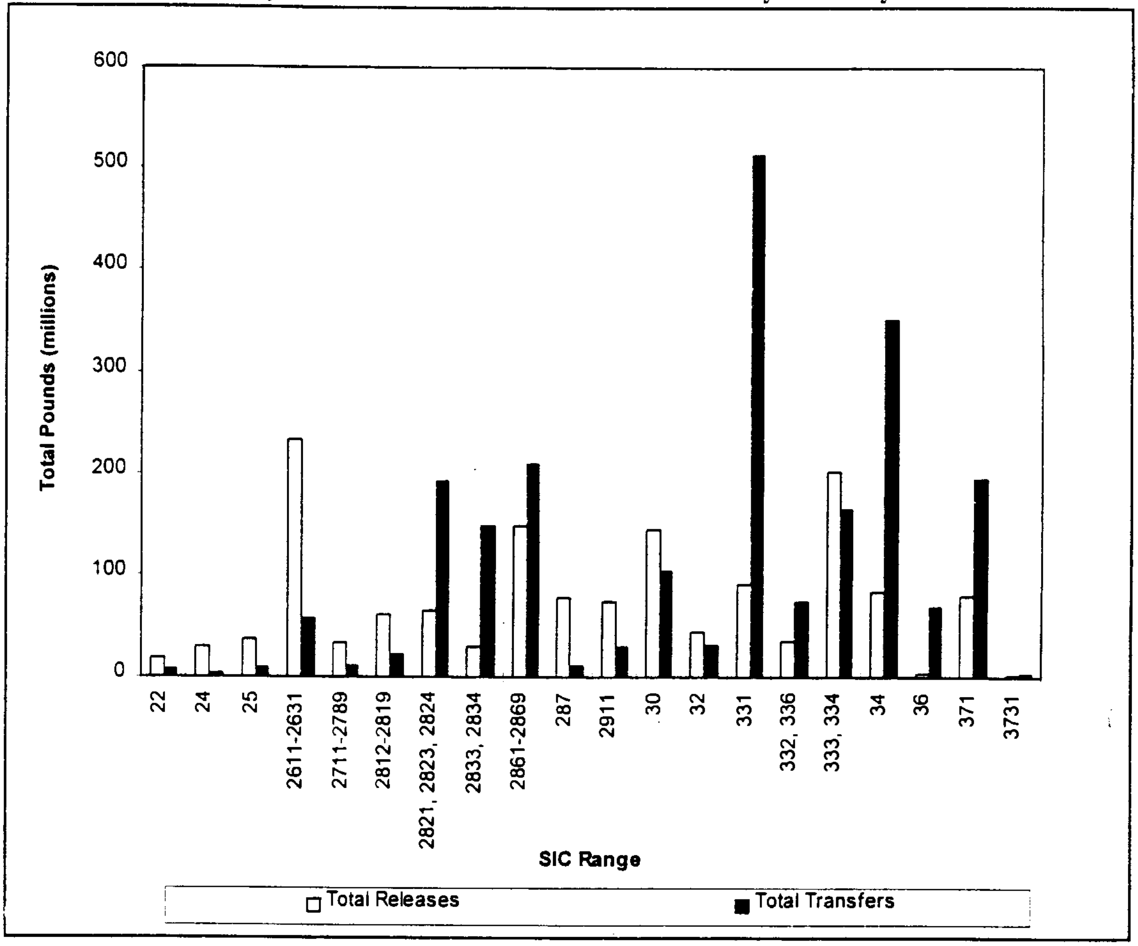
R0074162

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of TRI releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Figure 19 is a graphical representation of a summary of the TRI data for the Fertilizer, Pesticide, and Agricultural Chemical Industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the vertical axis. Industry sectors are presented in the order of increasing SIC code. The graph is based on the data shown in Table 23 and is meant to facilitate comparisons between the relative amounts of releases and transfers both within and between these sectors. Table 23 also presents the average releases per facility in each industry. The reader should note that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the Fertilizer, Pesticide, and Agricultural Chemical Industry, the 1995 TRI data presented here covers 236 facilities. These facilities listed SIC 2873, 2874, 2875, or 2879 as a primary SIC code.

Figure 19: Summary of 1995 TRI Releases and Transfers by Industry



Source: US EPA 1995 Toxics Release Inventory Database.

SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
22	Textiles	2833, 2834	Pharmaceuticals	332, 336	Metal Casting
24	Lumber and Wood Products	2861-2869	Organic Chem. Mfg.	333, 334	Nonferrous Metals
25	Furniture and Fixtures	**287**	**Agricultural Chemicals**	34	Fabricated Metals
2611-2631	Pulp and Paper	2911	Petroleum Refining	36	Electronic Equip. and Comp.
2711-2789	Printing	30	Rubber and Misc. Plastics	371	Motor Vehicles, Bodies, Parts, and Accessories
2812-2819	Inorganic Chemical Manufacturing	32	Stone, Clay, and Concrete	3731	Shipbuilding
2821, 2823, 2824	Resins and Plastics	331	Iron and Steel		

Table 23: 1995 Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	TRI Releases		TRI Transfers		Total Releases +Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
			Total Releases (million lbs.)	Ave. Releases per Facility (pounds)	Total Transfers (million lbs.)	Ave. Trans. per Facility (pounds)		
Textiles	22	339	17.8	53,000	7.0	21,000	24.8	74,000
Lumber and Wood Products	24	397	30.0	76,000	4.1	10,000	34.1	86,000
Furniture and Fixtures	25	336	37.6	112,000	9.9	29,000	47.5	141,000
Pulp and Paper	2611-2631	305	232.6	763,000	56.5	185,000	289.1	948,000
Printing	2711-2789	262	33.9	129,000	10.4	40,000	44.3	169,000
Inorganic Chem. Mfg.	2812-2819	413	60.7	468,000	21.7	191,000	438.5	659,000
Resins and Plastics	2821,2823, 2824	410	64.1	156,000	192.4	469,000	256.5	625,000
Pharmaceuticals	2833, 2834	200	29.9	150,000	147.2	736,000	177.1	886,000
Organic Chemical Mfg.	2861-2869	402	148.3	598,000	208.6	631,000	946.8	1,229,000
Agricultural Chemicals	**287**	**236**	**77.1**	**326,788**	**11.4**	**48,461**	**88.5**	**375,000**
Petroleum Refining	2911	180	73.8	410,000	29.2	162,000	103.0	572,000
Rubber and Misc. Plastics	30	1,947	143.1	73,000	102.6	53,000	245.7	126,000
Stone, Clay, and Concrete	32	623	43.9	70,000	31.8	51,000	75.7	121,000
Iron and Steel	331	423	90.7	214,000	513.9	1,215,000	604.6	1,429,000
Metal Casting	332, 336	654	36.0	55,000	73.9	113,000	109.9	168,000
Nonferrous Metals	333, 334	282	201.7	715,000	164	582,000	365.7	1,297,000
Fabricated Metals	34	2,676	83.5	31,000	350.5	131,000	434.0	162,000
Electronic Equip. and Comp.	36	407	4.3	11,000	68.8	169,000	73.1	180,000
Motor Vehicles, Bodies, Parts, and Accessories	371	754	79.3	105,000	194	257,000	273.3	362,000
Shipbuilding	3731	43	2.4	56,000	4.1	95,000	6.5	151,000

Source: US EPA Toxics Release Inventory Database, 1995.

R0074165

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and substituting toxic chemicals with those less toxic. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be feasiblely implemented. In the waste management hierarchy, if source reduction is not feasible the next alternative is recycling of wastes, followed by energy recovery, and waste treatment as a last alternative.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the Fertilizer, Pesticide, and Agricultural Chemical Industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be used effectively. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

The Fertilizer, Pesticide, and Agricultural Chemical Industry uses many pollution prevention (P2), recycle and reuse, and water conservation practices. Wastewaters are primarily generated not by the production or formulating processes themselves but by cleaning operations of the process areas and associated equipment. Because the wastewaters are mostly cleaning rinsates and not waters of reaction, the pollution prevention practices are not process-specific. There are many P2, recycle and reuse, and water conservation practices that are widely accepted and practiced by the Fertilizer, Pesticide, and Agricultural Chemical Industry today.

These pollution prevention, recycle and reuse, and water conservation practices fall into three groups: production practices, housekeeping practices, and practices that use equipment that, by design, promote pollution prevention. Some of these practices and equipment conserve water, others reduce the amount of fertilizer or pesticide product in the wastewater, and still others may prevent the generation of a wastewater altogether (USEPA, 1996). A number of common P2 practices are listed below.

Production practices include:

- triple-rinsing raw material shipping containers directly into the formulation
- scheduling production to minimize cleanouts
- segregating processing/formulating/packaging equipment by:
  - individual product
  - solvent-based versus water-based formulations
  - products that contain similar active ingredients in different concentrations
- storing interior equipment rinse waters for use in formulating the same product
- packaging products directly from formulation vessels
- using raw material drums for packaging final products
- dedicating equipment (possibly only mix tank or agitator) for "hard-to-clean" formulations

Housekeeping practices include:

- performing preventive maintenance on all valves, fittings, and pumps
- placing drip pans under leaky valves and fittings or under any valves or fittings where hoses or lines are routinely connected and disconnected
- cleaning up spills or leaks in outdoor bulk containment areas to prevent contamination of storm water

Equipment that promotes pollution prevention by reducing or eliminating wastewater generation includes:

- low-volume/high-pressure hoses
- spray nozzle attachments for hoses
- squeegees and mops
- low-volume/recirculating floor scrubbing machines
- portable steam cleaners
- drum triple rinsing stations
- roofs over outdoor tank farms (USEPA, 1996)

Table 24: Waste Minimization Methods for the Fertilizer, Pesticide, and Agricultural Chemical Industry

Waste Stream	Waste Minimization Methods
Equipment Cleaning Wastes	Maximize production runs. Store and reuse cleaning wastes. Use of wiper blades and squeegees. Use of low-volume, high-efficiency cleaning. Use of plastic or foam "pigs."
Spills and Area Washdowns	Use of dedicated vacuum system. Use of dry cleaning methods. Use of recycled water for initial cleanup. Actively involved supervision.
Off-Specification Products	Strict quality control and automation. Reformulating off-spec batches.
Containers	Return containers to supplier and or reuse as directed. Triple rinse containers. Drums with liners versus plastic drums or bags. Segregating solid waste.
Air Emissions	Control bulk storage air emissions. Dedicate dust collection systems. Use automatic enclosed cut-in hoppers. Eliminate emissions of ammonia from reaction of anhydrous ammonia and phosphoric acid.
Miscellaneous Wastewater Streams	Pave high spillage areas.

Source: Guides to Pollution Prevention, The Pesticide Formulating Industry, Center for Environmental Research Information, United States EPA, Cincinnati, Ohio, 1990.

V.A. Equipment Cleaning

Shipping Container/Drum Cleaning Operations

Fertilizer and pesticide facilities frequently receive raw materials in containers such as 55-gallon plastic or steel drums or 30-gallon fiber drums. In some cases, the empty drums are returned to the supplier, but usually the facility is responsible for disposal of the drums. The simplest, most cost-effective, and best approach to prevent pollution associated with cleaning drums and shipping containers is to rinse empty drums prior to disposal to capture the raw material residue for direct reuse in future formulations of the same product. In this way, the facility not only eliminates a potential highly contaminated wastewater source, but is also able to recover the product value of the raw material and avoids costs associated with storage of the wastewater (USEPA, 1996). However, pesticide chemicals formulating and packaging facilities and pesticide repackaging and refilling facilities should consult the List of Pollution Prevention Alternative Practices and ensure compliance with the effluent guidelines and standards found in 40 CFR 455 Subparts C and E before implementing pollution prevention techniques listed in this section.

Rinsing procedures for pesticide drums are provided in 40 CFR Part 165. The most common method of drum rinsing in the agrichemical industry is triple rinsing. After a drum containing AIs or pesticide products is emptied, it should be triple rinsed with the solvent that will be used in the formulation. This method prevents the creation of a rinsate that cannot be added directly to the formulation (e.g., a facility will not create a water-based rinsate when producing a solvent-based product). Note in some cases the label may specify how to rinse.

Some facilities use a high-pressure, low-volume wash system equipped with a hose and a spray nozzle to triple rinse drums; volumes of five to fifteen gallons of water per drum have been reported. EPA has identified many facilities that reuse these rinsates directly in product formulations. Other facilities treat drum rinsate and reuse the effluent for further drum or equipment rinsing. If the rinsate cannot be reused directly in product formulations, another effective method to reduce wastewater generation during shipping container/drum cleaning processes is the use of drum rinsing stations (USEPA, 1996).

One facility uses a three-cell station for triple-rinsing drums. The water in the first cell is used for the first rinse, the water in the second cell is used for the second rinse, and the water in the third cell is used for the final rinse. The rinse water in the first cell is reused until it is visually too contaminated to effectively clean the drums. At that time, it is removed from the cell (for treatment) and the rinse water from the second cell is transferred into the first cell. The rinse water from the third cell is transferred into the second cell, and the third cell is refilled with treated effluent from their treatment system. Each cell contains approximately 100 gallons of water; approximately 70 drums can be rinsed before the first cell requires water changing (USEPA, 1996).

Another site uses a unique, closed-loop set-up for emptying and triple rinsing raw material drums. The system was designed by the facility for several purposes: to aid it in emptying and cleaning drums and performing the triple rinse, to eliminate the need for storage of the water (or solvent) for reuse, and to prevent mathematical errors by the operators during the weighing out of raw materials and water (or solvent). The system consists of two 55-gallon drums, a formulation tank, and connecting hoses. One of the drums is permanently fixed on top of the formulation tank. The formulation tank and drum are situated on a load cell (used for weighing). The second drum, which is full of raw material, is placed on the ground next to the formulation tank. One hose is used to vacuum out the raw material and transfer it to the drum on the formulations tank/load cell. The other hose is equipped with a doughnut-shaped nozzle that provides the triple rinse by spraying the interior of the now empty raw material drum. The rinsate that is created by the triple rinse procedure is automatically removed by the vacuum line and is transferred to the drum on the formulation tank/load cell.

The load cell can be used to weigh the amount of raw material and/or rinsate that is added to the formulation by zeroing out the weight of the tank and drum. This allows the volume of both raw material and rinse water (or solvent) to be factored into the total volume of water (or solvent) required in the formulation. The drum on top of the formulation tank is equipped with a spring-loaded valve that enables the operator to take weight measurements prior to emptying the contents of the drum into the mix tank. This set-up has almost completely eliminated operator math errors and related formulation specification problems.

Bulk Tank and Equipment Cleaning

Pesticide formulating and fertilizer mixing facilities sometimes produce large quantities of formulated pesticide and fertilizer products and receive large quantities of raw materials used to produce those products. Those products and raw materials are stored on site in bulk tanks. The tanks are typically rinsed only when it becomes necessary to use the tank to store a different material. Each time the facility switches the product stored in a bulk tank, the tank is rinsed. Bulk tanks are sometimes also rinsed at the end of a season as a part of general maintenance (USEPA, 1996). Pesticide formulating and fertilizer mixing facilities should consult the List of Pollution Prevention Alternative Practices and ensure compliance with the effluent guidelines and standards found in 40 CFR Part 455 Subparts C and E before implementing pollution prevention techniques involving bulk tank and other equipment cleaning.

Product changeover cleanings can be eliminated or greatly reduced by dedicating equipment to specific products or groups of products. Although entire lines are not generally dedicated, there are many facilities that dedicate tanks to formulation mixing only, thereby eliminating one of the most highly contaminated wastewater streams generated at pesticide formulating and packaging facilities. Facilities also dedicate lines to the production of a specific product type, such as water-based versus solvent-based products, thereby reducing the number of cleanings required, and allowing greater reuse of the cleaning water or solvent.

Another effective pollution prevention technique is to schedule production to reduce the number of product changeovers, which reduces the number of equipment interior cleanings required. Facilities may also reduce the number of changeover cleanings required or the quantity of water or solvent used for cleaning by scheduling products in groups. Products may lend themselves to a particular production sequence if they have common active ingredients, assuming the products also have the same solvent base (including water). Where other raw material cross-contamination problems are not a concern, no cleaning would be required between changeover. Facilities that have implemented this technique have conducted testing to ensure that product quality is not adversely affected (USEPA, 1996).

Scheduling production according to packaging type can reduce changeover cleanings of packaging equipment. Packaging lines are often able to handle containers of different sizes; a slight adjustment to one packaging line, such as adding a short length of hose, may prevent the use of an entirely different set of packaging equipment that would also require cleaning. Packaging can also be performed directly out of the formulation vessels to avoid using and subsequently cleaning interim storage tanks and transfer hoses.

Another effective pollution prevention and water conservation technique to minimize the quantity of rinse water generated by equipment interior cleaning is the use of water hoses equipped with hand-control devices (for example, spray-gun nozzles such as those used on garden hoses). This practice prevents the free flow of water from unattended hoses. Another technique to conserve water is the use of high-pressure, low-volume washers instead of ordinary hoses. One of the facilities visited indicated that, by using high-pressure washers, they reduced typical equipment interior rinse volumes from twenty gallons per rinse to ten gallons per rinse (USEPA, 1996).

Steam cleaning can also be a particularly effective method to clean viscous products that otherwise require considerable volumes of water and/or the addition of a detergent to remove. Many facilities have access to steam from boilers on site; however, if there is no existing source of steam, steam cleaning equipment can be purchased. Although steam generation can increase energy consumption and add NO_x and SO_x pollutants to the atmosphere, there are benefits to be gained. Facilities may end up creating a much smaller volume of wastewater and may potentially avoid the need to use detergents or other cleaning agents that could prevent product recovery. However, steam would be a poor choice for cleaning applications where volatile organic solvents or inerts are part of the product, as the steam would accelerate the volatilization of the organic compounds.

Facilities also clean equipment interiors by using squeegees to remove the product from the formulation vessel and by using absorbent "pigs" to clean products out of the transfer lines before equipment rinsing. These techniques minimize the quantity of cleaning water required, although they generate a solid waste stream requiring disposal. Regardless of whether or not residual product is removed from equipment interiors before rinsing, if certain conditions are met, equipment interior rinsate can typically be reused as make-up water the next time that a water-based product is being formulated with the same chemical (USEPA, 1996). Pesticide chemicals formulating and packaging facilities and pesticide repackaging and refilling facilities should consult the List of Pollution Prevention Alternative Practices and ensure compliance with the effluent guidelines and standards found in 40 CFR Part 455 Subparts C and E before implementing pollution prevention techniques involving bulk tank and other equipment cleaning.

One facility uses a unique method of cleaning to reduce the volume of water needed to clean equipment interiors. At this facility, the production lines are hooked to dedicated product storage tanks. Prior to rinsing these production lines, the facility uses air to "blow" the residual product in the line back to product storage. Not only will these lines require less water to clean, but the residual product that is blown back to storage is not diluted and should not affect the product specifications in any way.

Another facility drastically reduced dichloromethane usage at several plants by switching to soap and water for cleaning. This change enabled the facility to cut its target chemicals by two-thirds. The facility also reduced the release of carbon tetrachloride, and installed a closed-loop recycling system, to reduce water usage (CMA, 1993).

Aerosol Container Leak Testing

No method of eliminating wastewater from test baths has been identified. However, the volume of water used may be minimized by using a contained (or batch) water bath as opposed to a continuous overflow water bath. A contained water bath is completely emptied and refilled with water when required, based upon visual inspection by the operator. Therefore, the quantity of wastewater generated depends on the frequency of refilling and the volume of the bath (200 gallons is a typical volume of the contained water baths). One facility uses a contained water bath and heats the bath with steam to ensure that the temperature of the cans reaches 130°F. This facility indicated that steam condensation causes some overflow that exits the bath via a standpipe. A continuous overflow bath would probably generate more wastewater per production unit than a batch water bath (USEPA, 1996).

One facility has installed a diatomaceous earth filter on one DOT test bath. The facility recirculates the bath water through the filter to remove contaminants such as oil and grease and suspended solids. The filtered water is then reused in the bath, thereby extending the usefulness of the bath water. The facility anticipates they will dispose of the filter as nonhazardous waste.

Another facility uses a can-washing step prior to the DOT test bath, presenting an additional source of wastewater. This can washing is performed at the operator's discretion to reduce the quantity of contaminants entering the bath water. The effectiveness of this step has not been quantitatively determined (USEPA, 1996).

Laboratory Equipment Cleaning

Many pesticide formulating and packaging facilities operate on-site laboratories for conducting quality control tests of raw materials and formulated products. Wastewater is generated from these tests and from cleaning glassware used in the tests. One effective pollution prevention/reuse technique during laboratory equipment cleaning operations is to dedicate laboratory sinks to certain products, and collect any wastewater generated from the testing of those products either for reuse in the same product or for transfer back to the AI manufacturer or product registrant. In the cases where the facility uses solvents in conjunction with the quality control tests performed in the laboratory, the solvent-contaminated water may not be able to be reused in the process (USEPA, 1996).

V.B. Process Changes

Storage Tanks

One method to reduce the amount of wastewater from ammonium nitrate production is to incorporate a wastewater evaporator system which reduces the amount of contaminated cooling water discharge. The wastewater passes through a series of evaporation steps whereby the vapors are used as wash water in the calcium carbonate filters and the concentrated solution is pumped to the neutralizers where it is mixed with the acidic nitrogen-phosphate solution and used to regulate the nitrogen-phosphate nutrient ratio of the fertilizer. Through this modified technology, steam and electric energy consumption increases somewhat, but such increases are balanced by the more effective utilization of nitrogen and the reduction of wastewater. More information on this method can be found in "Waste Water Evaporation Process for Fertilizer Production Technology," *Compendium on Low and Non-waste Technology*, United Nations Economic and Social Counsel. (http://es.inel.gov/studies/cs244.html)

Many methods are available for reducing the amount of emissions resulting from fixed roof storage tanks. Some of these methods include use of conservation vents, conversion to floating roof tanks, use of nitrogen blanketing to suppress emissions and reduce material oxidation, use of refrigerated condensers, use of lean-oil or carbon absorbers, or use of vapor equilibration lines. When dealing with volatile materials, employment of one or more of these methods can result in cost savings to the facility by reducing raw material losses and improving compliance with local air quality requirements (USEPA, 1996).

Air Emission Control Systems

Agricultural chemical facilities often produce large quantities of dust which are collected from numerous sources. The chemical composition of the various dust sources can vary widely. Opportunities often exist to reduce waste generation through segregation of these waste dusts and particulates.

At Daly-Herring Co., in Kingston, NC, dust streams from several different production areas were handled by a single baghouse. Since all of the streams were mixed, none of the waste could be recycled to the process that generated them. By installing separate dedicated baghouses for each production line, all of the collected pesticide dust could be recycled. The initial investment for the equipment was $9,600. The payback period was only ten months. Daly-Herring saved over $9,000 per year in disposal costs and $2,000 per year in raw material costs (Hunt, 1989).

At FMC Corp. in Fresno, CA, common dust collectors were used by multiple production systems. Due to the cross contamination of materials, recycling was impossible. To promote recycling, the company compartmentalized the dust collectors with each compartment serving a single source. All collected materials are analyzed for cross contamination and if none exists, they are reused in the succeeding product batch. Other work involved the installation of self-contained dust collectors at each inlet hopper dump station so that captured dust can be returned to the system (USEPA, 1996).

Facilities may also use wet scrubbers to control air emissions. Some facilities may only need a wet scrubber on one particular process (i.e., a dedicated scrubber). These facilities have been able to reuse the scrubber blowdown or changed-out scrubber water as make-up water in the formulation of that particular product. Some facilities with nondedicated scrubbers have been able to use the scrubber blowdown or changed-out scrubber water for floor or equipment exterior cleaning (USEPA, 1996).

Microprill Formation

Microprill formation resulting from partially plugged orifices of melt spray devices can increase fine dust loading and emissions. Certain designs (spinning buckets) and practices (vibration of spray plates) help reduce microprill formation. Reducing the ambient air temperature reduces emissions because the air flow required to cool prills and the formation of fumes are decreased at lower temperatures.

V.C. Good Housekeeping

Floor/Wall/Equipment Exterior Cleaning

During processing, formulating, and packaging operations, the exteriors of equipment may become soiled from drips, spills, and dust (especially equipment located near dry lines). The floors in the area become dirty in the same manner and also from normal traffic. Facility workers clean the equipment exteriors and floors for general housekeeping purposes, and to keep sources of product contamination to a minimum. When water is used, these cleaning procedures become a source of wastewater.

Wastewater can again be minimized through the use of high-pressure, low-volume washers rather than ordinary water hoses. Additionally, some facilities practice steam cleaning rather than water cleaning of equipment exteriors to reduce the amount of wastewater generated (USEPA, 1996).

Instead of hosing down the exterior of a piece of equipment, some facilities wipe equipment exteriors with rags or use a solvent cleaner, such as a commercially available stainless steel cleaner. This practice avoids generating a wastewater stream, but does create a solid waste that, depending on the solvent used, could be considered a hazardous waste. Squeegees are also used to clean equipment exteriors and floors, and are not disposed of after single uses. It may be possible to dedicate squeegees to a certain line or piece of equipment, but using squeegees may still require using some water (USEPA, 1996).

Some facilities use automated floor scrubbers, which replace the practice of hosing down floors. Floor scrubbers are mechanical devices that continually recirculate cleaning water to clean flat, smooth surfaces with circulating brushes. During operation, the scrubber collects the cleaning water in a small tank that is easily emptied after the cleaning process, or at a later date. Using a floor scrubbing machine can require as little as five to fifteen gallons of cleaning solution (typically water) per use. A mop and a single bucket of water can also be used in place of a hose. Floor mopping can generate as little as ten gallons of water per cleaning depending on the size of the surface to be cleaned (USEPA, 1996).

A number of facilities reuse their floor wash water with and without filtering. One facility has set up its production equipment on a steel-grated platform directly above a collection sump. Following production, the equipment and the floor of the platform, on which the operator stands when formulating product, are rinsed and the water is allowed to flow into the sump. A pump and a filter have been installed in the sump area to enable the operator to transfer this rinsate back into the formulation tank for the next formulation. This sump is also connected to floor trenches in the packaging area for the same product. When the exterior of the packaging equipment and the floors in this area are rinsed, this water is directed to the trenches and eventually ends up in the collection sump for reuse (USEPA, 1996).

Leaks and Spills Clean-Up

Dry products that have leaked or spilled can be vacuumed or swept without generating any wastewater. Liquid leaks and spills can be collected into a trench or sump (for reuse, discharge, or disposal) with a squeegee, leaving only a residue to be mopped up or hosed down if further water cleanup is required. Liquid leaks and spills can also be cleaned up using absorbent material, such as absorbent pads or soda ash. For an acidic product, soda ash or a similar base material will also serve to neutralize the spill. If a residue remains, some water may be used for mopping up or hosing the area down, but methods to reduce floor wash should be implemented whenever possible. Many facilities clean up leaks and spills from water-based products with water and then solvent-based products with absorbent materials. Using an absorbent material may be the best practice for cleaning up small scale solvent-based leaks and spills; however, EPA does recognize that this material then needs to be disposed of (cross-media transfer). Therefore, good housekeeping practices may be even more important in the case of organic solvent-based product spills and leaks because, if not prevented, these spills and leaks may have to be cleaned up with absorbent material and disposed of (USEPA, 1996).

Direct reuse of products which have leaked or spilled is another possible pollution prevention technique. If drip pans or other containers are used to catch leaks and spills, the material (either water-based or solvent-based) can be immediately reused in the product being processed, formulated, or packaged, or stored for use in the next product batch. Collection hoppers or tubs can be installed beneath packaging fillers to capture spills and immediately direct the spills back to the fillers. Leaks or spills around bulk storage tanks can be contained by dikes, which, in fact, are often required by state regulations (USEPA, 1996).

Precipitation Runoff

Precipitation runoff includes all precipitation that falls on facility surfaces that are believed to be contaminated. Contaminated precipitation runoff can be prevented by bringing all operations indoors, as many facilities have done, or by covering outdoor storage tanks and dikes with roofs, which has also been done at many facilities. The roofs would ideally extend low enough to prevent crosswinds from blowing rain into spill-containment dikes. To prevent rainwater contamination, the drain spouts and gutters should conduct roof runoff to areas away from process operations, and the roofs should be kept in good repair (USEPA, 1996).

If operations remain outdoors, a transfer, or containment pad should be installed with a sump or other means of collecting rinse water. The pad should be constructed of asphalt or concrete and maintained with crack sealer and a top coat sealer to control infiltration. The pad should also be large enough to contain wind-blown particulates from dry materials. If pads are cleaned before a rainfall, then uncontaminated precipitation runoff may be directly discharged to surface drains (CFA, 1996). Facilities can also monitor the water in a containment system by periodically testing for a variety of contaminants.

It may be difficult for facilities that do not require large volumes of water to reuse all the precipitation collected in the containment system. These facilities could keep the containment system free of any spilled pesticides through good housekeeping practices so that precipitation falling into the containment system does not become contaminated. Some facilities house their pesticide bulk storage area inside a building or under a covered area to eliminate precipitation from collecting in the containment system, as well as to protect the area from vandalism and severe weather (USEPA, 1996).

Containment Pad in the Loading/Unloading Area

Agrichemical dealers sometimes install loading/containment pads in the operation area to contain and collect any product spills that may occur during pesticide loading operations. The pad is usually installed contiguous to the bulk storage tanks and the repackaging of products into smaller containers. Facilities may also conduct all their portable cleaning operations, such as rinsing minibulk containers, directly on the pad in order to contain and collect the rinsates.

The pad is normally constructed of concrete and is sloped to a sump area. Some facilities divide the sump area into individual collection basins so that the facilities can segregate wastewaters contaminated by different products and reuse these wastewaters for applications. For instance, facilities in the Midwest frequently have two collection basins; one basin collects wastewaters contaminated with corn herbicides and the other collects wastewaters contaminated with soybean herbicides. As part of this collection system, some facilities install one or more tanks to store wastewater until it can be applied to land, while other facilities use portable minibulk tanks to store the wastewater. When facilities collect wastewaters that must be segregated by different types of products, multiple storage tanks are used to avoid contamination (USEPA, 1996).

V. D. Energy Efficiency

Installation of a Feed-Gas Saturator

A mixture of steam and natural gas with a volumetric ratio of steam to carbon of about 3.5:1 is reacted in the primary reformer of reforming ammonia plants. Most of the steam is generated from heat sources within the plant, but the balance of the steam has to be produced in auxiliary boilers. This retrofit permits the use of low-level heat from the flue gases, which would otherwise be lost, to be used in saturating the feed natural gas with water. This generates extra steam which replaces some of the steam generated in the boiler (UNEP, 1996).

Modification of Convection Coils

As a result of other modifications, the temperature profile of the flue gases may change considerably in the cold-leg section of the primary reformer. This change can be compensated for by replacing the low steam superheat coil with a new one with additional rows of tubes and heavier fins on all tubes (UNEP, 1996).

Low-heat Removal of Carbon Dioxide

The traditional systems used for removal of carbon dioxide from the process steam uses hot potassium carbonate which requires heat for regeneration. This heat comes from process heat but needs to be supplemented with external steam. A new low-heat removal system is now available, which uses flashing for part of the regeneration process, and requires less external heat (UNEP, 1996).

Ammonia Synthesis Modifications

Ammonia Converter Retrofit

The vertical quench-type converters are changed from axial flow to radial flow, greatly decreasing the pressure drop across the converter which in turn allows the use of smaller size catalyst with a larger surface area. This improved catalyst yields a higher conversion per pass, generating a lower recycle volume. The lower recycle volume and the lower pressure drop result in reduced energy requirements. This modification yields an increase effective capacity of the ammonia converter of about 35 percent (UNEP, 1996).

Addition of Process Computer

A dedicated process computer can be installed along with other on-line analysis and control systems to monitor and control key variables. With this system, continuous set point changes are possible to optimize the operation of several plant areas such as hydrogen/nitrogen ratio, steam/carbon ratio, synthesis loop purge, methane leakage, converter control, and refrigeration purge (UNEP, 1996).

Hydrogen Recovery from the Purge Gas

Inert gases must be pumped from the plant to avoid their buildup in the system. This purge is carried out by removing a side stream of synthesis gas after recovering the ammonia. By installing the proper recovery system, the hydrogen in this gas mixture can be recovered decreasing the energy requirements of the process by about five percent or permitting an increase of about five percent in production capacity (UNEP, 1996).

THIS PAGE WAS INTENTIONALLY LEFT BLANK

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A contains a general overview of major statutes
- Section VI.B contains a list of regulations specific to this industry
- Section VI.C contains a general discussion on State regulation of pesticides
- Section VI.D contains a list of pending and proposed regulatory requirements

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations (CFR) and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides, and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration
Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enforcement authority for facilities/persons that are not in compliance with FIFRA.

Product Registration
Under section 3 of FIFRA, all pesticides (with few exceptions) sold or

distributed in the United States must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site, i.e., where the product may be used, and amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process often requires either the citation or submission of extensive environmental, health, and safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA section 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be required to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA section 3(c)(2)(B) and section 4.

Use Restrictions

As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration

Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (section 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions

A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR sections 163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension

EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order which makes the suspension immediately effective.

Imports and Exports

Under FIFRA section 17(a), pesticides not registered in the United States and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified in sections 40 CFR sections 168.65, 168.75, and 168.85.

Under FIFRA section 17(c), imported pesticides and devices must comply with United States pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA section 17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. United States

Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to United States Customs when the shipment arrives in the United States NOA forms can be obtained from contacts in the EPA Regional Offices or www.epa.gov/oppfead1/international/noalist.htm.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs' homepage at www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture and Ecosystem Division at http://es.epa.gov/oeca/agecodiv.htm, or The National Agriculture Compliance Assistance Center toll-free at 888-663-2155 or http://es.epa.gov/oeca/ag. Other sources include the National Pesticide Telecommunications Network toll-free at 800-858-7378 and the National Antimicrobial Information Network toll-free at 800-447-6349.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either "toxic" pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and "indirect" dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA section 402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and 1 territory to administer the NPDES program), contain industry-specific, technology-based and water quality-based limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR section 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA section 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under section 307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands

Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the United States Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA section 404 permit program for activities that impact wetlands. EPA's authority under section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the section 404 program to the states.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water Resource Center at (202) 260-7786.

Oil Pollution Prevention Regulation

Section 311(b) of the CWA prohibits the discharge of oil, in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990, Congress passed the Oil Pollution Act which amended section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. The 40 CFR section 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with DPCC plans required by the state provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to 1 million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past 5 years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. The FRPs that meet EPA's requirements can be combined with United States Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards that are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. The UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is often state/tribe-enforced, since EPA has authorized many states/tribes to administer the program. Currently, EPA shares the UIC permit program responsibility in seven states and runs the program in 10 states and on all tribal lands.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1) delineating the source water protection area; (2) conducting a contaminant source inventory; (3) determining the susceptibility of the public water supply to contamination from the inventories sources; and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at http://www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR section 262.34) without a permit or interim status.

Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit. Subtitle C permits for treatment, storage, or disposal facilities contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two United States territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers Standards** (40 CFR Part 264-265, Subpart CC) contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. The CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR section 302.4. A release report may trigger a response by EPA or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning and Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing Local Emergency Planning Committees (LEPCs). EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA section 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA section 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA section 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR Part 302) or an EPCRA extremely hazardous substance.

- **EPCRA sections 311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the

R0074194

SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA section 313** requires certain covered facilities, including SIC codes 20 through 39 and others, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under section 110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone were finalized in 1997. However, these revised NAAQSs are currently being challenged before the U.S. Supreme Court.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. The NSPSs are based on the pollution control technology available to that category of industrial source (*see* 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of sources that emit any of 188 HAPs and to develop regulations for these categories of sources. To date EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their usage and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996. Methyl bromide, a common pesticide, has been identified as a significant stratospheric ozone depleting chemical. The production and importation of methyl bromide, therefore, is currently being phased out in the United States and internationally. As specified in the Federal Register of June 1, 1999 (Volume 64, Number 104) and in 40 CFR Part 82, methyl bromide production and importation will be reduced from 1991 levels by 25% in 1999, by 50% in 2001, by 70% in 2003, and completely phased out by 2005. Some uses of methyl bromide, such the production, importation, and consumption of methyl bromide to fumigate commodities entering or leaving the United States or any state (or political subdivision thereof) for purposes of compliance with Animal and Plant Health Inspection Service requirements or with any international, federal, state, or local sanitation or food protection standard, will be exempt from this rule. After 2005, exceptions may also be made for critical agricultural uses. The United States EPA and the United Nations Environment Programme have identified alternatives to using methyl bromide in agriculture. Information on the methyl bromide phase-out, including alternatives, can be found at the EPA Methyl Bromide Phase-Out Web Site: (http://www.epa.gov/docs/ozone/mbr/mbrqa.html).

EPA's Clean Air Technology Center, at (919) 541-0800 and at the Center's homepage at http://www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996 and at http://www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Hotline, at (800) 535-0202 and at http://www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA section 112(r); and information on air toxics can be accessed through the Unified Air Toxics website at http://www.epa.gov/ttn/uatw. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA section 5, EPA established an inventory of chemical substances. If a chemical substance is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA section 6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under section 6 authority are asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs).

Under TSCA section 8(e), EPA requires the producers and importers (and others) of chemicals to report information on a chemical's production, use, exposure, and risks. Companies producing and importing chemicals can be required to report unpublished health and safety studies on listed chemicals and to collect and record any allegations of adverse reactions or any information indicating that a substance may pose a substantial risk to humans or the environment.

EPA's TSCA Assistance Information Service, at 202 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added section 6217 (16 U.S.C. section 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The section 6217 program is administered at the federal level jointly by EPA and the National

Oceanic and Atmospheric Agency (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds at http://www.epa.gov/owow or from the Watershed Information Network at http://www.epa.gov/win. The NOAA website at http://www.nos.noaa.gov/ocrm/czm/ also contains additional information on coastal zone management.

VI.B. Industry Specific Requirements

The agricultural chemical industry is affected by several major federal environmental statutes. In addition, the industry is subject to numerous laws and regulations from state and local governments designed to protect health, safety, and the environment. A summary of the major federal regulations affecting the agricultural chemical industry follows.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

Every regulation promulgated under FIFRA affects the agricultural chemical industry in some way. The FIFRA regulations are found in 40 CFR Parts 152 through 186. Each part and its title are listed below.

Part 152 -	Pesticide Registration and Classification Procedures
Part 153 -	Registration Policies and Interpretations
Part 154 -	Special Review Procedures
Part 155 -	Registration Standards
Part 156 -	Labeling Requirements for Pesticides and Devices
Part 157 -	Packaging Requirements for Pesticides and Devices
Part 158 -	Data Requirements for Registration
Part 160 -	Good Laboratory Practice Standards
Part 162 -	State Registration of Pesticide Products
Part 163 -	Certification of Usefulness of Pesticide Chemicals
Part 164 -	Rules of Practice Governing Hearings, Under FIFRA, Arising from Refusals to Register, Cancellations of Registrations, Changes of Classifications, Suspensions of Registrations and Other Hearings Called Pursuant to section 6 of the Act
Part 166 -	Exemption of Federal and State Agencies for Use of Pesticides Under Emergency Conditions
Part 167 -	Registration of Pesticide and Active Ingredient Producing Establishments, Submission of Pesticide Reports
Part 168 -	Statements of Enforcement Policies and Interpretations
Part 169 -	Books and Records of Pesticide Production and Distribution
Part 170 -	Worker Protection Standards
Part 171 -	Certification of Pesticide Applicators
Part 172 -	Experimental Use Permits
Part 173 -	Procedures Governing the Rescission of State Primary Enforcement Responsibility for Pesticide Use Violations
Part 177 -	Issuance of Food Additive Regulations

Part 178 - Objections and Requests for Hearings
Part 179 - Formal Evidentiary Public Hearing
Part 180 - Tolerances and Exemptions from Tolerances for Pesticide Chemicals in or on Raw Agricultural Commodities
Part 185 - Tolerances for Pesticides in Food
Part 186 - Pesticides in Animal Feed

Please refer to the general discussion of FIFRA in Section VI.A for additional requirements not discussed below.

Product Registration Data Requirements
EPA requires the citation or submission of extensive environmental, health, and/or safety data during the registration application process. The categories of data required include the product's chemistry; environmental fate; residue chemistry, hazards to humans, domestic animals, and nontarget organisms; spray drift characteristics; reentry protection requirements; and performance (40 CFR Part 158). Under the "product chemistry" category, applicants must supply technical information describing the product's active and inert ingredients, manufacturing or formulating processes and physical and chemical characteristics. Data from "environmental fate" studies are used to assess the effects of pesticide residues on the environment, including its toxicity to people through consumption or exposure to applied areas and its effect on nontarget organisms and their habitat. Residue chemistry information includes the expected frequency, amounts, and time of application, and test results of residue remaining on treated food or feed. Information under "hazards to humans, domestic animals, and non-target organisms" includes specific test data assessing acute, subchronic, and chronic toxicity. All studies required to be submitted must satisfy Good Laboratory Practice (GLP) regulations (40 CFR Part 160). Guidelines for studies of product chemistry, residue chemistry, environmental chemistry, hazard evaluation and occupational and residential exposure can be found in 40 CFR Part 158.

Registration of Establishments
Any person producing a pesticide or device, except a custom blender,[4] is subject to section 7 and 40 CFR. Part 167; and is required to register his

[4] A *custom blender* means any establishment which provides the service of mixing pesticides to a customer's specifications, usually a pesticide(s)-fertilizer(s), pesticide-pesticide, or a pesticide animal feed mixture, when: (1) The blend is prepared to the order of the customer and is not held in inventory by the blender; (2) the blend is to be used on the customer's property (including leased or rented property); (3) the pesticide(s) used in the blend bears end-use labeling directions which do not prohibit use of the product in such a blend; (4) the blend is prepared from registered pesticides; (b) the blend is delivered to the end-user along with a copy of the end-use labeling of each pesticide used in the blend and a statement specifying the composition of mixture; and (6) no other pesticide production activity is performed at the establishment.

establishment with EPA prior to beginning production. Foreign establishments also must register with EPA if they produce a pesticidal product for import to the United States. Establishments must be registered with EPA if they intend that a substance produced will be used as an active ingredient of a pesticide or if they have actual or constructive notice that the substance will be used as an active ingredient. If a pesticide is produced for export, whether registered or unregistered, or is produced under an experimental use permit, the producing establishment must be registered.

In order to register an establishment with EPA, contact the EPA Regional office where the establishment is located, or for a foreign establishment, the Washington, DC EPA office. The following information must be submitted on EPA Form 3540-1 when registering an establishment: (1) the name and address of the company; (2) the type of ownership; and (3) the name and address of each producing establishment for which registration is sought. Any changes to the information provided must be submitted to EPA within thirty days after such changes occur. Upon receiving a complete application, EPA will assign a registration number for each listed establishment. This number must appear on the label.

Establishment Reporting Requirements

Under section 7(c)and 40 CFR. section 167.85, each registered pesticide producing establishment must submit an annual production report to EPA by March 1 of each year. Domestic establishments submit their report to the EPA regional office where the company headquarters is located. Foreign establishment production reports are submitted to the Washington, DC EPA office. Custom blenders are exempt from this requirement.

The report must cover any pesticide, active ingredient, or device produced. The report, to be submitted on specific EPA forms, includes the following information: (1) the name and address of the establishment; (2) the amount of each pesticide produced, repackaged, or relabeled in the past year; (3) the amount of each pesticide sold, distributed, or exported in the past year; and (4) the amount of the pesticide estimated to be produced, repackaged, or relabeled in the current year. Foreign establishments only are required to submit a report on pesticides imported into the United States.

Maintenance of Records

All producers of pesticides, devices, or active ingredients used in producing any pesticide must maintain records concerning the production and shipment of each pesticide under 40 CFR Part 169. These records are independent of other required records, including in-plant maintenance, extermination, or sanitation programs. Each establishment must maintain these records for two years. In addition, records on disposal methods must be maintained for 20 years, as well as authorized human trials. Records containing research data must be maintained as long as the registration is valid and the producer is in business. All required records must be available if requested by an inspector.

Prior Informed Consent
As part of its participation in a voluntary international program known as the Prior Informed Consent procedure, EPA prepares the following lists of pesticides that are suspended, canceled or severely restricted. These lists were last updated by EPA in August of 1997.

A "Suspended or Canceled" pesticide is defined as a pesticide for which all registered uses have been prohibited by final government action, or for which all requests for registration or equivalent action for all uses have, for health or environmental reasons, not been granted.

- Suspended or Canceled

1. aldrin
2. benzene hexachloride [BHC] (voluntary cancellation)
3. 2,3,4,5-Bis(2-butylene)tetrahydro-2-furaldehyde [Repellent-11]
4. bromoxynil butyrate (voluntary cancellation)
5. cadmium compounds (voluntary cancellation)
6. calcium arsenate (voluntary cancellation)
7. captafol (voluntary cancellation)
8. carbon tetrachloride
9. chloranil (voluntary cancellation)
10. chlordane
11. chlordimeform (voluntary cancellation)
12. chlorinated camphene [Toxaphene] (voluntary cancellation)
13. chlorobenzilate (voluntary cancellation)
14. chloromethoxypropylmercuric acetate [CPMA]
15. copper arsenate (voluntary cancellation)
16. cyhexatin (voluntary cancellation)
17. DBCP
18. decachlorooctahydro-1,3,4-metheno-2H-cyclobuta(cd) pentalen-2-one[chlordecone]
19. DDT
20. dieldrin
21. dinoseb and salts
22. Di(phenylmercury)dodecenylsuccinate [PMDS] (voluntary cancellation)
23. EDB
24. endrin (voluntary cancellation)
25. EPN (voluntary cancellation)
26. ethyl hexyleneglycol [6-12] (voluntary cancellation)
27. hexachlorobenzene [HCB] (voluntary cancellation)
28. lead arsenate (voluntary cancellation)
29. leptophos (Never received initial registration)

30. mercurous chloride
31. mercuric chloride
32. mevinphos
33. mirex (voluntary cancellation)
34. monocrotophos (voluntary cancellation)
35. nitrofen (TOK) (voluntary cancellation)
36. OMPA (octamethylpyrophosphoramide)
37. phenylmercury acetate [PMA]
38. phenylmercuric oleate [PMO] (voluntary cancellation)
39. potassium 2,4,5-trichlorophenate [2,4,5-TCP]
40. pyriminil [Vacor] (voluntary cancellation)
41. safrole (voluntary cancellation)
42. silvex
43. sodium arsenite
44. TDE (voluntary cancellation)
45. Terpene polychlorinates [Strobane] (voluntary cancellation)
46. thallium sulfate
47. 2,4,5-Trichlorophenoxyacetic acid [2,4,5-T]
48. vinyl chloride

A "Severely Restricted" pesticide means a pesticide for which virtually all registered uses have been prohibited by final government regulatory action, but for which certain specific registered use or uses remain authorized.

- Severely Restricted

1. arsenic trioxide
2. azinphos methyl
3. carbofuran (voluntary cancellation)
4. daminozide (voluntary cancellation)
5. heptachlor
6. methyl parathion
7. sodium arsenate
8. tributyltin compounds

Federal Food, Drug, and Cosmetics Act

Under the Federal Food, Drug, and Cosmetics Act (FFDCA), EPA sets tolerances for pesticide residues in food. This authority originally belonged to the Food and Drug Administration (FDA), but was transferred when EPA was formed in 1970. FDA still has responsibility for enforcing compliance with the tolerances. An agricultural product is deemed unsafe under the FFDCA if it contains pesticide residues above the tolerance level established by EPA or if there is no tolerance, unless it is exempt from the requirement for tolerances.

The FFDCA also contains the Delaney Clause that bars the establishment of food additive regulations covering substances that induce cancer in humans or animals. Prior to the Food Quality Protection Act of 1996, this provision applied to certain pesticide residues in processed food. With the 1996 amendments, pesticide residues are now governed by a single safety clause set forth in section 408.

Toxic Substances Control Act (TSCA)

TSCA gives EPA comprehensive authority to regulate any chemical substance whose manufacture, processing, distribution in commerce, use, or disposal may present an unreasonable risk of injury to health or the environment. EPA keeps an inventory of existing chemicals regulated under TSCA (TSCA section 8(b)). Certain chemicals are specifically excluded from the TSCA inventory, such as pesticides, as defined when manufactured, processed, or distributed in commerce for use as a pesticide under FIFRA (40 CFR section 710.2(h)(2)). However, if a chemical has multiple uses, those uses not subject to FIFRA are regulated by TSCA. In addition, certain mixtures of chemicals are exempt from TSCA (40 CFR section 710.2(h)(1)) (Landfair, 1993).

Four sections are of primary importance to the remainder of the agricultural chemical industry. Section 5 mandates that chemical companies submit to EPA pre-manufacture notices that provide information on health and environmental effects for each new product and test existing products for these effects (40 CFR Part 720). Over 20,000 premanufacture notices have been filed. Section 4 authorizes EPA to require testing of certain substances (40 CFR Part 790). Section 6 gives EPA the authority to prohibit, limit, or ban the manufacture, process, and usage of chemicals (40 CFR Part 750). Among the chemicals EPA regulates under section 6 are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs). For certain chemicals, TSCA section 8 also imposes record-keeping and reporting requirements including substantial risk notification; record-keeping for data relative to adverse reactions; and periodic updates to the TSCA Inventory.

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) was enacted in 1976 to address problems related to hazardous and solid waste management. RCRA gives EPA the authority to establish a list of solid and hazardous wastes and to establish standards and regulations for the treatment, storage, and disposal of these wastes. Regulations in Subtitle C of RCRA address the identification, generation, transportation, treatment, storage, and disposal of hazardous wastes. These regulations are found in 40 CFR Part 124 and CFR Parts 260-279. Under RCRA, persons who generate waste must determine whether the waste is defined as solid waste or hazardous waste. Solid wastes are considered hazardous wastes if they are listed by EPA as hazardous or if they exhibit characteristics of a hazardous waste: toxicity, ignitability, corrosivity, or reactivity.

Products, intermediates, and off-specification products potentially generated at agricultural chemical facilities that are considered hazardous wastes are listed in 40 CFR Part 261. Some of the handling and treatment requirements for RCRA hazardous waste generators are covered under 40 CFR Part 262 and include the following: determining what constitutes a RCRA hazardous waste (Subpart A); manifesting (Subpart B); packaging, labeling, and accumulation time limits (Subpart C); and record keeping and reporting (Subpart D).

Many agricultural chemical facilities store some hazardous wastes at the facility beyond the accumulation time limits available to generators (e.g., 90 or 180 days). Such facilities are required to have a RCRA treatment, storage, and disposal facility (TSDF) permit (40 CFR Part 262.34). Some agricultural chemical facilities are considered TSDF facilities and are subject to a number of regulations, including but not limited to those covered under 40 CFR Part 264: contingency plans and emergency procedures (40 CFR Part 264 Subpart D); manifesting, record keeping, and reporting (40 CFR Part 264 Subpart E); use and management of containers (40 CFR Part 264 Subpart I); tank systems (40 CFR Part 264 Subpart J); surface impoundments (40 CFR Part 264 Subpart K); land treatment (40 CFR Part 264 Subpart M); corrective action of hazardous waste releases (40 CFR Part 264 Subpart S); air emissions standards for process vents of processes that process or generate hazardous wastes (40 CFR Part 264 Subpart AA); emissions standards for leaks in hazardous waste handling equipment (40 CFR Part 264 Subpart BB); and emissions standards for containers, tanks, and surface impoundments that contain hazardous wastes (40 CFR Part 264 Subpart CC).

Many agricultural chemical facilities are also subject to the underground storage tank (UST) program (40 CFR Part 280). The UST regulations apply to facilities that store either petroleum products or hazardous substances (except hazardous waste) identified under the Comprehensive Environmental Response, Compensation, and Liability Act. UST regulations address design standards, leak detection, operating practices, response to releases, financial responsibility for releases, and closure standards.

A number of RCRA wastes have been prohibited from land disposal unless treated to meet specific standards under the RCRA Land Disposal Restriction (LDR) program. The wastes covered by the RCRA LDRs are listed in 40 CFR Part 268 Subpart C and include a number of wastes that could potentially be generated at agricultural chemical facilities. Standards for the treatment and storage of restricted wastes are described in Subparts D and E, respectively.

The LDRs also apply to the use of fertilizers containing hazardous wastes. Therefore, fertilizers containing hazardous wastes that do not meet the applicable land disposal treatment standards cannot be spread on the land, with some exceptions. Specific exemptions to the use of certain recycled materials and hazardous wastes in fertilizers have been provided in 40 CFR Part 266, Subpart C - Recycled Materials Used in a Manner Constituting Disposal. Subpart C states that products containing recyclable materials are not subject to regulation under RCRA if the recyclables are physically inseparable from the product or if they meet the standards of 40 CFR Part 268, Subpart D "for each recyclable material (i.e., hazardous waste) that they contain." These standards include limits on heavy metals. Subpart C also states that zinc-containing fertilizers using hazardous waste K061 (emission control dust/sludge from the primary production of steel in electric furnaces) which is listed as hazardous due to its hexavalent chromium, lead, and cadmium content, are not subject to the land disposal requirements.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) provide the basic legal framework for the federal "Superfund" program to clean up abandoned hazardous waste sites (40 CFR Part 300 et seq.). The 1986 SARA legislation extended CERCLA taxes for five years and adopted a new broad-based corporate environmental tax, applicable to the allied chemicals (SIC 28) industry, which includes the agricultural chemical industry. In 1990, Congress passed a simple reauthorization that did not substantially change the law but extended the program authority until 1994 and the taxing authority until the end of 1995. A comprehensive reauthorization was considered in 1994, but not passed. Since the expiration of the taxing authority on December 31, 1995, taxes for Superfund have been temporarily suspended. The taxes can only be reinstated by reauthorization of Superfund or an omnibus reconciliation act which could specifically reauthorize taxing authority. The allied chemical industry paid about $300 million a year in Superfund chemical feedstock taxes. Joint and several liability generally requires Potentially Responsible Parties (PRPs) to perform or pay for their fair share of cleanup costs.

Title III of the 1986 SARA amendments (also known as Emergency Response and Community Right-to-Know Act, EPCRA) requires all manufacturing facilities, including agricultural chemical facilities, to report annual information about stored toxic substances, as well as release of these substances into the environment, to local and state governments and to the public. This is known as the Toxic Release Inventory (TRI). EPCRA also establishes requirements for federal, state, and local governments regarding emergency planning. In 1994, over 300 more chemicals were added to the list of chemicals for which reporting is required.

Clean Air Act (CAA)

The original CAA authorized EPA to set limits on agricultural chemical facility emissions. The new source performance standards (NSPS) for fertilizer manufacturers can be found in 40 CFR Part 60:

Subpart G -	Standards of Performance for Nitric Acid Plants (40 CFR section 60.70 - 60.74)
Subpart T -	Standards of Performance for the Phosphate Fertilizer Industry: Wet Process Phosphoric Acid Plants (40 CFR section 60.200 - 60.204)
Subpart U -	Standards of Performance for the Phosphate Fertilizer Industry: Superphosphoric Acid Plants (40 CFR section 60.210 - 60.214)
Subpart V -	Standards of Performance for the Phosphate Fertilizer Industry: Diammonium Phosphate Plants (40 CFR section 60.220 - 60.224)
Subpart W -	Standards of Performance for the Phosphate Fertilizer Industry: Triple Superphosphate Plants (40 CFR section 60.230 - 60.234)
Subpart X -	Standards of Performance for the Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities (40 CFR section 60.240 - 60.244)

These standards primarily consist of emission and monitoring standards for nitrogen oxides (Nitric Acid Plants) and fluorides (Phosphatic Fertilizer Industry) .

The Clean Air Act Amendments of 1990 set National Emission Standards for Hazardous Air Pollutants (NESHAP) from industrial sources for 41 hazardous air pollutants to be met by 1995 and for 148 other hazardous air pollutants to be reached by 2003. National emission standards for new and existing major sources in phosphoric acid manufacturing, phosphate fertilizers production and pesticide active ingredient production are listed in 40 CFR Parts 9 and 63. 40 CFR Parts 61 and 63 contains several provisions dealing with emissions sources potentially found at an agricultural chemical facility (e.g. equipment leaks, tanks, surface impoundments, separators, and waste treatment operations) may affect the agricultural chemical industry. A number of the chemicals used and produced at agricultural chemical manufacturing and formulating facilities are hazardous air pollutants under CAA.

Under section 112(r) of CAA, owners and operators of stationary sources who produce, process, handle, or store substances listed under CAA section 112(r)(3) or any other extremely hazardous substance have a "general duty" to initiate specific activities to prevent and mitigate accidental releases. Since the general duty requirements apply to stationary sources regardless of the quantity of substances managed at the facility, many agricultural chemical manufacturing and formulating facilities are subject. Activities such as identifying hazards which may result from accidental releases using appropriate hazard assessment techniques; designing, maintaining and operating a safe facility; and minimizing the consequences of accidental releases if they occur are considered essential activities to satisfy the general duty requirements. These statutory requirements have been in affect since the passage of the Clean Air Act in 1990. Although there is no list of "extremely hazardous substances," EPA's Chemical Emergency Preparedness and Prevention Office provides some guidance at its website: http://www.epa.gov/swercepp.html.

Also under section 112(r), EPA was required to develop a list of at least 100 substances that, in the event of an accidental release, could cause death, injury, or serious adverse effects to human health or the environment. The list promulgated by EPA is contained in 40 CFR section 68.130 and includes acutely toxic chemicals, flammable gases and volatile flammable liquids. Under section 112(r)(7), facilities handling more than a threshold quantity (ranging from 500 to 20,000 pounds) of these substances are subject to chemical accident prevention provisions including the development and implementation of a risk management program (40 CFR sections 68.150-68.220). The requirements in 40 CFR Part 68 begin to go into effect in June 1999. Many of the chemicals on the 112(r) list are commonly handled by agricultural chemical manufacturers and formulators in quantities greater than the threshold values. Ammonia held by farmers for use as an agricultural nutrient is exempt from the chemical accident prevention provisions.

Standards in 40 CFR Part 61 Subpart R - National Emission Standards for Radon Emissions from Phosphogypsum Stacks (40 CFR sections 61.200 - 61.210) deal specifically with the phosphatic fertilizer industry. The standards require monitoring and reporting of radon-222 emissions from the stacks and sets limits on the amounts of radon-222 that can be emitted into the air. EPA has also set standards for the maximum concentration of radium-226 allowed in phosphogypsum removed from stacks for use in agriculture.

Clean Water Act (CWA)

The Clean Water Act, first passed in 1972 and amended in 1977 and 1987, gives EPA the authority to regulate effluents from sewage treatment works, chemical plants, and other industrial sources into waters. The act sets standards for treatment of wastes for both direct and indirect (to a Publicly Owned Treatment Works (POTW)) discharges. EPA has set effluent guidelines for both the fertilizer manufacturing and formulating, and pesticide formulating, packaging and repackaging point source categories. The implementation of the guidelines is left primarily to the states who issue National Pollutant Discharge Elimination System (NPDES) permits for each facility (EPA has authorized 43 states to operate the NPDES program).

Effluent guidelines specific to the fertilizer manufacturing and formulating point source category are contained in 40 CFR Part 418 and are divided into product specific effluent guidelines as follows:

Subpart A - Phosphates (40 CFR section 418.10 - 418.17)

Subpart B - Ammonia (40 CFR section 418.20 - 418.27)

Subpart C - Urea (40 CFR section 418.30 - 418.36)

Subpart D - Ammonium Nitrate (40 CFR section 418.40 - 418.46)

Subpart E - Nitric Acid (40 CFR section 418.50 - 418.56)

Subpart F - Ammonium Sulfate (40 CFR section 418.60 - 418.67)

Subpart G - Mixed and Blend Fertilizer Production (40 CFR section 418.70 - 418.77)

In 1997, revised effluent guidelines were finalized for the Pesticide Formulating, Packaging and Repackaging Subcategory. These regulations replace the effluent guidelines established in 1978 for the Pesticide Formulating and Packaging Subcategory. The revised guidelines are contained in 40 CFR Part 455 and are divided into the following subcategories:

Subpart C - Pesticide Chemicals Formulating and Packaging Subcategory

Subpart E - Repackaging of Agricultural Pesticides Performed at Refilling Establishments

Each Subpart consists of effluent standards representing the amount of effluent reduction possible by using either best practicable control technologies (BPT), best conventional pollution technologies (BCT), or best available technologies (BAT). The states and EPA give effect to these standards through NPDES permits that they issue to direct dischargers. BCT standards limit the discharge of conventional pollutants, while BPT and BAT standards represent successive levels of control of priority pollutants and non-conventional pollutants.

For Subcategory C, EPA established effluent limitations and pretreatment standards which allow each facility a choice of meeting a zero discharge limitation or to comply with a pollution prevention alternative that authorizes the discharge of some pesticide active ingredients (AIs) and priority pollutants after various pollution prevention practices are followed and treatment is conducted as needed. For Subcategory E, EPA has established a zero discharge limitation and pretreatment standard.

The Storm Water Rule (40 CFR section 122.26) requires fertilizer manufacturing and formulating and pesticide formulating facilities discharging storm water associated with industrial activities (40 CFR section 122.26 (b)(14)(ii)) to apply for NPDES permits for those discharges.

Under 40 CFR 503 Subpart B - Land Application, EPA regulates the land application of sewerage treatment sludge, which includes fertilizers derived from sewerage treatment sludge. Subpart B regulations include specific limitations on heavy metal content, as well as general operational and management standards.

VI.C. State Regulation of Pesticides

All states have their own pesticide laws and many states have their own pesticide registration requirements. States have primary use enforcement authority if EPA has determined that the state has adequate pesticide use laws and has adopted adequate procedures to enforce those laws. The EPA may enter into a cooperative agreement with a state to carry out enforcement of state laws and train and certify applicators. The FIFRA allows states to administer their own EPA-approved applicator certifications program. Also, each state is allowed to regulate the sale and use of pesticides as long as the regulations are at least as stringent as EPA's and the regulations do not conflict or differ from EPA's labeling and packaging restrictions.

States typically require that fertilizer products be registered with the state and that claims made on fertilizer labels can be substantiated. States also regulate the efficacy of fertilizers through labeling requirements. State fertilizer labeling requirements typically require that the label indicate the product name, the brand and grade, the percentage of each nutrient (nitrogen, available phosphate, potassium, etc.), and the name and address of the registrant. Some states also require that the label indicate materials from which the nutrients are derived.

Additional information on specific state requirements can be obtained from *the Association of American Pesticide Control Officials, Inc. (AAPCO) at: http://aapco.ceris.purdue.edu/index.html. This website contains a list of state pesticide control officials that includes contact information.*

VI.D. Pending and Proposed Regulatory Requirements

FIFRA

Registration

- In order to reduce the potential for groundwater contamination from certain pesticides, EPA proposed the Ground Water Pesticide Management Plan Rule in June of 1996 (61 FR 33259). EPA is proposing to restrict the use of certain pesticides by providing states and tribes with the flexibility to protect the ground water in the most appropriate way for local conditions, through the development and use of Pesticide Management Plans (PMPs). When finalized, the regulations will likely give states and tribes the authority to develop management plans that specify risk reduction measures for the following four pesticides: atrazine, alachlor, simazine, and metolachlor. Without EPA-approved plans, use of these chemicals would be prohibited. A final rule is expected to be published in late 2000. (Contact: Arty Williams, United States EPA Office of Prevention, Pesticides and Toxic Substances, 703-305-5239)

- In response to the Food Quality Protection Act of 1996, EPA is planning to propose revisions to antimicrobial registration and classification procedures (40 CFR Part 152) that will reduce to the extent possible the review time for antimicrobial pesticides. Revisions to labeling requirements (40 CFR Part 156) and data requirements for antimicrobial registration (40 CFR Part 158) are also being proposed. The revisions are expected to be released in early 2001. This regulation would also implement some general provisions of FIFRA that pertain to all pesticides, including labeling requirements and notification procedures. (Contact: Jean Frane, United States EPA Office of Prevention, Pesticides, and Toxic Substances, 703-305-5944 and Paul Parsons, United States EPA Office of Prevention, Pesticides, and Toxic Substances, 703-308-9073)

- In order to evaluate the registrability of pesticide products, EPA is expected to propose revisions to the data requirements for FIFRA registration (40 CFR Part 158). These revisions would clarify all data requirements to reflect current practice and are expected to be published in 2001. (Contact: Jean Frane, United States EPA Office of Prevention, Pesticides, and Toxic Substances, 703-305-5944)

Use Restrictions

- In May of 1991, EPA proposed amendments to the existing Restricted Use Classification (RUC) regulations (40 CFR Part 152, Subpart I) to add criteria pertaining to the groundwater contamination potential of pesticides (56 FR 22076). The criteria would be used to determine which pesticides should be considered for restricted use classifications to protect groundwater. A policy statement is expected to be issued in late 2000. (Contact: Joseph Hogue, United States EPA Office of Prevention, Pesticides, and Toxic Substances, 703-308-9072)

Tolerances and Exemptions

- EPA expects to reassess pesticide tolerances and exemptions for raw and processed foods established prior to August 3, 1996 (40 CFR Part 180, 40 CFR Part 185, 40 CFR Part 186), to determine whether they meet the standard of the Federal Food, Drug and Cosmetic Act (FFDCA). FFDCA section 408 (q), as amended by the Food Quality Protection Act, requires that EPA conduct this reassessment on a phased 10-year schedule. For the current phased schedule, EPA is required to complete reassessments as follows: 33% by August 3, 1999, 66% by August 3, 2002, and 100% by August 3, 2006. Based on its reassessment, EPA will likely propose a series of regulatory actions to modify or revoke tolerances. (Contacts: Robert McNally, United States EPA, Office of Prevention, Pesticides and Toxic Substances, 703-308-8085 and Joseph Nevola, United States EPA Office of Prevention Pesticides and Toxic Substances, 703-308-8037)

- Regulations specifying policies and procedures under which the EPA can establish food tolerances associated with the use of pesticides under emergency exemptions (40 CFR Part 176) are expected to be finalized in late 2000. The EPA issues emergency exemptions for temporary use of pesticides where emergency conditions exist. Under FFDCA, as amended by the Food Quality Protection Act, EPA must establish time-limited tolerances for such pesticides if the use is likely to result in residues in food. (Contact: Joseph Hogue, United States EPA Office of Prevention, Pesticides, and Toxic Substances, 703-308-9072)

- EPA proposed a rule to adjust and update the fee structure and fee amounts for tolerance actions, which are required under FFDCA (40 CFR section 180.33). The rule is expected to finalized in late 2000. (Contact: Carol Peterson, United States EPA, Office of Prevention, Pesticides, and Toxic Substances, 703-305-6598)

- Revisions to regulations on emergency exemptions under section 18 of FIFRA, are expected to be issued in late 2001 (40 CFR Part 166). EPA is considering revisions in four areas: 1) Options for increased authority for states to administer certain aspects of the exemption process, and/or increased use by the EPA of multi-year exemptions; 2) the use of emergency exemptions to address pesticide resistance; 3) the possibility of granting exemptions based upon reduced risk considerations; and 4) definitions of emergency situation and significant economic loss, which would affect whether or not an exemption may be granted. (Contact: Joseph Hogue, United States EPA Office of Prevention, Pesticides, and Toxic Substances, 703-308-9072)

Pesticide Storage and Disposal

- In 1994, EPA proposed a rule, authorized under section 19 of FIFRA, to establish standards for pesticide containers and secondary containment relating to the distribution and sale of pesticides (59 FR 6712). Standards are expected to be developed for the removal of pesticides from containers, rinsing containers, container design, container labeling, container refilling, the containment of stationary bulk containers and for the containment of pesticide dispensing areas (40 CFR Part 165, 40 CFR Part 156). A final rule is expected to be published in late 2000. (Contact: Nancy Fitz, United States EPA, Office of Prevention, Pesticides and Toxic Substances, 703-305-7385)

Exports

- The Rotterdam Agreement, signed in 1998, requires that certain banned or severely restricted hazardous chemicals are subject to intensive information exchange procedures, and if an importing country decides against import, exporting countries are obligated to prohibit export to that country. Twenty-four pesticides are currently covered by the treaty. As a result of the United States signing of this treaty, EPA has drafted legislation that allows it in the future to propose revisions to its pesticide export policy. (Contact: Cathleen Barnes, United States EPA Office of Prevention, Pesticides and Toxic Substances, 703-305-7101)

Worker Protection

- EPA has proposed a change to the Worker Protection Standards (WPS) of FIFRA (40 CFR Part 170). Specifically, the glove requirements may be modified to allow glove liners to be worn inside chemically resistant gloves. The proposed rule will be finalized in 2001. (Contact: Kevin Keaney, United States EPA Office of Prevention, Pesticides and Toxic Substances, 703-305-5557)

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Federal Insecticide, Fungicide, and Rodenticide Act, the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (*See* Section II). With sectors dominated by small

businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, state, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (April 1, 1992 to March 31, 1997) and the other for the most recent twelve-month period (April 1, 1996 to March 31, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across EPA regions for certain sectors.[5] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office

[5] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

R0074217

databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are: AFS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in section II.

Facilities Inspected --- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation

(NOVs). A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times, e.g., a facility with 3 enforcement actions counts as 3.

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of usage by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Fertilizer, Pesticide, and Agricultural Chemical Industry Compliance History

Table 25 provides an overview of the reported compliance and enforcement data for the Fertilizer, Pesticide, and Agricultural Chemical Industry over five years from April 1992 to April 1997. These data are also broken out by EPA Regions thereby permitting geographical comparisons. A few points evident from the data are listed below.

- About 75 percent of agricultural chemical facility inspections and 73 percent of enforcement actions occurred in EPA Regions IV, V, VI, and VII.

- Region IX had the highest ratio of enforcement actions to inspections (0.13) and the longest average time between inspections (21 months). This indicates that fewer inspections were conducted in relation to the number of facilities in the Region, but that these inspections were more likely to result in an enforcement action than inspections conducted in other Regions.

- With the exception of Region I, in which no inspections or enforcement actions were carried out in between 1992 and 1997, Region VIII had the lowest enforcement to inspection rate (0.03).

Table 25: Five-Year Enforcement and Compliance Summary for the Fertilizer, Pesticide, and Agricultural Chemical Industry

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	3	0	0	--	0	0	0%	0%	--
II	11	8	50	13	3	4	75%	25%	0.08
III	18	16	123	9	2	10	80%	20%	0.08
IV	77	44	449	10	15	41	83%	17%	0.09
V	35	23	128	16	4	7	57%	43%	0.05
VI	34	21	167	12	5	9	56%	44%	0.05
VII	43	31	225	11	8	17	71%	29%	0.08
VIII	9	5	33	16	1	1	100%	0%	0.03
IX	25	10	72	21	5	9	78%	22%	0.13
X	8	6	46	10	4	4	25%	75%	0.09
TOTAL	263	164	1,293	12	47	102	74%	26%	0.08

Source: Data obtained from EPA's Integrated Data for Enforcement Analysis (IDEA) system in 1997.

R0074221

VII.B. Comparison of Enforcement Activity Between Selected Industries

Tables 26 and 27 allow the compliance history of the agricultural chemical sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Tables 26 and 27 permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering five years (April 1992 to April 1997) to that of the last year for which data were available (April 1996 to April 1997). Some points evident from the data are listed below.

- The agricultural chemical sector was inspected more frequently than most of the sectors shown (12 months on average between inspections).

- Between 1992 and 1997, the industry had a higher enforcement to inspection rate than most sectors (0.08); however, in 1997 the ratio decreased to 0.05 which is lower than most sectors.

- The agricultural chemical sector had one of the highest percentages of facilities inspected with one or more violations (97 percent) in 1997, but one of the lowest percentages of facilities with one or more enforcement actions (5 percent).

Tables 28 and 29 provide a more in-depth comparison between the Fertilizer, Pesticide, and Agricultural Chemical Industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Tables (Tables 26 and 27), the data cover the years 1992 to 1997 (Table 28) and 1997 (Table 29) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- The percent of inspections carried out under each environmental statute has changed only slightly between the average of the years 1992 to 1997 and that of the past year. The Clean Air Act accounted for the most inspections (43 percent) during this period. This increased to almost half of all agricultural chemical facility inspections (49 percent) in 1997.

- The percent of enforcement actions taken under each environmental statute changed significantly from the 1992 to 1997 period to the past year. Enforcement actions taken under the Clean Air Act increased from 39 percent to 55 percent and enforcement actions taken under RCRA increased from 30 percent to 36 percent. At the same time, the enforcement actions taken under the Clean Water Act went from 20 percent in 1992 to 1995 to no actions in 1997.

Table 26: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	**263**	**164**	**1,293**	**12**	**47**	**102**	**74%**	**26%**	**0.08**
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Table 27: One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	**263**	**105**	**206**	**102**	**97%**	**5**	**5%**	**11**	**0.05**
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06

Table 28: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries											
Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	**164**	**1,293**	**102**	**43%**	**39%**	**24%**	**20%**	**28%**	**30%**	**5%**	**11%**
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

Table 29: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	**105**	**206**	**11**	**48%**	**55%**	**22%**	**0%**	**30%**	**36%**	**0%**	**9%**
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

R0074226

VII.C. Review of Major Legal Actions

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

VII.C.1. Review of Major Cases

As indicated in EPA's *Enforcement Accomplishments Report, FY1995 and FY1996* publications, about 17 significant enforcement actions were resolved between 1995 and 1996 for the Fertilizer, Pesticide, and Agricultural Chemical Industry.

American Cyanamid Company On June 28, 1995, Region II issued an administrative complaint against American Cyanamid Company for violations at its Lederle Laboratories facility located in Pearl River, New York. The complaint proposed assessment of a $272,424 fine for the company's failure to submit timely TRI Form Rs for 1,1,1-trichloroethane, naphthalene, phosphoric acid, toluene, manganese compounds and zinc compounds for the reporting years 1990, 1991, 1992, and 1993.

Precision Generators, Inc. The Regional Administrator signed a consent order in the *Precision Generators, Inc.*, a FIFRA case, in which the respondent agreed to pay the proposed penalty of $4,000. The administrative complaint cited the respondent's sale and misbranding of its unregistered pesticide product ethylene fluid used to accelerate the ripening of fruits and vegetables. Such a product is a "plant regulator" falling within the definition of "pesticide" in FIFRA.

E.C. Geiger, Inc. On August 18, 1995, the Regional Administrator signed a consent agreement and consent order finalizing settlement of the administrative proceeding against E.C. Geiger, Inc. of Harleysville, Pennsylvania, for violations of sections 12(a)(1)(A) and (B) of FIFRA, 7 U.S.C. section 136j(a)(1)(A) and (B). The complaint alleged that during 1992, Geiger sold or distributed an unregistered and misbranded pesticide product, a rooting hormone called "Indole-3-butyric Acid-Horticultural Grade." For these violations the complaint sought a $14,000 penalty. Geiger has agreed to pay a penalty of $8,900.

Rhone-Poulenc, Inc. Region III reached a settlement with Rhone-Poulenc, Inc., in a Part II administrative action brought for violations of RCRA boiler and industrial furnace (BIF) regulations at Rhone-Poulenc's Institute, West Virginia plant. The settlement calls for Rhone-Poulenc to pay a penalty of over $244,000 and to undertake numerous compliance tasks.

IMC-Agrico Company On November 8, 1994, the Regional Administrator ratified a consent decree between the United States and IMC-Agrico Company concerning IMC's violations of section 301(a) of the CWA. IMC owns and operates phosphate rock mines and associated processing facilities in Florida and Louisiana. Eight of its mineral extraction operations located throughout Florida and its Port Sutton Phosphate Terminal located in Tampa, Florida, were the subject of this referral. The action arose out of IMC's violation of its permit effluent limits for a variety of parameters including dissolved oxygen, suspended solids, ammonia, and phosphorous, as well as non-reporting and stormwater violations at the various facilities-over 1,500 permit violations total. The case was initiated following review of the facility discharge monitoring reports and EPA and state inspections of the sites. The consent decree settlement involved an up-front payment of $835,000 and a $265,000 Supplemental Environmental Project (SEP). The pollution prevention SEP involved converting IMC's scrubber discharge and intake water systems into a closed loop system, greatly reducing pollution loading at the Port Sutton facility, by April 1995.

J.T. Eaton & Company, Inc. J.T. Eaton & Company, Inc. distributed and sold at least 13 unregistered pesticides (mostly rodenticides). These unregistered pesticides resulted from varying the form of the rodent bait and the packaging of several of Eaton's registered products (e.g., registered as a bulk product) but sold in ready-to-use place packs. The company also distributed and sold a misbranded pesticide product and made inaccurate claims in advertising for another product. A stop sale, use, or removal order and an administrative complaint were issued simultaneously on March 23, 1995. The penalty assessed in the complaint was $67,500. The complaint was settled on August 25, 1995, for $40,000.

Citizens Elevator Co., Inc. Citizens Elevator Co. repackaged and distributed and sold the pesticide "Preview" in five gallon buckets, many bearing pie filling labels, to at least 24 customers, constituting the distribution and sale of an unregistered pesticide. The complaint, issued June 30, 1994, assessed a penalty of $108,000. In supplemental environmental projects for the prevention of spills of pesticides and fertilizers and the safer, more efficient storage and application of pesticides and fertilizer. The respondent spent $184,771. A consent agreement signed June 30, 1995, settled the case for $8,400.

Nitrogen Products, Inc. On September 25, 1995, a joint stipulation and order of dismissal was filed in the United States District Court for the Eastern District of Arkansas. Nitrogen Products, Inc. (NPI), agreed to pay a civil penalty of $243,600 to the United States for violations of the Clean Air Act, and Subparts A and R of 40 CFR Part 61. The foreign parent corporation, Internationale Nederlanden Bank, N.V., acquired the facility through foreclosure and expended over $2 million to cover the phosphogypsum stack and regrade.

Micro Chemical, Inc. The illegal transportation of hazardous waste by a Louisiana pesticide formulation company, Micro Chemical, Inc., to an unpermitted disposal facility in violation of RCRA resulted in a $500,000 fine. five years of probation, and compliance with corrective action measures contained in a corrective action administrative order on consent. In March 1990. Micro Chemical transported 100 cubic yards of hazardous waste from its facility to a field in Baskin, Louisiana-a location that did not have a RCRA permit. After its discovery, it was removed under the Louisiana Department of Agriculture's guidance. Micro Chemical has taken measures to stabilize and prevent the spread of pesticide contamination from the Micro Chemical facility site, as required by a RCRA 3008(h) corrective action administrative order on consent. The order will result in the removal of all contaminated soil at the site, and the remediation of all off-site contamination that has migrated into a drainage basin located adjacent to the site.

Chempace Corporation On September 26, 1996, Region V PTES filed a civil administrative complaint against Chempace corporation of Toledo, Ohio alleging 99 counts for the distribution or sale of unregistered and misbranded pesticides, and pesticide production in unregistered establishments. The total proposed penalty in the complaint is $200,000. The case is significant in that Chempace had, previous to the complaint, canceled all of the company's pesticide product registrations pursuant to section 4 of FIFRA, as well as their establishment registration pursuant to section 7. However, the company continued to produce and sell those canceled pesticides in a facility that was not registered.

Northrup King Co. On September 30, 1996, as a result of a FIFRA inspection conducted by Region V on March 27-28, 1996, Region V issued a FIFRA civil complaint to Northrup King Co. of Golden Valley, Minnesota. The pesticide involved in the case is a genetically engineered corn seed that protects against the corn borer. Because this case is the first FIFRA complaint involving a genetically engineered pesticide, the case is nationally significant. The complaint alleged 21 counts of sale and distribution of an unregistered pesticide, 21 counts for failure to file a Notice of Arrival for pesticide imports, and 8 counts of pesticide production in unregistered establishments, for a total proposed penalty of $206,500. A consent agreement and consent order was filed simultaneously with, and in resolution of the complaint. The respondent agreed to pay $165,200, which is the largest penalty collected by Region V under FIFRA.

Micro Chemical. Micro Chemical is a pesticide formulating, mixing, and packaging facility 3,000 feet up gradient of the Winnsboro's groundwater well complex. In March 1990, a release from the facility was reported by a citizen. Investigations revealed that the company had attempted to dump 100 cubic yards of pesticide contaminated soil offsite. People living near the dump site became ill from the fumes and the state ordered the soil to be returned to Micro Chemical. Ultimately a criminal case was initiated for the midnight dumping. Other storage violations detected were the subject of an administrative complaint issued in September 1992. A RCRA 3008(h) order on consent was entered into on September 1994 to remediate the site. In resolving the September 1992 complaint, a final order was issued on March 28, 1996. Micro Chemical agreed to pay a penalty of $25,000 and agreed to fund a SEP valued at $25,000. The SEP established collection events for household waste and waste pesticides in the Franklin Parish area. During FY96, the SEP enabled about 100 tons of waste to be collected and properly disposed.

Terra Industries, Inc. At the request of the Chemical Emergency Prevention and Preparedness Office (CEPPO), and in accordance with section 112(r) of the CAA, EPA released the results of its investigation into the cause of an explosion of the ammonium nitrate plant at this nitrogen fertilizer manufacturing facility. The report released in January 1996 identifies numerous unsafe operating procedures at the plant as contributing factors to the explosion, and recommends certain standard operating procedures which would help prevent similar occurrences at ammonium nitrate production facilities.

The Terra explosion occurred on December 13, 1994, killing four individuals and injuring 18 others. It also resulted in the release of approximately 5,700 tons of anhydrous ammonia to the air and approximately 25,000 gallons of nitric acid to the ground and required evacuation over a two-state area of over 2,500 persons from their homes.

In a subsequent action, an administrative civil complaint alleging violations of EPCRA sections 213 and 313, and section 8(a) of TSCA, was filed citing that Terra International failed to submit Toxic Release Inventory (TRI) information to EPA in a timely manner, and data submitted to EPA by Terra failed to include releases of more than 17 million pounds of toxic chemicals to the environment on-site.

Pfizer/AgrEvo Reporting of unreasonable adverse effects information is required under FIFRA section 6(a)(2), and failure to submit such reports has resulted in a $192,000 settlement involving AgrEvo Environmental Health, Inc. and Pfizer, Inc. The case arose in early 1994 after an individual reported disabling neurological symptoms and chemical sensitivity after using RID products to kill lice. The ensuing EPA investigation revealed numerous additional unreported incidents involving RID which is manufactured by AgrEvo and distributed by Pfizer. EPA amended the complaint charging 24 counts against each company. FIFRA 6(a)(2) requires pesticide registrants to submit to EPA any additional information (beyond that submitted in the pesticide registration process) that they have regarding unreasonable adverse effects of their pesticides on human health or the environment. The information is used by the Agency in the determination of risks associated with pesticides.

Rohm and Haas Company This complaint cited Rohm and Haas for 66 violations under FIFRA section 12(a)(1)(c), for the distribution or sale of a registered pesticide the composition of which differed from the composition as described in its registration under FIFRA section 3. EPA registers pesticides based upon the accurate assessment of components used in the manufacture of the product. Use of an unapproved formula can lead to production of a pesticide for which no assessment of risk has been determined or result in unknown synergistic effects. Following settlement negotiations, and in accordance with the FIFRA Enforcement Response Policy, the original penalty of $330,000 was reduced to $118,800, based on a 20% reduction to the gravity level, a 40% reduction for immediate self-disclosure, mitigation, and corrective actions, and a 15% reduction for good attitude, cooperation, and efforts to comply with FIFRA.

VII.C.2. Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the Internet at http://es.epa.gov/oeca/sep.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those initiated independently by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

National Agricultural Compliance Assistance Center (Ag Center)

EPA's Office of Compliance, with the support from the United States Department of Agriculture (USDA), developed EPA's National Agriculture Compliance Assistance Center (Ag Center). The Ag Center offers comprehensive, easy-to-understand information about approaches to compliance that are both environmentally protective and agriculturally sound.

The Ag Center focuses on providing information about EPA's own requirements. In doing so, the center relies heavily on existing sources of agricultural information and established distribution channels. Educational and technical information on agricultural production is provided by the USDA and other agencies, but assistance in complying with environmental requirements has not traditionally been as readily available. The Ag Center is currently working with USDA and other federal and state agencies to provide the agricultural community, including regional and state regulatory agencies, with a definitive source for federal environmental compliance information. The Ag Center offers information on a variety of topics, including the following:

- Pesticides
- Animal waste management
- Emergency planning and response
- Groundwater and surface water
- Tanks / containment
- Solid / hazardous waste

Through a toll-free telephone number and a website that is regularly updated and expanded, the Ag Center offers a variety of resources including:

- current news, compliance policies and guidelines, pollution prevention information, sources of additional information and expertise, and summaries of regulatory initiatives and requirements

- user-friendly materials that consolidate information about compliance requirements, pollution prevention, and technical assistance resources for use by regional and state assistance and educational programs, trade associations, businesses, citizens, and local governments

- agriculture-related information on reducing pollution and using the latest pollution prevention methods and technologies

- information on ways to reduce the costs of meeting environmental requirements, including identification of barriers to compliance

The Ag Center's toll-free number is 1-888-663-2155 and the website address is: http://es.epa.gov/oeca/ag/

National Pesticide Information Retrieval System (NPIRS)

Purdue University has developed a collection of databases through their Center for Environmental and Regulatory Information Systems, one of which is the National Pesticide Information Retrieval System. NPIRS is a collection of six databases related to pesticides, including product registration document information, data submitter information, residue tolerances, fact sheets, material safety data sheets, and the daily federal register. Full search access to the NPIRS databases is by annual subscription.

Association of American Plant Food Control Officials (AAPFCO) Label Recommendations

The AAPFCO is considering a set of recommendations issued by a task force of fertilizer producers and state officials. These recommendations call for labeling and standards for non-nutrient constituents in fertilizer and directions that will allow users to apply fertilizers at a rate that will not exceed these standards. One proposed addition to labels is to list all raw materials, including recycled wastes; however, the concentration of these materials will not be required (ARA, 1997).

Agricultural Research Institute

ARI was founded in 1951 as a part of the National Academy of Sciences, then incorporated separately in 1973. ARI analyzes agricultural problems and promotes research by its members to solve them. ARI publishes annual meeting minutes, a directory, books, pamphlets, and newsletters.

National Association of State Departments of Agriculture (NASDA)

NASDA was founded in 1916 by directors of state and territorial departments of agriculture to coordinate policies, procedures, laws, and activities between the states and federal agencies and Congress. NASDA conducts research, holds a trade show, and distributes several bulletins, newsletters, and directories.

ChemAlliance

EPA's Office of Compliance developed ChemAlliance, a new Compliance Assistance Center for the chemical industry. Among its features is an exciting "expert help," which offers an interactive guide to finding compliance resources specific to a user's needs. Take a "virtual plant tour" to find out which regulations apply to your company's operations by clicking on a detailed chemical plant illustration. ChemAlliance can be reached at 1-800-672-6048; its web site is located at . *http://www.chemalliance.org,*

VIII.B. EPA Voluntary Programs

Pesticide Environmental Stewardship Program (PESP)

The Pesticide Environmental Stewardship Program (PESP) is a broad effort by EPA, USDA, and the FDA to reduce pesticide use and risk in both agriculture and nonagricultural settings. In September 1993, the three agencies announced a federal commitment to two major goals: 1) developing specific use/risk reduction strategies that include reliance on biological pesticides and other approaches to pest control that are thought to be safer than traditional chemical methods, and 2) by the year 2000, having 75 percent of United States agricultural acreage adopt integrated pest management programs.

A key part of the PESP is the public/private partnership which began when EPA, USDA, and FDA announced the partnership and more than 20 private organizations signed on as charter members. All organizations with a commitment to pesticide use/risk reduction are eligible to join the PESP, either as Partners or Supporters. The PESP program has 35 partners. Together, these partners represent at least 45,000 pesticide users. The program has a goal of adding 35 new partners per year.

33/50 Program

The 33/50 Program is a ground breaking program that has focused on reducing pollution from seventeen high-priority chemicals through voluntary partnerships with industry. The program's name stems from its goals: a 33% reduction in toxic releases by 1992, and a 50% reduction by 1995, against a baseline of 1.5 billion pounds of releases and transfers in 1988. The results have been impressive: 1,300 companies have joined the 33/50 Program (representing over 6,000 facilities) and have reached the national targets a year ahead of schedule. The 33% goal was reached in 1991, and the 50% goal -- a reduction of 745 million pounds of toxic wastes -- was reached in 1994. The 33/50 Program can provide case studies on many of the corporate accomplishments in reducing waste (Contact 33/50 Program Director David Sarokin -- 202-260-6396).

Table 30 lists those companies participating in the 33/50 program that reported the

R0074234

SIC codes 2873, 2874, 2875, and 2879 to TRI. Some of the companies shown also listed facilities that are not producing agricultural chemicals. The number of facilities within each company that are participating in the 33/50 program and that report SIC codes 2873, 2874, 2875, and 2879 is shown. Where available and quantifiable against 1988 releases and transfers, each company's 33/50 goals for 1995 and the actual total releases and transfers and percent reduction between 1988 and 1995 are presented. Eleven of the seventeen target chemicals were reported to TRI by agricultural chemical facilities in 1995.

Table 30 shows that 24 companies comprised of 78 facilities reporting SIC 287 participated in the 33/50 program. For those companies shown with more than one agricultural chemical facility, all facilities may not have participated in 33/50. The 33/50 goals shown for companies with multiple facilities, however, were company-wide, potentially aggregating more than one facility and facilities not carrying out agricultural chemical operations. In addition to company-wide goals, individual facilities within a company may have had their own 33/50 goals or may have been specifically listed as not participating in the 33/50 program. Since the actual percent reductions shown in the last column apply to only the companies' agricultural chemical facilities, direct comparisons to those company goals incorporating non-agricultural chemical facilities or excluding certain facilities may not be possible. For information on specific facilities participating in 33/50, contact David Sarokin (202-260-6907) at the 33/50 Program Office.

Table 30: Fertilizer, Pesticide, and Agricultural Chemical Industry Participation in the 33/50 Program

Parent Company (Headquarters Location)	Company-Owned Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988 to 1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	1995 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	% of Change per Facility (1988-1995)
AMERICAN HOME PRODUCTS CORP. MADISON, NJ	2	49	47,950	73,876	-54
ARCADIAN CORP. MEMPHIS, TN	6	0	4,340	10,127	-133
BAY ZINC CO. INC. MOXEE CITY, WA	1	50	77,250	252	100
CHEM-TECH LTD. DES MOINES, IA	1	90	800	0	100
CHEVRON CORP. SAN FRANCISCO, CA	3	50	8,746	0	100
CONAGRA INC. OMAHA, NE	6	8	17,086	5,238	69
E.I. DU PONT DE NEMOURS & CO WILMINGTON, DE	2	50	144,412	440,370	-205
ELF AQUITAINE INC. NEW YORK, NY	1	49	3,068	0	100
FIRST MISSISSIPPI CORP. JACKSON, MS	7	0	701,144	214,334	69
FMC CORPORATION CHICAGO, IL	5	50	6,190	2,339	62
GLAXO WELLCOME INC. RESEARCH TRIANGLE PARK, NC	1	37	1,125	0	100
GOWAN COMPANY YUMA, AZ	1	0	0	2,207	---
IMC FERTILIZER GROUP INC. NORTHBROOK, IL	7	0	56,350	51,548	9
ISK AMERICAS INC. ATLANTA, GA	2	50	884,412	726,713	18
LAROCHE HOLDINGS INC. ATLANTA, GA	1	0	17,590	0	100
MALLINCKRODT GROUP INC. SAINT LOUIS, MO	1	44	0	0	---
MILES INC. PITTSBURGH, PA	1	38	39,822	6,650	83
MONSANTO COMPANY SAINT LOUIS, MO	1	23	0	1,260	---
RHONE-POULENC INC. MONMOUTH JUNCTION, NJ	21	50	3,128,263	1,392,117	55
SC JOHNSON & SON INC. RACINE, WI	1	50	19,086	20,096	-5
SANDOZ CORPORATION NEW YORK, NY	3	50	207,086	87,000	58
TALLEY INDUSTRIES PHOENIX, AZ	1	0	8,243	2,289	72
UNIVERSAL COOPERATIVES INC. MINNEAPOLIS, MN	1	70	17,750	1,265	93
UNOCAL CORPORATION LOS ANGELES, CA	2	50	0	9	---
Total	78	—	5,390,713	3,037,690	44

Source: United States EPA 33/50 Program Office, 1997.

1 Company-Wide Reduction Goals aggregate all company-owned facilities which may include facilities not producing agricultural chemicals.

2 Releases and Transfers are from facilities only. 1995 33/50 TRI data were not available at time of publication.

* = Reduction goal not quantifiable against 1988 TRI data. ** = Use reduction goal only. *** = No numeric reduction goal.

R0074236

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups.

There have been at least two Project XL proposals relating to fertilizer production, however both of these have been either rejected or withdrawn. PCS Nitrogen (formerly Arcadian Fertilizer) had proposed to reuse stockpiled phosphogypsum as an ingredient in a soil enhancer. Another proposal by Dow Chemical Company in Louisiana was to trade off equipment leak reductions for relief from some emissions control, monitoring, reporting and record-keeping requirements.

EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Fax-on-Demand Hotline 202-260-8590, Web: http://www.epa.gov/ProjectXL, or Christopher Knopes at EPA's Office of Policy, Planning and Evaluation 202-260-9298)

Climate Wise Program

EPA's ENERGY STAR Buildings Program is a voluntary, profit-based program designed to improve the energy-efficiency in commercial and industrial buildings. Expanding the successful Green Lights Program, ENERGY STAR Buildings was launched in 1995. This program relies on a 5-stage strategy designed to maximize energy savings thereby lowering energy bills, improving occupant comfort, and preventing pollution -- all at the same time. If implemented in every commercial and industrial building in the United States, ENERGY STAR Buildings could cut the nation's energy bill by up to $25 billion and prevent up to 35% of carbon dioxide emissions. (This is equivalent to taking 60 million cars of the road). ENERGY STAR Buildings participants include corporations; small and medium sized businesses; local, federal and state governments; non-profit groups; schools; universities; and health care facilities. EPA provides technical and non-technical support including software, workshops, manuals, communication tools, and an information hotline.

EPA's Office of Air and Radiation manages the operation of the ENERGY STAR Buildings Program. (Contact: Green Light/Energy Star Hotline at 1-888-STAR-YES or Maria Tikoff Vargas, EPA Program Director at 202-233-9178 or visit the ENERGY STAR Buildings Program website at http://www.epa.gov/appdstar/buildings/)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging United States institutions to use energy-efficient lighting technologies. The program saves money for businesses and organizations and creates a cleaner environment by reducing pollutants released into the atmosphere. The program has over 2,345 participants which include major corporations, small and medium sized businesses, federal, state and local governments, non-profit groups, schools, universities, and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. As of March 1997, participants had lowered their electric bills by $289 million annually. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and an information hotline. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Green Light/Energy Star Hotline at 1-888-STARYES or Maria Tikoff Vargar, EPA Program Director, at 202-233-9178)

WasteWiSe Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1997, the program had about 500 companies as members, one third of whom are Fortune 1000 corporations. Members agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports. To member companies, EPA, in turn, provides technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at 1-800-372-9473 or Joanne Oxley, EPA Program Manager, 703-308-0199)

NICE³

The United States Department of Energy is administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE³). By providing grants of up to 45 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, and demonstrate new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the forest products, chemicals, petroleum refining, steel, aluminum, metal casting and glass manufacturing sectors. (Contact: http//www.oit.doe.gov/access/ nice3, Chris Sifri, DOE, 303-275-4723 or Eric Hass, DOE, 303-275-4728)

Design for the Environment (DfE)

DfE is working with several industries to identify cost-effective pollution prevention strategies that reduce risks to workers and the environment. DfE helps businesses compare and evaluate the performance, cost, pollution prevention benefits, and human health and environmental risks associated with existing and alternative technologies. The goal of these projects is to encourage businesses to consider and use cleaner products, processes, and technologies. For more information about the DfE Program, call (202)-260-1678. To obtain copies of DfE materials or for general information about DfE, contact EPA's Pollution Prevention Information Clearinghouse at (202) 260-1023 or visit the DfE Website at http://es.inel.gov/dfe.

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. State Advisory Groups

Association of American Pesticide Control Officials (AAPCO)
P.O. Box 1249 Members: 55
Hardwick, VT 05843 Staff: 1
Phone: 802-472-6956
Fax: 802-472-6957
E-mail: aapco@plainfield.bypass.com

Formed in 1947, the Association of American Pesticide Control Officials (AAPCO) consists of state and federal pesticide regulatory officials. All federal and provincial Canadian officials, officials of all North American countries involved with the regulation of pesticides may be members of AAPCO as well. AAPCO holds meetings twice a year and publishes an annual handbook that contains uniform policies and model pesticide legislation that the association has adopted.

AAPCO aims to promote uniform and effective state legislation and pesticide regulatory programs. Its other objectives are to develop inspection procedures, to promote labeling and safe use of pesticides, to provide opportunities for members to exchange information, and to work with industry to promote the usefulness and effectiveness of pesticide products.

R0074239

State FIFRA Issues Research and Evaluation Group (SFIREG)
P.O. Box 1249
Hardwick, VT 05843
Phone: 802-472-6956
Fax: 802-472-6957
E-mail: aapco@plainfield.bypass.com

Members:
10 state representatives

The State FIFRA Issues Research and Evaluation Group evolved in 1978 out of a cooperative agreement between the EPA's Office of Pesticide Programs (OPP) and the Association of American Pesticide Control Officials (AAPCO). SFIREG is an independent but related body of AAPCO that provides state comments to the Office of Pesticide Programs on issues relating to the manufacture, use and disposal of pesticides. Its membership is comprised of ten state representatives, who represent and are selected by the states in each of the ten EPA Regions.

R0074240

VIII.C.2. Trade Associations

Association of American Plant Food Control Officials (AAPFCO)
University of Kentucky — Members: 200
Division of Regulatory Services
103 Regional Services Building
Lexington, KY 40546-0275
Phone: 606-257-2668
606-257-2970
Fax: 606-257-7351

The AAPFCO is an organization of state fertilizer control officials from the United States and Canada who are involved in the administration of fertilizer regulations and laws. The AAPFCO's purpose is to achieve uniformity throughout their membership with regards to promoting effective legislation, adequate sampling, accurate labeling, and safe use of fertilizers, as well as to study and discuss relevant issues.

Agricultural Retailers Association (ARA)
11701 Borman Dr., Ste. 110 — Members:1,100
St. Louis, MO 63146 — Staff: 17
Phone: 800-844-4900
Fax: 314-567-6808

The Agricultural Retailers Association was founded in 1954 and is made up of dealers, manufacturers, and suppliers of fluid fertilizers and agrichemicals, as well as equipment manufacturers, retail affiliations, and state association affiliates. ARA was formerly known as the National Nitrogen Solutions Association. Their publications include *Agricultural Retailers Association-Membership Directory and Buyer's Guide* (annual), *Connections*, a bimonthly newsletter, and the *Fluid Fertilizer Manual.*

Fertilizer Industry Round Table (FIRT)
5234 Glen Arm Rd. — Nonmembership
Glen Arm, MD 21057
Phone: 410-592-6271
Fax: 410-592-5796

The Fertilizer Industry Round Table was founded in 1951. Participants include production, technical, and research personnel in the fertilizer industry. FIRT acts as a forum for discussion of technical and production problems. They hold an annual meeting and publish the proceedings.

R0074241

The Fertilizer Institute (TFI)
501 2nd St., NE
Washington, DC 20002
Phone: 202-675-8250
Fax: 202-544-8123

Members: 300
Staff: 22

The Fertilizer Institute was founded in 1970 and now has 48 affiliated groups. Members include producers, manufacturers, retailers, trading firms, and equipment manufacturers. TFI represents members in various legislative, educational, and technical areas, and provides information and public relations programs. Publications include: *Directory of Fertilizer References*, annual; *Fertilizer Facts and Figures*, annual; *Fertilizer Institute--Action Letter*, monthly; *Fertilizer Record*, periodic.

Chemical Manufacturers Association (CMA)
1300 Wilson Blvd.
Arlington, VA 22209
Phone: 703-741-5000
Fax: 703-741-6000

Members: 185
Staff: 280

The Chemical Manufacturers Association was founded in 1872 and now has a budget of $36 million. CMA conducts advocacy and administers research areas of broad import to chemical manufacturing, such as pollution prevention and other special research programs. CMA also conducts committee studies, operates the Chemical Emergency Center (CHEMTREC) for guidance to emergency service on handling emergencies involving chemicals and the Chemical Reference Center which offers health and safety information about chemicals to the public. Publications include semi-monthly newsletters, *ChemEcology* and *CMA News*, and the *CMA Directory and User's Guide.*

Chemical Specialties Manufacturers Association (CSMA)
1913 Eye St., NW
Washington, DC 20006
Phone: 202-872-8110
Fax: 202-872-8114

Members: 425
Staff: 31

The Chemical Specialties Manufacturers Association was founded in 1914 and is made up of manufacturers, marketers, formulators, and suppliers of household, industrial, and personal care chemical specialty products such as pesticides, cleaning products, disinfectants, sanitizers, and polishes. CSMA serves as a liaison to federal and state agencies and public representatives, provides information and sponsors seminars on governmental activities and scientific developments.

American Crop Protection Association (ACPA)
1156 15th St., NW, Ste. 400 Members: 82
Washington, DC 20005 Staff: 29
Phone: 202-296-1585
Fax: 202-463-0474

The American Crop Protection Association was founded in 1933 and now has a budget of $7 million. Members include companies involved in producing or formulating agricultural chemical products including agricultural fumigants, agricultural scalicides, chemical plant sprays and dusts, defoliants, soil disinfectants, weed killers, and others. It is comprised of legislative, regulatory and science departments and publishes a periodic bulletin, manuals, *Growing Possibilities*, quarterly, and *This Week and Next*, weekly.

Western Crop Protection Association (WCPA)
3835 N. Freeway Blvd. Ste. 140 Members: 170
Sacramento, CA 95834 Staff: 6
Phone: 916-568-3660
Fax: 916-565-0113

The WCPA is a regional organization of manufacturers, formulators, distributors, and dealers of basic pesticide chemicals and suppliers of solvents, diluents, emulsifiers, and containers. They are affiliated with the American Crop Protection Association. They publish several bulletins and periodicals.

National Pest Control Association (NPCA)
8100 Oak St. Members: 2,300
Dunn Loring, VA 22027 Staff: 21
Phone: 703-573-8330
Fax: 703-573-4116

The National Pest Control Association was founded in 1933 and now has a budget of $2.8 million. Members include companies engaged in control of insects, rodents, birds, and other pests. NPCA provides advisory services on control procedures, new products, and safety and business administration practices. NPCA sponsors research at several universities, furnishes technical information and advice to standards and code writing groups, and maintains an extensive library on pests. NPCA publishes many titles including manuals, newsletters, membership guides, technical releases, and reports.

International Fertilizer Development Center (IFDC)
PO Box 2040 Nonmembership
Muscle Shoals, AL 35662 Staff: 180
Phone: 205-381-6600
Fax: 205-381-7408

The International Fertilizer Development Center was founded in 1974 and includes participants such as scientists, engineers, economists and specialists in market research and development and communications. IFDC uses a $13.5 million budget to try to alleviate world hunger by increasing agricultural production in the tropics and subtropics through development of improved fertilizers. IFDC sponsors and conducts studies in fertilizer efficiencies and offers courses on fertilizer production, environmental issues, and crop sustainability. They maintain greenhouses and laboratories, and publish several periodicals and manuals.

United Products Formulators and Distributors Association(UPFDA)
1 Executive Concourse No. 103 Members: 102
Duluth, GA 30136 Staff: 1
Phone: 404-623-8721
Fax: 404-623-1714

The United Products Formulators and Distributors Association was founded in 1968 and is made up of companies engaged in formulating and distributing pesticide products. The UPFDA works to solve problems of member companies and promote sound and beneficial legislation and to cooperate with allied industries.

North American Horticultural Supply Association (NAHSA)
1790 Arch St. Members: 135
Philadelphia, PA 19103 Staff: 3
Phone: 215-564-3484
Fax: 215-564-2175

The North American Horticultural Supply Association was founded in 1988 and represents horticultural supplies such as greenhouse building materials and supplies, pesticides, and fertilizers. The NAHSA works to strengthen and enhance the relationship between manufacturers and distributors and promotes distribution in the market. They publish a quarterly newsletter, *NAHSA News*, and an annual *Industry Calendar*.

American Agricultural Economics Association (AAEA)
1110 Buckeye Ave. Members: 4,500
Ames, IA 50010-8063 Staff: 6
Phone: 515-233-3202
Fax: 515-233-3101

The American Agricultural Economics Association, founded in 1910, is a professional society of state, federal, and industrial agricultural economists, teachers, and extension workers. The AAEA works to further knowledge of agricultural economics through scientific research, instruction, publications, meetings, and other activities. They publish a bimonthly newsletter, a semi-bimonthly *American Journal of Agricultural Economics*, a quarterly magazine *Choices*, and a biennial *Handbook Directory*.

Institute for Agriculture and Trade Policy (IATP)
1313 5th St., SE, No. 303
Minneapolis, MN 55414
Phone: 612-379-5980
Fax: 612-379-5982

The IATP was founded in 1986 and has an annual budget of $1.15 million. They maintain a speakers bureau and conduct research programs on trade agriculture, global institutions, North-South relations, and the Third World. They publish several periodical bulletins.

California Fertilizers Association (CFA)
1700 I St., Ste. 130
Sacramento, CA 95814
Phone: 916-441-1584
Fax: 916-441-2569

The CFA represents fertilizer manufacturers, distributors, wholesalers, and retail dealers that sell products within California. They maintain a legislative hotline and publish studies and handbooks on issues pertaining to fertilizers.

American Society of Agronomy (ASA)
677 S. Segoe Rd.
Madison, WI 53711
Phone: 608-273-8080
Fax: (608) 273-2021

Members: 12,500
Staff: 30

The ASA was founded in 1907 and presently operates on a budget of 2.5 million dollars per year. ASA is a professional society of plant breeders, soil scientists, chemists, educators, technicians, and other concerned with crop production and soil management. ASA sponsors fellowship programs and provides placement service. ASA publishes annual, bimonthly, and monthly periodicals as well as special publications.

Potash and Phosphate Institute (PPI)
655 Engineering Drive No. 110
Norcross, GA 30092
Phone: 770-447-0335
Fax: 770-448-0439

Members: 14
Staff: 30

PPI supports scientific research in the areas of soil fertility, soil testing, plant analysis, and tissue testing. PPI participates in farmers meetings, workshops, and training courses and publish a quarterly magazine, *Better Crops with Plant Food.*

THIS PAGE WAS INTENTIONALLY LEFT BLANK

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the Fertilizer, Pesticide, and Agricultural Chemical Industry, a list of contacts and publications are provided below.

Contacts[6]

Name	Organization	Telephone	Subject
Michelle C. Yaras	EPA, Office of Enforcement and Compliance Assurance (OECA), Agriculture and Ecosystems Division, Agriculture Branch	202 564-4153	Notebook Contact
Arty Williams	EPA, Office of Prevention, Pesticides and Toxic Substances (OPPT)	703 305-5239	Ground Water Pesticide Management Plan Rule
Jean Frane	EPA, OPPT	703 305-5944	Food Quality Protection Act
Paul Parsons	EPA, OPPT	703 308-9073	FIFRA Data Requirements
David Stangel	EPA, OECA	202 564-4162	Stored or Suspended Pesticides; Good Laboratory Practice Standards; Pesticide Management and Disposal
Joseph Hogue	EPA, OPPT	703 308-9072	FIFRA Restricted Use Classifications
Robert McNally	EPA, OPPT	703 308-8085	FIFRA Pesticide Tolerances
Joseph Nevola	EPA, OPPT	703 308-8037	FIFRA Pesticide Tolerances
Ellen Kramer	EPA, OPPT	703 305-6475	FIFRA Pesticide Tolerances
Carol Peterson	EPA, OPPT	703 305-6598	FIFRA Tolerance Fee Structure
Robert A. Forrest	EPA, OPPT	703 308-9376	FIFRA Exemptions
Nancy Fitz	EPA, OPPT	703 305-7385	FIFRA Pesticide Management and Disposal
Cathleen Barnes	EPA, OPPT	703 305-7101	FIFRA Prior Informed Consent
John MacDonald	EPA, OPPT	703 305-7370	Certification and Training
Kevin Keaney	EPA, OPPT	703 305-5557	FIFRA Worker Protection Standards

The following people received a draft copy of this Sector Notebook and may have provided

[6] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

R0074248

comments.

Name	Organization	Telephone
Paul Bangser	EPA, Office of General Counsel, Water Division	202 260-7630
Philip J. Ross	EPA, Office of General Counsel, Pesticides and Toxic Substances Division	202 260-0779
Don Olson, Chief	EPA, Industrial Branch, OECA, Office of Regulatory Enforcement, Water Enforcement Division	202 564-5558
Jon Jacobs	EPA, OECA, Office of Regulatory Enforcement, Case Development, Policy and Enforcement Branch -Eastern Regions, Toxics and Pesticides Enforcement Division	202 564-4037
Jerry Stubbs	EPA, Case Development, Policy and Enforcement Branch-Western Regions, Toxics and Pesticides Enforcement Division, Office of Regulatory Enforcement	202 564-4178
Anne E. Lindsay, Director	EPA, Field and External Affairs Division Office of Pesticide Programs	703 305-5265
Marcia E. Mulkey, Director	EPA, Office of Pesticide Programs	703 305-7090
Artie Williams, Chief	EPA, Environmental Field Branch, Field and External Affairs Division, Office of Pesticide Programs	703 305-5239
Seth Heminway	EPA, OC Sector Notebook Coordinator	202 564-7017
Sam Silverman	EPA, Enforcement Coordinator Region 1	617 565-3443
Laura Livingston	EPA, Enforcement Coordinator Region 2	212 637-4059
Samantha Fairchild	EPA, Enforcement Coordinator Region 3	215 814-5710
Sherri Fields	EPA, Enforcement Coordinator Region 4	404 562-9684
Tinka Hyde	EPA, EPA, Enforcement Coordinator Region 5	312 886-9296
Robert Lawrence	EPA, Enforcement Coordinator Region 6	214 665-6580
Diane Callier	EPA, Enforcement Coordinator Region 7	913 551-7459
Mike Gaydosh	EPA, Enforcement Coordinator Region 8	303 312-6773
Jo-Ann Semones	EPA, Enforcement Coordinator Region 9	415 744-1547
Ron Kreizenbeck	EPA, Enforcement Coordinator Region 10	206 553-1265
Edward M. White	Assistant Pesticide Administrator, Indiana State Chemist Office, Purdue University	765 494-1587

Dale Dubberly, Chief	Bureau of Compliance Monitoring Florida Department of Agriculture & Consumer Services	850 488-8731
Robin Rosenbaum	Pesticide Registration Manager, Pesticide & Plant Pest Management Division, Michigan Department of Agriculture	517 335-6542
Buzz Vance	Nebraska Department of Agriculture	402 471-6853
Donnie Dippel	Assistant Commissioner, Pesticide Programs, Texas Department of Agriculture	512 463-7476
Paul Kindinger	Agricultural Retailers Association (ARA)	314 567-6655
Joel Padmore	Association of American Plant Food Control Officials (AAPFCO), Food & Drug Protection Division North Carolina Department of Agriculture	919 733-7366
Renee Pinel	California Fertilizers Association	916 441-1584
Mark Muller	Institute for Agriculture and Trade Policy	612 870-3420
Rick Kirchhoff	National Association of State Departments of Agriculture (NASDA)	202 296-9680
Robert Rosenberg	National Pest Control Association	703 573-8330
Robert E. Roberts	Executive Director Environmental Council of States (ECOS)	202 624-3660
Diane Bateman	The Fertilizer Institute (TFI)	202 675-8250
Jay Vroom	American Crop Protection Association	202 296-1585

Section II: Introduction to the Fertilizer, Pesticide, and Agricultural Chemical Industry

1992 Census of Manufacturers Industry Series: Agricultural Chemicals, United States Department of Commerce, Bureau of Census, Economics and Statistics Administration, Washington, DC, May 1995.

1987 Standard Industrial Classification Manual, Office of Management and Budget, 1987.

Aspelin, Arnold, *Pesticide Industry Sales and Usage, 1994 and 1995 Market Estimates*, Office of Prevention, Pesticides and Toxic Substances, USEPA, August 1997.

"Facts and Figures for the Chemical Industry," *Chemical and Engineering News*, June 23, 1998.

Hodge, Charles A. and Popovici, Neculai N., ed., *Pollution Control in Fertilizer Production*, Marcel Dekker, Inc., 1994.

Hoffmeister, George. "Fertilizers", *Kirk-Othmer Encyclopedia ofChemical Technology, 4th ed.* New York: John Wiley & Sons. 1993.

Kent, James A., ed., *Riegel's Handbook of Industrial Chemistry*, Ninth edition, Van Nostrand Reinhold, New York, 1992.

Ollinger, Michael, and Fernandez-Cornejo, Jorge. *Regulation, Innovation, and Market Structure in the United States Pesticide Industry*, Economic Research Service, USDA, June 1995.

Andrilenas, Paul, and Vroomen, Harry. United States Department of Agriculture, *Seven Farm Input Industries, Fertilizer*, Economic Research Service, U.S.D.A., September 1990.

Dun & Bradstreet's Million Dollar Directory, 1997.

United Nations Environment Programme and United Nations Industrial Development Organization, *Mineral Fertilizer Production and the Environment*, UNEP, Paris, 1996.

United States Environmental Protection Agency, Enforcement, Planning, Targeting & Data Division,, *FIFRA, section 7 Data System*, United States EPA. 1996.

United States Environmental Protection Agency, *Development Document for Best Available Technology, Pretreatment Technology, and New Source Performance Technology for the Pesticide Formulating, Packaging, and Repackaging Industry- Final*, EPA, Office of Water, Washington, DC, September 1996.

United States Environmental Protection Agency, *Biopesticides Web Site*, Office of Pesticide Programs, <http://www.epa.gov/oppbppd1/biopesticides/>, August 1999.

United States Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors (AP-42)*, Fifth edition, EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1993.

United States Environmental Protection Agency, *Guides to Pollution Prevention, The Pesticide Formulating Industry*, EPA, Center for Environmental Research Information, Cincinnati, February 1990.

United States Industry & Trade Outlook '98, United States Department of Commerce, International Trade Administration, Washington, DC, 1998.

United States International Trade Commission, *Industry & Trade Summary, Pesticide Products and Formulations*, USITC Publication 2750, Office of Industries, March 1994.

Section III: Industrial Process Description

Air and Waste Management Association, Buonicore, Anthony J. and Davis, Wayne T., ed., *Air Pollution Engineering Manual*, Van Nostrand Reinhold, New York, 1992.

Cremlyn, R., *Pesticides*, John Wiley & Sons, New York, 1978.

Hargett, Norman and Pay, Ralph, "Retail Marketing of Fertilizers in the United States" Presented at the Fertilizer Industry Round Table, Atlanta, Georgia, 1980.

Hoffmeister, George. "Fertilizers", *Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. Volume 10,* New York: John Wiley & Sons. 1993.

Kroschwitz, Jacqueline, and Howe-Grant, Mary (eds.). "Ammonia", *Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. Volume 2,* New York: John Wiley & Sons. 1992.

Hodge, Charles A. and Popovici, Neculai N., ed., *Pollution Control in Fertilizer Production*, Marcel Dekker, Inc., 1994.

Kent, James A., ed., *Riegel's Handbook of Industrial Chemistry*, Ninth edition, Van Nostrand Reinhold, New York, 1992.

Korcak, R.F. "Utilization of Coal Combustion By-Products in Agriculture and Horticulture," *Agricultural Utilization of Urban and Industrial By-Products*, American Society of Agronomy, Madison, WI, 1995.

Lewis, Richard J., Sr., ed., *Hawley's Condensed Chemical Dictionary*, Twelfth edition, Van Nostrand Reinhold, New York, 1993.

Manual on Fertilizer Statistics, Food and Agriculture Organization of the United Nations, Rome, 1991.

Miller, W.P. "Environmental Considerations in Land Application of By-Product Gypsum," *Agricultural Utilization of Urban and Industrial By-Products*, American Society of Agronomy, Madison, WI, 1995.

Nielson. Francis T., *Manual of Fertilizer Processing*, Marcel Dekker, Inc., New York, 1987.

The Fertilizer Institute (TFI), comments submitted by Jim Skillen on a draft of this Sector Notebook. September 1999.

United Nations Environment Programme, *Mineral Fertilizer Production and the Environment*, Technical Report N.26, United Nations Industrial Development Organization, 1996.

United States Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors (AP-42)*, Fifth edition, EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, July 1993a.

United States Environmental Protection Agency, *Development Document for Best Available Technology, Pretreatment Technology, and New Source Performance Technology for the Pesticide Formulating, Packaging, and Repackaging Industry- Final*, EPA, Office of Water, Washington, DC. September 1996.

United States Environmental Protection Agency, *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Basic Fertilizer Chemicals Segment of the Fertilizer Manufacturing Point Source Category*, EPA, Office of Air and Water Programs, Washington, DC, March 1974.

United States Environmental Protection Agency, *Guides to Pollution Prevention, The Pesticide Formulating Industry*, Risk Reduction Engineering Laboratory and Center for Environmental Research Information, Office of Research and Development, February 1990.

United States Environmental Protection Agency, *Pesticide Industry Sales and Usage, 1994 and 1995 Market Estimates*, Office of Prevention, Pesticides and Toxic Substances, August 1997.

United States Environmental Protection Agency, *Report to Congress for Cement Kiln Dust*. Volume II: Methods and Findings. Springfield, VA: United States Department of Commerce, December 1993b.

United States Environmental Protection Agency, *1996 Toxics Release Inventory Database*.

Water Environment Federation, *Pretreatment of Industrial Wastes*, Manual of Practice FD-3, Alexandria, VA, 1994.

Section IV: Chemical Release and Transfer Profile

United States Environmental Protection Agency, *1996 Toxics Release Inventory Database*.

United States Environmental Protection Agency, *1995 Toxics Release Inventory Database*.

United States EPA Office of Air and Radiation, AIRS Database, 1997.

United States Environmental Protection Agency, *1995 Toxics Release Inventory Public Data Release*, United States EPA Office of Pollution Prevention and Toxics, April 1997. (EPA 745-R-97-005)

Section V: Pollution Prevention Opportunities

California Fertilizer Association, *Dry and Liquid Fertilizer Handling Guidelines for Retail Fertilizer Facilities.* CFA, http://www.calfertilizer.org/fertguide.html, November 1996.

Hunt, Gary, et. al., eds. *Case Summaries of Waste Reduction by Industries in the Southeast.* Waste Reduction Resource Center for the Southeast, North Carolina department of Natural Resources and Community Development, Raleigh, NC, July 1989.

Preventing Pollution in the Chemical Industry, Five Years of Progress, Chemical Manufacturers Association, 1993.

United Nations Environment Programme, *Mineral Fertilizer Production and the Environment*, Technical Report N.26, United Nations Industrial Development Organization, 1996.

United States Environmental Protection Agency, *Development Document for Best Available Technology, Pretreatment Technology, and New Source Performance Technology for the Pesticide Formulating, Packaging, and Repackaging Industry- Final*, EPA, Office of Water, Washington, DC, September 1996.

United States Environmental Protection Agency, *Guides to Pollution Prevention, The Pesticide Formulating Industry*, EPA, Center for Environmental Research Information, Cincinnati, February 1990.

Section VI: Summary of Applicable Federal Statutes and Regulations

Haugrud, K. Jack. "Agriculture," Chapter 8 in *Sustainable Environmental Law, Integrating Natural Resource and Pollution Abatement Law from Resources to Recovery*, Environmental Law Institute, St. Paul, 1993.

Landfair, Stanley W. "Toxic Substances Control Act," Chapter 11 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Miller, Marshall E. "Federal Regulation of Pesticides," Chapter 13 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Section VII: Compliance and Enforcement History

United States Environmental Protection Agency, Data obtained from EPA's *Integrated Data for Enforcement Analysis (IDEA)* system in 1997.

Section VIII: Compliance Activities and Initiatives

Agricultural Retailers Association, *Retailer Facts by FAX*, ARA Weekly, November 7, 1997.

Center for Environmental and Regulatory Information Services. <http://www.ceris.purdue.edu>

Jaszczak, Sandra, ed. *Gale Encyclopedia of Associations.* 31st ed., International Thomson Publishing Co., 1996.

United States Environmental Protection Agency, 33/50 Program Office, 1997.

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

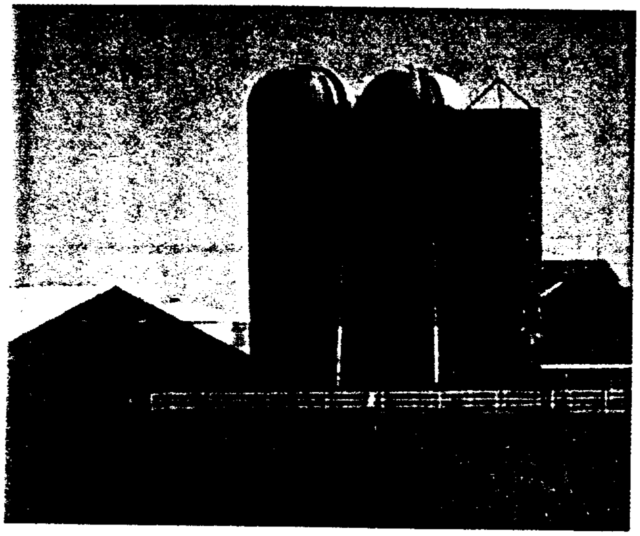
United States
Environmental Protection
Agency

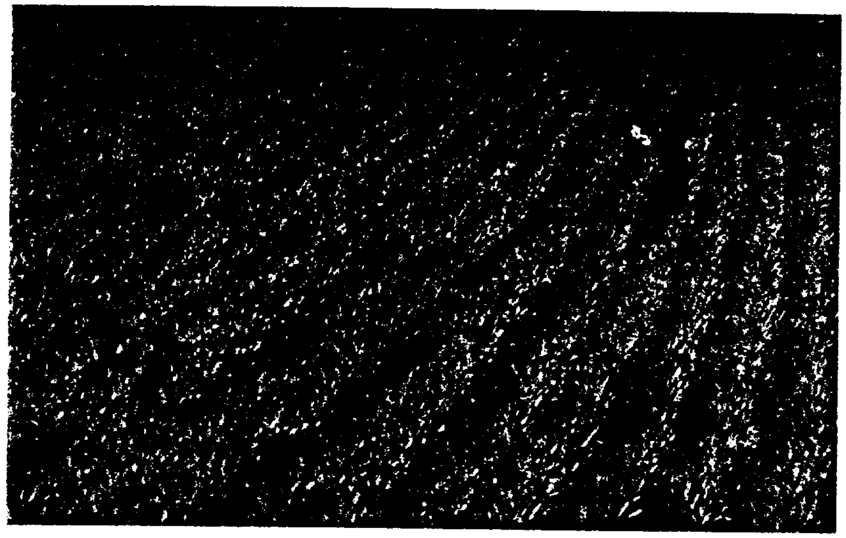
Enforcement and
Compliance Assurance
(2221-A)

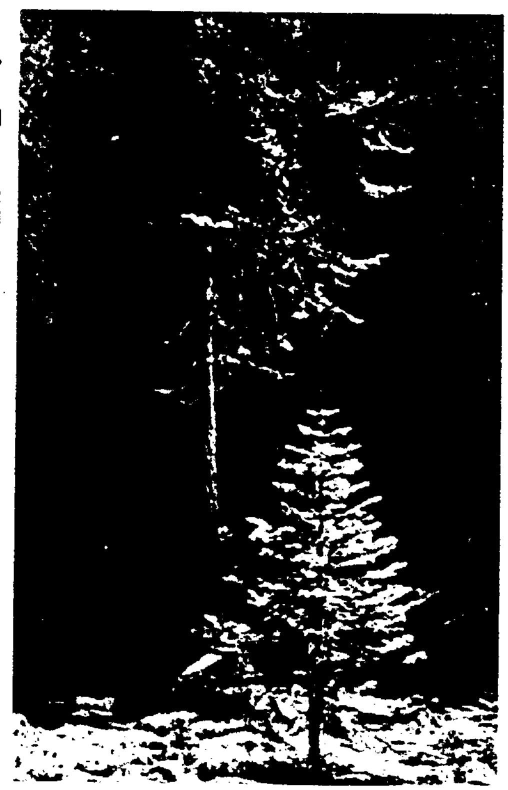
EPA 310-R-00-001
September 2000

EPA

Profile of the Agricultural Crop Production Industry







EPA Office of Compliance Sector Notebook Project

EPA/310-R-00-001

EPA Office of Compliance Sector Notebook Project

Profile of the Agricultural Crop Production Industry

September 2000

U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: (202) 512-1800 Fax: (202) 512-2250
Mail: Stop SSOP, Washington, DC 20402-0001

ISBN 0-16-050742-1

GENERAL INFORMATION

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by GeoLogics Corporation (Alexandria, VA), Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

Obtaining copies:

Electronic versions of all sector notebooks are available via Internet on the EnviroSenSe World Wide Web at **www.epa.gov/oeca/sector**. EnviroSenSe is a free, public, environmental exchange system operated by EPA's Office of Enforcement and Compliance Assurance and Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization. Direct technical questions to the "Feedback" button on the bottom of the web page.

Purchase printed bound copies from the **Government Printing Office (GPO)** by consulting the order form at the back of this document or order via the Internet by visiting the on-line GPO Sales Product Catalog at **http://orders.access.gpo.gov/su_docs/sale/prf/prf.html**. Search using the exact title of the document "Profile of the XXXX Industry" or simply "Sector Notebook." When ordering, use the GPO document number found on the order form at the back of this document.

Complimentary volumes are available to certain groups or subscribers, including public and academic libraries; federal, state, tribal, and local governments; and the media from EPA's National Service Center for Environmental Publications at **(800) 490-9198.** When ordering, use the EPA publication number found on the following page.

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460
(202) 564-7017

For further information, and for answers to questions pertaining to these documents, please refer to the contact names listed on the following page.

SECTOR NOTEBOOK CONTACTS

Questions and comments regarding the individual documents should be directed to the specialists listed below. **See the Notebook web page at: *www.epa.gov/oeca/sector* for the most recent titles and staff contacts.**

EPA Publication Number	Industry	Contact	Phone
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry	Joyce Chandler	202-564-7073
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*	Steve Hoover	202-564-7007
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry	Bob Marshall	202-564-7021
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*	Walter DeRieux	202-564-7067
EPA/310-R-95-005.	Profile of the Iron and Steel Industry	Maria Malave	202-564-7027
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry	Seth Heminway	202-564-7017
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*	Scott Throwe	202-564-7013
EPA/310-R-95-008.	Profile of the Metal Mining Industry	Maria Malave	202-564-5027
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry	Anthony Raia	202-564-6045
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry	Debbie Thomas	202-564-5041
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	202-564-2628
EPA/310-R-95-012.	Profile of the Organic Chemical Industry *	Walter DeRieux	202-564-7067
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry	Tom Ripp	202-564-7003
EPA/310-R-95-014.	Profile of the Printing Industry	Ginger Gotliffe	202-564-7072
EPA/310-R-95-015.	Profile of the Pulp and Paper Industry	Seth Heminway	202-564-7017
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry		202-564-2310
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	202-564-7013
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.	Virginia Lathrop	202-564-7057
EPA/310-R-97-001.	Profile of the Air Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-002.	Profile of the Ground Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-003.	Profile of the Water Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-004.	Profile of the Metal Casting Industry	Steve Hoover	202-564-7007
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry	Emily Chow	202-564-7071
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	202-564-7074
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	202-564-7028
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry	Anthony Raia	202-564-6045
EPA/310-R-97-009.	Profile of the Textile Industry		202-564-2310
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **	Seth Heminway	202-564-7017
EPA/310-R-98-001.	Profile of the Aerospace Industry	Anthony Raia	202-564-6045
EPA/310-R-99-006.	Profile of the Oil and Gas Extraction Industry	Dan Chadwick	202-564-7054
EPA/310-R-00-001.	Profile of the Agricultural Crop Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-002.	Profile of the Agricultural Livestock Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry	Michelle Yaras	202-564-4153

Government Series

EPA/310-R-99-001.	Profile of Local Government Operations		202-564-2310

* Spanish translations available.

** This document revises compliance, enforcement, and toxic release inventory data for all profiles published in 1995.

R0074260

Table of Contents

LIST OF EXHIBITS

R0074263

LIST OF ACRONYMS

ACM	Asbestos-Containing Materials
AFO	Animal Feeding Operations
AFPA	American Forest Paper Association
AFS	AIRS Facility Subsystem (CAA database)
ANSI	American National Standards Institute
BIF	Boiler and Industrial Furnace
BLM	Bureau of Land Management
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
Bt	Bacillus thuringiensis
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CCAP	Climate Change Action Plan
CDA	Controlled Droplet Application
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	CERCLA Information System (CERCLA database)
CESQG	Conditionally Exempt Small Quantity Generator
CFC	Chlorofluorocarbon
CFO	Conservation Farm Option
CFR	Code of Federal Regulations
CNMP	Comprehensive Nutrient Management Plan
CPA	Conservation Priority Area
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CZARA	Coastal Zone Act Reauthorization Amendments
DOT	United States Department of Transportation
DOJ	United States Department of Justice
DUN	Dun and Bradstreet
EMS	Environmental Management Systems
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EQIP	Environmental Quality Incentives Program
ESPP	Endangered Species Protection Program
FDA	United States Food and Drug Administration
FFDCA	Federal Food, Drug and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FQPA	Food Quality Protection Act
FR	Federal Register

R0074264

LIST OF ACRONYMS (CONTINUED)

FS	Forest Service
FSA	Farm Service Agency
FWS	Fish and Wildlife Service
FY	Fiscal Year
GPS	Global Positioning System
HAP	Hazardous Air Pollutant (CAA)
HSWA	Hazardous and Solid Waste Amendments
HUD	United States Department of Housing and Urban Development
IDEA	Integrated Data for Enforcement Analysis
IPM	Integrated Pest Management
ISO	International Organization for Standardization
LDR	Land Disposal Restrictions (RCRA)
LEPC	Local Emergency Planning Committee
LQG	Large Quantity Generator
MACT	Maximum Achievable Control Technology (CAA)
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards (CAA)
NAICS	North American Industrial Classification System
NASS	National Agricultural Statistics Service
NCDB	National Compliance Database, Office of Prevention, Pesticides and Toxic Substances
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
$NICE^3$	National Industrial Competitiveness Through Energy, Environment, and Economics
NOA	Notice of Arrival
NPS	Nonpoint Source Management Program
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System (CWA)
NPL	National Priorities List
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standards (CAA)
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PCS	Permit Compliance System

LIST OF ACRONYMS (CONTINUED)

PESP	Pesticide Environmental Stewardship Program
PMN	Premanufacture Notice
POTW	Publicly Owned Treatment Works
PWS	Public Water Systems
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System (RCRA database)
RMP	Risk Management Plan
RQ	Reportable Quantities
RUP	Restricted Use Pesticides
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEP	Supplemental Environmental Project
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SPCC	Spill Prevention, Control, and Countermeasure
SQG	Small Quantity Generator
TMDL	Total Maximum Daily Load
TRI	Toxic Release Inventory
TRIS	Toxics Release Inventory System
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
USDA	U.S. Department of Agriculture
UST	Underground Storage Tank (RCRA)
WHIP	Wildlife Habitat Incentives Program
WPS	Worker Protection Standard Requirements for Users
WRP	Wetlands Reserve Program

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are becoming an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies addressing all media for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach by the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above alone could be the subject of a lengthy volume. However, to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be explored further based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be sent via the web page.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the relative national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or repackage the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers also may want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks, please contact the Office of Compliance at 202-564-2310.

II. INTRODUCTION TO THE AGRICULTURAL PRODUCTION INDUSTRIES: CROPS, GREENHOUSES/NURSERIES, AND FORESTRY

This section provides background information on three types of agricultural production industries:

- Establishments that produce crops, including oilseed and grains, vegetables and melons, fruit and tree nuts, and other crops
- Greenhouses and nurseries
- Establishments engaged in forestry and logging.

> The Office of Management and Budget (OMB) has replaced the Standard Industrial Classification (SIC) system, which was used to track the flow of goods and services within the economy, with the NAICS. The NAICS, which is based on similar production processes to the SIC system, is being implemented by OMB.

This section defines these industries in terms of their North American Industrial Classification System (NAICS) codes. According to NAICS, establishments that produce crops and greenhouses/nurseries are classified in ***NAICS code 111 (Crop Production)***. Because greenhouses/nurseries comprise a large number of the entities in NAICS 111 and are somewhat different in actual practices, this notebook presents data and information on them separately from crop production. Greenhouse, nursery, and floriculture production is classified as ***NAICS code 1114.*** Establishments engaged in forestry are classified in ***NAICS code 113 (Forestry and Logging)***. The forestry production industry has practices that differ significantly from those used for crops and greenhouses/nurseries.

Establishments primarily engaged in crop production and forestry are classified in subgroup(s), up to six digits long, based on the total value of sales of agricultural products. An establishment would be placed in the group that represents 50 percent or more of its total sales. For example, if 51 percent of the total sales of an establishment is wheat, then it would be classified under NAICS codes 1111 (Oilseed and Grain Farming) and 11114 (Wheat Farming).

Data for the notebook, specifically in this chapter, were obtained from the U.S. Department of Agriculture (USDA) and the 1997 Agriculture Census (Ag Census). All data are the most recent publicly available data for the source cited.

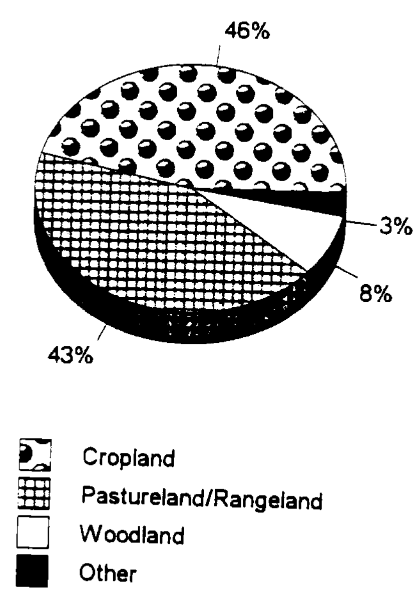
II.A. General Overview of Agricultural Establishments

This section presents a general overview of agricultural establishments to provide background information regarding the number of such establishments and production data. The USDA's National Agricultural Statistics Service (NASS) defines an *agricultural establishment* (i.e., farm) based on production. It defines a farm as a place which produced or sold, or normally would have produced or sold, $1,000 or more of agricultural products during the year. Agricultural products include all products grown by establishments described in this profile, which are classified under NAICS codes 111, 113, and 1114, as well as those in NAICS code 112 - Animal Production, which are covered in the *Profile of the Agricultural Livestock Production Industry*.

According to the 1997 Ag Census, there were more than 1.9 million farms (i.e., agricultural establishments) in the United States. Of these, approximately 47 percent (902,372 farms) were classified as NAICS code 111 - Crop Production. The other 53 percent (1,009,487 farms) were classified as NAICS code 112 - Animal Production. These 1.9 million agricultural establishments represent nearly 932 million acres of land, with the average agricultural establishment consisting of 487 acres. (Note: 1 acre is approximately the size of a football field.) Both of these numbers--932 million acres and 487 acres--are smaller than those for 1992, which were 946 million acres and 491 acres, respectively.

As shown in Exhibit 1, of the 932 million acres of agricultural land, the overwhelming majority (89%) consists of cropland and pastureland/rangeland.

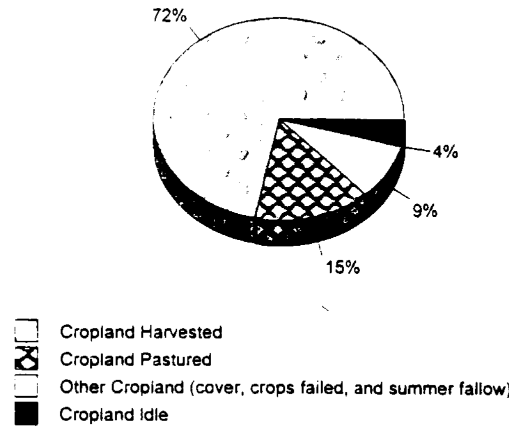
Exhibit 1. Agricultural Land Use in the U.S. (1997 Ag Census)



R0074270

As presented in Exhibit 2, the 1997 Ag Census describes cropland as:

Exhibit 2. Types of Cropland (1997 Ag Census)



- *Harvested cropland* -- Includes all acreage from which crops are harvested, such as: (1) corn, wheat, barley, oats, sorghum, soybeans, cotton, and tobacco; (2) wild or tame harvested hay, silage, and green chop; and (3) vegetables. It also includes land in orchards and vineyards; all acres in greenhouses, nurseries, Christmas trees, and sod; and any other acreage from which a crop is harvested even if the crop is considered a partial failure and the yield is very low.

- *Cropland used only for pasture or grazing* -- Includes land pastured or grazed which could be used for crops without any additional improvement, and land in planted crops that is pastured or grazed before reaching maturity.

- *Cropland used for cover crops* -- Includes land used only to grow cover crops for controlling erosion or to be plowed under for improving the soil.

- *Cropland on which all crops failed* -- Includes: (1) all land from which a crop failed (except fruit or nuts in an orchard, grove, or vineyard being maintained for production) and no other crop is harvested and which is not pastured or grazed, and (2) acreage not harvested due to low prices or labor shortages.

- *Cultivated summer fallow* -- Includes cropland left unseeded for harvest, and cultivated or treated with herbicides to control weeds and conserve moisture.

- *Idle cropland* -- Includes any other acreage which could be used for crops without any additional improvement and which is not included in one of the above categories of cropland.

The 1997 Ag Census describes pastureland and rangeland as land, other than cropland or woodland pasture, that is normally used for pasture or grazing. This land, sometimes called "meadow" or "prairie," may be composed of bunchgrass, shortgrass, buffalo grass, bluestem, bluegrass, switchgrass, desert shrubs, sagebrush, mesquite, greasewood, mountain browse, salt brush, cactus, juniper, and pinion. It also can be predominantly covered with brush or browse.

As shown in Exhibit 3, approximately 82 percent of agricultural establishments in 1997 consisted of fewer than 500 acres; only 4 percent consisted of 2,000 or more acres.

According to the 1997 Ag Census, all agricultural establishments combined to produce approximately $197 billion worth of agricultural products.

Exhibit 3. Acreage of Agricultural Establishments in the U.S. (1997 Ag Census)

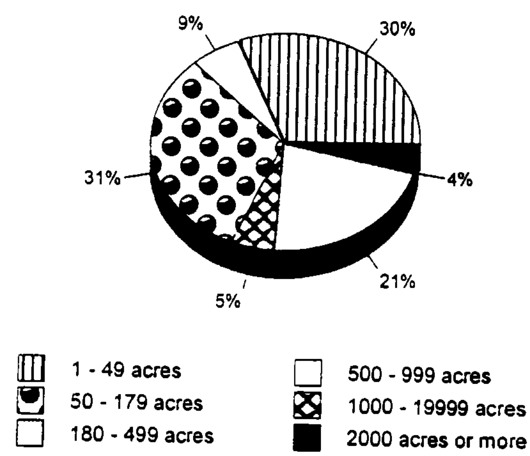
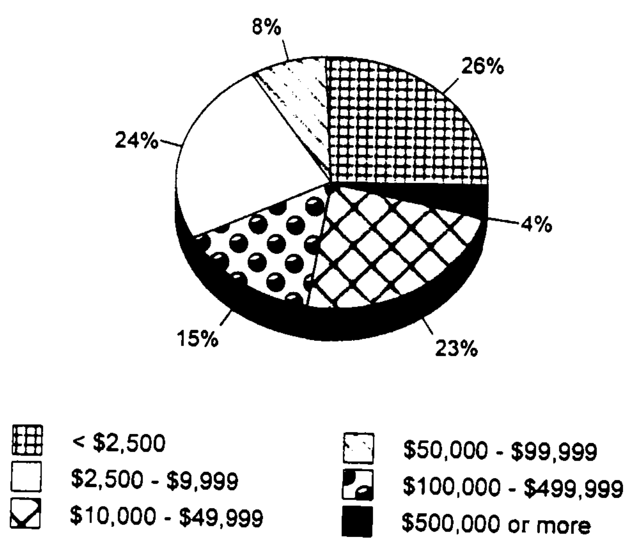


Exhibit 4. Agricultural Establishments by Value of Sales (1997 Ag Census)



The market value of the agricultural products sold was split almost evenly between crop production, including nursery and greenhouse crops (49.6%) and livestock production (50.4%).

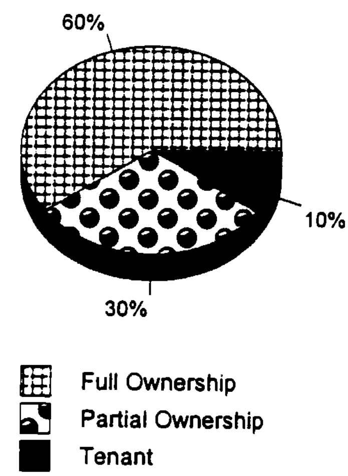
As shown in Exhibit 4, approximately 73 percent of all agricultural establishments produced less than $50,000 worth of agricultural products.

R0074272

In addition to tracking the number of agricultural establishments and the value of products sold, the Ag Census tracks and identifies other characteristics of agricultural establishments, such as ownership and organization. Exhibit 5 presents a breakdown of the ownership status of agricultural establishments in the U.S. The Ag Census basically identifies the ownership status of agricultural establishments by one of three categories:

- Full ownership, in which full owners operate only the land they own.
- Partial ownership, in which partial owners operate land they own and also land they rent from others.
- Tenant/rental arrangement, in which tenants operate only land they rent from others or work on shares for others.

Exhibit 5. Ownership Status of Agricultural Establishments in the U.S. (1997 Ag Census)



The Census further classifies agricultural establishment ownership by the person or entity who owns the establishment. There are four distinct types of organization: (1) individual or family (sole proprietorship); (2) partnership, including family partnership; (3) corporation, including family corporation, and (4) other, including cooperatives, estate or trust, and institutional. Approximately 86 percent of all establishments are owned and operated by individuals or families. Partnerships account for another 9 percent of the establishments and corporations own just more than 4 percent of the establishments. Fewer than 1 percent of all farms are owned by other organizations. (1997 Ag Census).

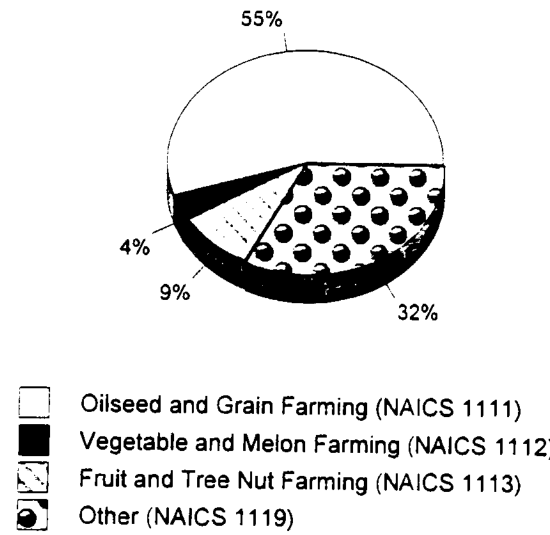
II.B. Characterization of the Crop Production Industry

This section provides data and information on the crop production industry. For the purposes of this profile, crop production includes the four categories of commodities presented in Exhibit 6. This notebook follows the structure provided by the 1997 Ag Census, which classifies all of these commodity production operations within NAICS code 111. Because the notebook is addressing greenhouse, nursery, and floriculture products separately in the next section, they are not included within this discussion.

Exhibit 6. 1997 NAICS Descriptions for Crop Production (NAICS 111)

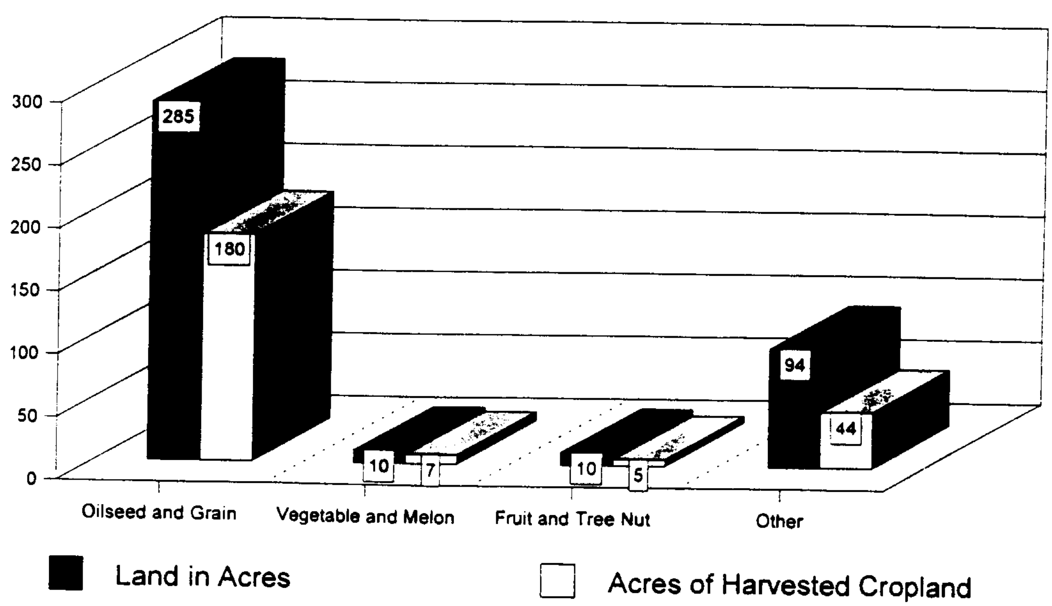
Type of Establishment	NAICS Code	SIC Code	Description
Oilseed and Grain	1111	0116, 0119	Establishments primarily engaged in: 1) growing oilseed and/or grain crops and/or 2) producing oilseed and grain seeds. These crops have an annual growth cycle and are typically grown in open fields.
Vegetables and Melons	1112	0134, 0139, 0161	Establishments primarily engaged in growing root and tuber crops (except sugar beets and peanuts) or edible plants and/or producing root and tuber or edible plant seeds. The crops included in this group have an annual growth cycle and are grown in open fields.
Fruits and Tree Nuts	1113	0171, 0172, 0173, 0174, 0175, 0179	Establishments primarily engaged in growing fruit and/or tree nut crops. The crops included in this industry group are generally not grown from seeds and have a perennial life cycle.
Other Crops	1119	0131, 0132, 0133, 0139, 0191, 0831, 2099	Establishments primarily engaged in: 1) growing crops (other than those listed previously), such as tobacco, cotton, sugarcane, hay, sugar beets, peanuts, agave, herbs and spices, and hay and grass seeds, or 2) growing a combination of these crops.

Exhibit 7. Number of Farms
(1997 Ag Census)



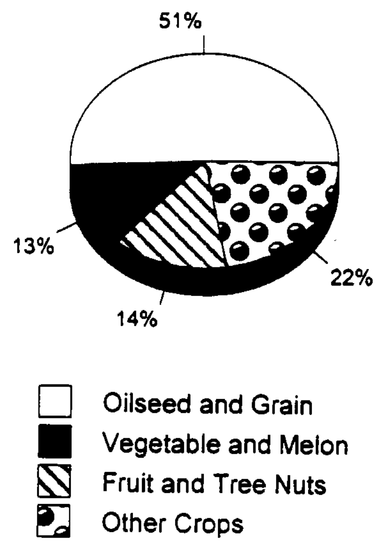
In 1997, there were 845,180 establishments producing the four categories of commodities referenced above. All these establishments combined covered nearly 400 million acres, of which more than half (236 million acres) was harvested cropland. The average crop producing establishment in 1997 was approximately 473 acres in size and averaged approximately 279 acres of harvested cropland. Of the 845,180 crop producing establishments, more than 50 percent (462,877) were classified as oilseed and grain farming (see Exhibit 7). Also, as shown in Exhibit 8, oilseed and grain farming accounted for the majority of the land in acres as well as harvested cropland.

Exhibit 8. Land in Acres vs. Acres of Harvested Cropland (in millions of acres)
(1997 Agriculture Census)



R0074275

Exhibit 9. Percent of Sales by Type of Establishment (1997 Ag Census)



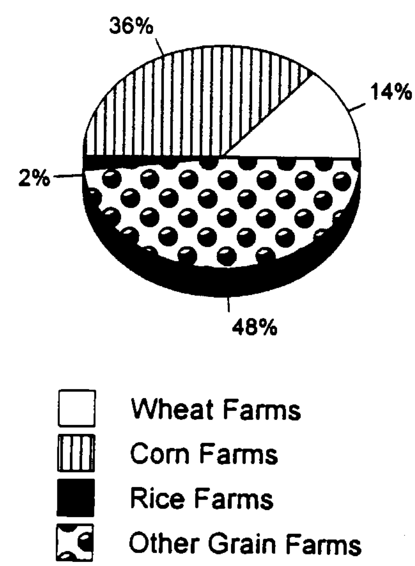
The four types of crop-producing establishments defined above accounted for approximately $87 billion worth of products sold in 1997. Exhibit 9 presents the distribution of those sales among the four types of establishments.

II.B.1. Oilseed and Grain

Oilseed and grain accounted for the majority of agricultural sales in the U.S. in 1997. For the purposes of the 1997 Ag Census, oilseed includes primarily soybeans, but also dry peas and beans, canola, flaxseeds, mustard seeds, oilseeds, rapeseeds, safflower, sesame seeds, and sunflowers. Grain includes wheat, corn, rice, and other grains such as barley, broomcorn, buckwheat, milo, oats, rye, sorghum, and wild rice. These grains are considered both food and feed grains, meaning they may be used either in food production or as feed for livestock.

In 1997, there were 462,877 oilseed and grain establishments in the U.S.; 94,481 were oilseed establishments and 368,396 were grain establishments. As shown in Exhibit 10, corn-producing establishments comprise the majority of the grain establishments in the U.S. On average, each grain-producing establishment is approximately 671 acres. Of those, approximately 407 acres are harvested cropland.

Exhibit 10. Types of Grain Farms (1997 Ag Census)



R0074276

II.B.2. Vegetables and Melons

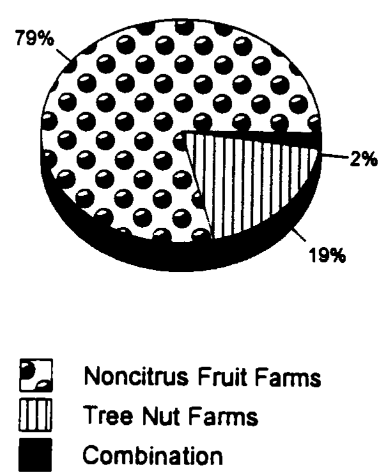
Vegetable and melon farming accounts for 31,030 establishments, or just less than 4 percent of the total crop-producing establishments in the U.S. An average vegetable and melon establishment consists of approximately 330 acres, of which approximately 170 acres are harvested cropland. Potato farming is the largest subgroup within vegetable and melon farming. It comprises nearly 12 percent of all vegetable and melon farms. The average potato-producing establishment has approximately 981 acres; approximately 730 of these acres are harvested cropland.

II.B.3. Fruit and Tree Nuts

Fruit and tree nut farming comprised the third largest group of crop-producing establishments combining for 81,956 establishments. This category is basically broken into two categories: 1) citrus fruits, and 2) noncitrus fruits and tree nuts. Citrus-producing establishments (i.e., groves) accounted for 12,275 establishments, or approximately 15 percent of all fruit and tree nut establishments. Noncitrus fruits and tree nuts, which include apples, grapes, strawberries, other berries, tree nuts, and other noncitrus fruits, comprised the remainder of the establishments (69,681) in 1997. (Tree nuts include almonds, hazelnuts, walnuts, macadamia nuts, pecans, and pistachios.) The percentages of noncitrus fruit and tree nut establishments are presented in Exhibit 11.

In 1997, the average fruit and tree nut establishment was 127 acres, with approximately half of those acres being harvested. Orange groves accounted for more than 75 percent of all citrus fruit establishments. Florida dominates citrus fruit production, except for lemons. Noncitrus fruits are grown across the country. Tree nuts are grown primarily in California and Hawaii.

Exhibit 11. Noncitrus Fruit and Tree Nut Farms (1997 Ag Census)



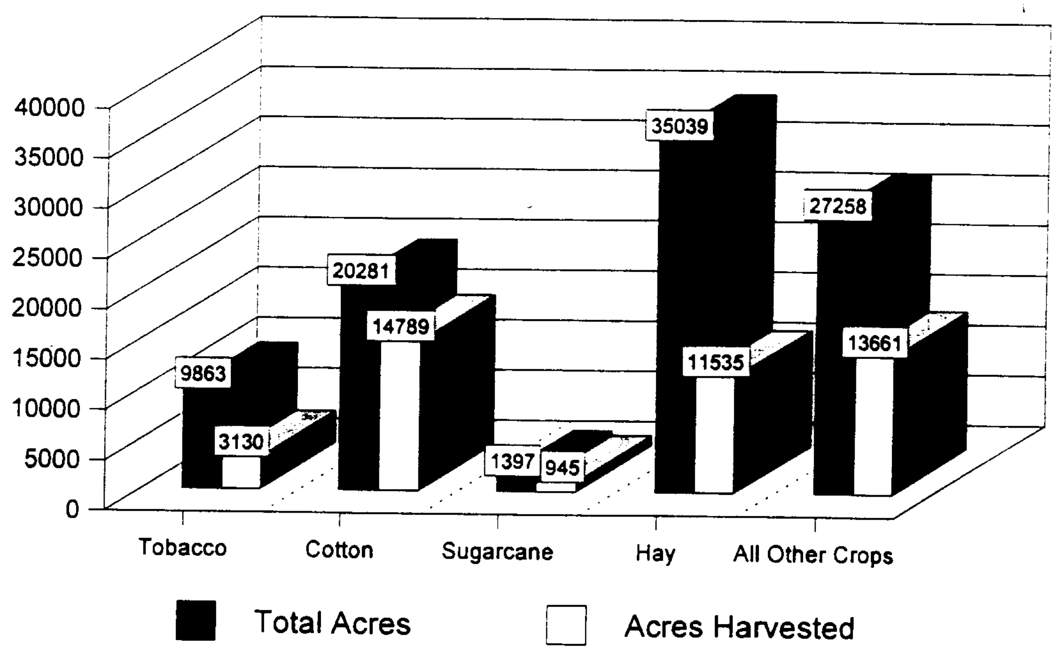
R0074277

II.B.4. Other Crops

The category of Other Crops comprised the second largest group of crop-producing establishments in the U.S. in 1997. A total of 269,317 farms were classified as NAICS code 1119 - Other Crops Farming. These other crops include tobacco, cotton, sugarcane, and hay, as well as other specialty crops such as honey and sugarbeets. Of the 269,317 other crop farms, 52 percent were classified as hay farms. Tobacco farms accounted for 24 percent of these establishments and cotton-producing establishments represented 7 percent. Sugarcane farms accounted for less than 1 percent of all establishments in this category. The remaining 17 percent were classified in the All Other Crops category.

These establishments combined for a total land area of approximately 94 million acres, or approximately 349 acres per establishment. The average number of acres harvested was 164 acres. Exhibit 12 provides a comparison of total acres to acres harvested for other crops.

Exhibit 12. Total Acres vs. Acres Harvested of Other Crops (in thousands of acres) (1997 Ag Census)



R0074278

II.C. Characterization of the Greenhouse, Nursery, and Floriculture Production Industry

Although the greenhouse, nursery, and floriculture industry is classified under NAICS code 111, this profile separates it into its own section because its practices and environmental impacts are different from those associated with the crops discussed in Section II.B.

In 1997, according to the Ag Census, there were 57,192 farms classified as NAICS code 1114, which is Greenhouse, Nursery, and Floriculture Production. This industry group consists of establishments that primarily grow crops of any kind under cover and/or grow nursery stock and flowers. "Under cover" is generally defined as in greenhouses, cold frames, cloth houses, and lath houses. The crops grown are removed at various stages of maturity and have annual and perennial life cycles. The nursery stock includes short rotation woody crops that have growth cycles of 10 years or less.

Of the 57,192 establishments classified as NAICS 1114, 97 percent were nursery and floriculture production (NAICS code 11142). The remaining 3 percent were classified as NAICS code 11141 - food crops grown under cover. Within the nursery and floriculture classification, there are two distinct categories:

- ***Nursery and tree production***, which consists of establishments primarily engaged in growing nursery products, nursery stock, shrubbery, bulbs, fruit stock, and sod, and those engaged in growing short rotation woody trees with a growth and harvest cycle of 10 years or less for pulp or tree stock, such as Christmas trees, under cover or in open fields.

- ***Floriculture production***, which consists of establishments primarily engaged in growing and/or producing floriculture products, such as cut flowers, cut cultivated greens (e.g., leatherleaf ferns, chamaedorea, etc.), potted flowering and foliage plants, and flower seeds, under cover or in open fields.

In 1997, there were 33,935 nursery and tree production establishments and 21,824 floriculture establishments. These establishments combined for total sales of nearly $10 billion, or approximately 10 percent of the total value of all crops sold in 1997. The average size of nursery and tree production establishments is nearly 92 acres, with an average of approximately 35 acres being harvested cropland. Floriculture production establishments average 35 acres in size with approximately one-third of that acreage being harvested cropland. California and Florida account for the majority of the establishments, as well as sales, in the floriculture industry.

Exhibits 13 and 14 show the value of greenhouse, nursery, and floriculture production compared to total crop production, and the value of greenhouse, nursery, and floriculture production sales, respectively.

Exhibit 13. Value of Greenhouse, Nursery, and Floriculture Production Compared to Total Crop Production (1997 Ag Census)

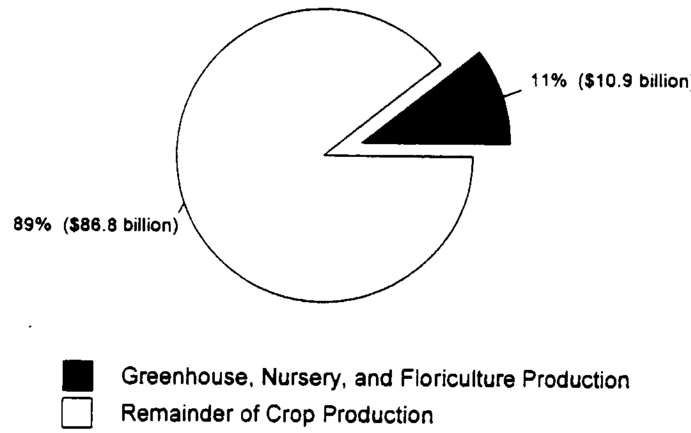
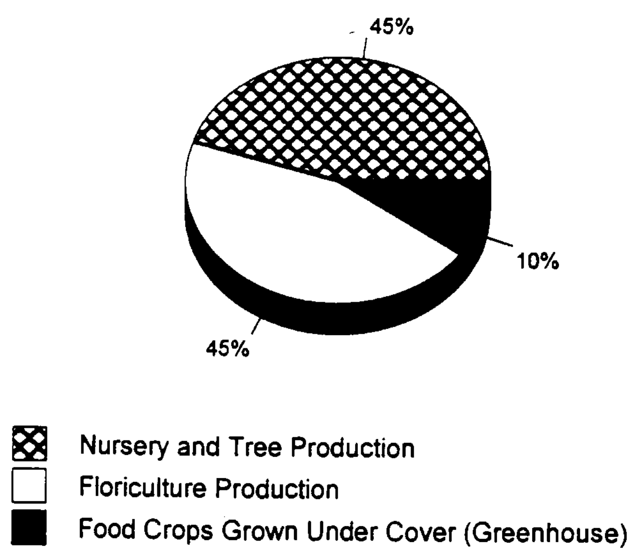


Exhibit 14. Values of Greenhouse, Nursery, and Floriculture Production Sales (1997 Ag Census)



R0074280

II.D. Characterization of the Forestry Production Industry

This section pertains to the forestry industry as classified within ***NAICS code 113 - Forestry and Logging***. As defined by NAICS, industries in this sector grow and harvest timber on a long production cycle (i.e., 10 years or more). Long production cycles use different production processes than short production cycles, which require more horticultural interventions prior to harvest, resulting in processes more similar to those found in the previous sections of this profile. The three subsectors included within NAICS code 113 are:

- ***Timber tract operations (NAICS code 1131)***, which consist of establishments engaged in operating timber tracts for the purpose of selling standing timber.

- ***Forest nurseries and gathering of forest products (NAICS code 1132)***, which primarily engage in growing trees for reforestation and gather forest products, such as gums, barks, balsam needles, rhizomes, fibers, Spanish moss, ginseng, and truffles.

- ***Logging (NAICS code 1133)***, which consists of establishments primarily engaged in cutting timber, cutting and transporting timber, and producing wood chips in the field.

Industries usually specialize in different stages of the production cycle, as indicated by the three NAICS codes. Reforestation requires production of seedlings in specialized nurseries. Timber production requires natural forest or suitable areas of land that are available for a long duration. The harvesting of timber (except when done on an extremely small scale) requires specialized machinery unique to the industry. Establishments gathering forest products, such as gums, barks, balsam needles, rhizomes, fibers, Spanish moss, and ginseng and truffles, are also included in this industry.

II.D.1. Definition of Forest Land

The U.S. Forest Service defines a forested area as "forest land" if it is at least one acre in size and *at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use.* (Examples of non-forest uses include areas for crops, improved pasture, residential areas, and other similar areas.) Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10 percent stocked with forest trees and forest areas adjacent to urban and built-up lands (36 CFR 219).

In the United States, there are approximately 736.7 million acres of forest land. The distribution of this forest land among geographic regions is presented in Exhibit 15.

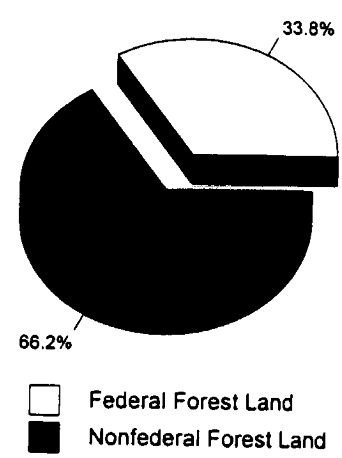
Exhibit 15. Distribution of U.S. Forested Land Area

Geographic Region	Total Land Area (in thousands of acres)	Forested Acres (in thousands)	Percent Forested
Northeast	126,816	85,380	67
North Central	286,764	83,108	29
Pacific Northwest	469,093	177,611	38
Pacific Southwest	103,934	39,011	38
Great Plains	194,299	4,232	2
Southeast	147,419	88,078	60
South Central	387,104	123,760	32
Rocky Mountains	547,918	135,499	25
Total	**2,263,347**	**736,679**	
Source: American Forest and Paper Association (AFPA), 1995			

Federal Versus Nonfederal Forest Lands

Of the 736.7 million acres, approximately 249.1 million acres (or 33.8 percent) are owned by the federal government. The remaining 487.6 million acres are owned by nonfederal entities, such as state or local governments, private citizens, or companies (see Exhibit 16).

Exhibit 16. Federal vs. Nonfederal Forest Lands (AFPA 1995)



R0074282

Approximately 57 percent of all productive forest land in the U.S. is owned by 9.3 million non-industrial private landowners. These 353 million acres of land produce more than half of the nation's wood supply (AFPA, 1995).

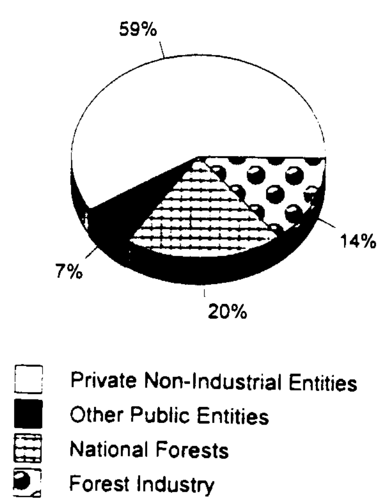
The majority of federal forest land is managed as the national forest system (NFS). The NFS includes:

- National forest lands reserved from the U.S. public domain.
- National forest lands acquired through purchase, exchange, donation, or other means.
- National grasslands.
- Other lands, waters, or interests administered by the U.S. Forest Service (FS) or designated for administration through the FS as part of the system.

The NFS contains 191 million acres, or 77 percent, of federal forest lands. (The remaining federal forest lands are managed by the Bureau of Land Management, the National Park Service, and other federal agencies.) The NFS is contained in 43 states and creates about 500,000 private sector jobs. Of the remaining nonfederal forests, privately held commercial forest lands make up the largest portion accounting for 347 million acres (71 percent).

Timberlands. Two-thirds of U.S. forest lands, or almost 490 million acres, are classified as timberlands. Timberlands are defined as forest lands used for the production of commercial wood products. Commercial timberland can be used for repeated growing and harvesting of trees. Seventy percent of timberlands are located in the East (AFPA, 1995). Exhibit 17 presents additional information about timberland ownership. Of the 490 million acres of timberland, federal, state, and local governments own 131 million acres (27 percent) and non-industrial private entities own 288 million acres (59 percent).

Exhibit 17. Timberland Ownership (AFPA 1995)



R0074283

Private timberlands are mostly on small tracts of forest land. Only 600,000 landowners have holdings larger than 100 acres (AFPA, 1995). The forest products industry owns about 70 million acres (14 percent) of commercial timberland. One-third of the nation's annual timber harvest is from these forests (AFPA, 1995).

II.D.2. Consumption and Regeneration of Forest Products

The United States is the world's leading producer and consumer of forest products (e.g., paper products) and accounts for approximately one-fourth of the world's production and consumption (AFPA, 1995). The United States is also the world's largest producer of softwood and hardwood lumber. Specifically for timber, in 1996, total annual sales for commercial (i.e., nonfederal) timber and nontimber forest products were approximately $3.8 billion. Timber alone accounted for approximately 69 percent of those sales.

In fiscal year 1998, the NFS sold approximately174 million cubic feet (or 870 million board feet) of timber valued at approximately $80 million. NFS timber sales from the past 6 years are presented in Exhibit 18. Also in fiscal year 1998, BLM sold 43.7 million cubic feet (or 261 million board feet) of timber. (A value was not provided for the BLM timber sales.)

Exhibit 18. NFS Timber Sales, FY 1993-1998
(from U.S. Forest Service)

Fiscal Year	Approx. Volume (million cubic feet)	Value
1993	250	$192,942,739
1994	177	$125,340,385
1995	240	$140,460,250
1996	212	$125,226,853
1997	195	$123,681,846
1998	174	$80,195,720

Exhibit 19. Acres Seeded and Acres of Tree Planting (FY 1996)

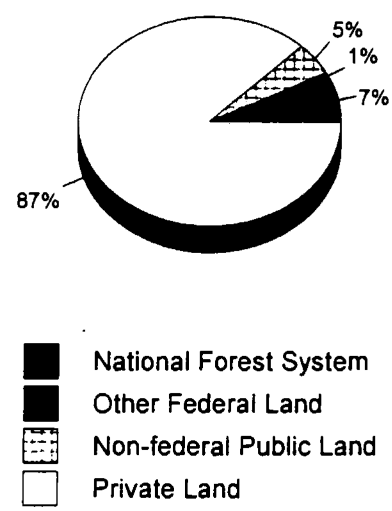


Exhibit 19 provides a breakout of where regeneration efforts occurred. To replenish the forests, more than 2.4 million acres in the U.S. were either seeded or planted with trees in government fiscal year 1996 (October 1995 - September 1996). The overwhelming majority of the regeneration efforts occurred on private lands where nearly 2.1 million acres were seeded or planted.

II.E. Geographic Distribution and Economic Trends

According to the 1997 National Resource Inventory (NRI), some changes have occurred in land use. Since 1982, federal land increased by 4.6 million acres, nonfederal rural land decreased by 36.7 million acres, and developed land increased by nearly 30 million acres. Cropland acreage, classified as irrigated, non-irrigated, cultivated, or non-cultivated acreage, nationally decreased by 45.9 million acres between 1982 and 1997. Rangeland decreased by 12.4 million acres and pastureland decreased by almost 14 million acres. Generally, a shift has occurred in irrigated agriculture from west to east across the country.

The distribution of prime farmland by land cover/use has also changed in the past 15 years. There were 330.6 million acres of prime farmland in 1997, which was down 11.7 million acres from 1982. Most (64 percent) of the prime farmland is in cropland, but large amounts are in pastureland (35.5 million acres) and forest land (47.7 million acres).

R0074285

For more information from the 1997 NRI, please visit the website http://www.nhq.nrcs.usda.gov/NRI/1997. Additional information on the geographic distribution of the crop production industries and their economic trends is very extensive and available through many sources. National and state-specific information can be accessed through the Internet from the 1997 Agriculture Census at http://www.nass.usda.gov/census/ and the National Agriculture Statistics Service at http://www.usda.gov/nass/.

III. Summary of Operations, Impacts, and Pollution Prevention Opportunities for the Agricultural Production Industries: Crops, Greenhouses/Nurseries, and Forestry

This section provides an overview of commonly employed operations and maintenance activities in the agricultural production industries of crops, greenhouses/nurseries, and forestry. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the material inputs, major pollution outputs, and associated environmental impacts from these agricultural production practices. General pollution prevention and waste minimization opportunities are also discussed in the context of each of the operations and maintenance activities.

The choice of practices or operations influences the material used and the resulting pollution outputs and environmental impacts. Keep in mind that environmental impacts are relative, as some kinds of pollution outputs have far greater impacts than others.

Impact of Agriculture on the Environment

> The Clean Water Act Plan of 1998 called for the development of the EPA/USDA Unified National Strategy for AFOs to minimize the water quality and public health impacts of AFOs.

According to the *EPA/USDA Unified National Strategy for Animal Feeding Operations* (March 9, 1999), despite progress in improving water quality, 40 percent of the Nation's waterways assessed by States do not meet goals for fishing, swimming, or both. While pollution from factories and sewage treatment plants has been dramatically reduced, the runoff from city streets, agricultural activities, including AFOs, and other sources continues to degrade the environment and puts environmental resources (i.e., surface water, drinking water) at risk. According to EPA's 1996 305(b) water quality report, the top two pollutants from agriculture were identified as sediment and nutrients, respectively. Additional agricultural pollutants, such as animal wastes, salts, and pesticides, were identified by EPA[1]. The following presents a brief discussion of the environmental impacts or effects of agricultural pollutants.

(1) ***Nutrients***. Excess nutrients in water (i.e., phosphorus and nitrogen) can result in or contribute to low levels of dissolved oxygen (anoxia),

[1] *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, U.S. Environmental Protection Agency, January 1993.

eutrophication, and toxic algal blooms. These conditions may be harmful to human health and ecosystems; may adversely affect the suitability of the water for other uses; and, in combination with other circumstances, have been associated with outbreaks of microbes such as *Pfiesteria piscicida*.

- Phosphorus. Phosphorus determines the amount of algae growth and aging that occurs in freshwater bodies. Runoff and erosion can carry some of the applied phosphorus to nearby water bodies.

- Nitrogen. In addition to eutrophication, excessive nitrogen causes other water quality problems. Dissolved ammonia at concentrations above 0.2 mg/L may be toxic to fish. Biologically important inorganic forms of nitrogen are ammonium, nitrate, and nitrite. Ammonium becomes adsorbed to the soil and is lost primarily with eroding sediment. Even if nitrogen is not in a readily available form as it leaves the field, it can be converted to an available form either during transport or after delivery to water bodies. Nitrogen in the form of nitrate, can contaminate drinking water supplies drawn from groundwater. Nitrates above 10 ppm in drinking water are potentially dangerous, especially to newborn infants.

(2) ***Sediment.*** Sediment affects the use of water in many ways. Suspended solids reduce the amount of sunlight available to aquatic plants, cover fish spawning areas and food supplies, clog the filtering capacity of filter feeders, and clog and harm the gills of fish. Turbidity interferes with the feeding habits of fish. These effects combine to reduce fish and plant populations and decrease the overall productivity of waters. In addition, recreation is limited because of the decreased fish population and the water's unappealing, turbid appearance. Turbidity also reduces visibility, making swimming less safe.

(3) ***Animal Wastes.*** Animal waste includes the fecal and urinary wastes of livestock and poultry; process water (such as from a milking parlor); and the feed, bedding, litter, and soil with which fecal and urinary matter and process water become intermixed. Manure and wastewater from animal feeding operations have the potential to contribute pollutants such as nutrients (e.g., nitrogen and phosphorus), organic matter, sediments, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment. Decomposing organic matter (i.e., animal waste) can reduce oxygen levels and cause fish kills. Solids

deposited in water bodies can accelerate eutrophication through the release of nutrients over extended periods of time.

Contamination of groundwater can be a problem if runoff results from the misapplication or over application of manure to land or if storage structures are not built to minimize seepage. Because animal feed sometimes contains heavy metals (e.g., arsenic, copper, zinc), the possibility for harmful accumulations of metals on land where manure is improperly or over applied is possible.

(4) ***Salts***. Salts are a product of the natural weathering process of soil and geologic material. In soils that have poor subsurface drainage, high salt concentrations are created within the root zone where most water extraction occurs. The accumulation of soluble and exchangeable salts (i.e., metal compounds in the soil that can chemically change) leads to soil dispersion (i.e., movement of soil in air and water), structure breakdown, decreased infiltration, and possible toxicity; thus, salts often become a serious problem on irrigated land, both for continued agricultural production and for water quality considerations. High salt concentrations in streams can harm freshwater aquatic plants just as excess soil salinity damages agricultural crops.

(5) ***Pesticides.*** The primary pollutants from pesticides are the active and inert ingredients, diluents, and any persistent degradation products. Pesticides and their degradation products may enter groundwater and surface water in solution, in emulsion, or bound to soils. Pesticides may, in some instances, cause impairments to the uses of surface waters and groundwater. Both the degradation and sorption characteristics of pesticides are highly variable. Some types of pesticides are resistant to degradation and may persist and/or accumulate in aquatic ecosystems. Pesticides may harm the environment by eliminating or reducing populations of desirable organisms, including endangered species.

At a crop production establishment, pesticides may be applied directly to crops or to structures (e.g., barns, housing units) to control pests, including parasites, vectors (i.e., an organism, such as a mosquito or tick, that carries disease-causing microorganisms from one host to another), and predators. Potential contamination from pesticides is generally greatest when rainfall is intense and occurs shortly after pesticide application, a condition during which water runoff and soil losses are also greatest. Pesticides can be transported to receiving waters either in dissolved form or attached to soil. Dissolved pesticides may be leached into groundwater supplies.

People, wildlife, and the environment can also be exposed to pesticide residues in the form of spray drift. Spray drift is the physical movement of a pesticide through air at the time of application or soon thereafter, to any site other than that intended for application. A number of factors influence spray drift including weather conditions, topography, the crop or area being sprayed, and application equipment and methods.

Pesticides are both suspected and known for causing immediate and delayed-onset health hazards for humans. If exposed to pesticides, humans may experience adverse effects, such as nausea, respiratory distress, or more severe symptoms up to and including death. Animals and birds impacted by pesticides can experience similar illnesses or develop other types of physical distress.

Pollution Prevention/Waste Minimization Opportunities in Crop Production, Greenhouses/Nurseries, and Forestry

The best way to reduce pollution is to prevent it in the first place. Industries have creatively implemented pollution prevention techniques that improve operations and increase profits while minimizing environmental impacts. This can be done in many ways such as reducing material inputs, reusing byproducts, improving management practices, and employing substitute toxic chemicals.

To encourage these approaches, this section provides general descriptions of some pollution prevention advances that have been implemented within the agricultural production industries for crops, greenhouses/nurseries, and forestry. While the list is not exhaustive, it does provide core information that can be used as the starting point for establishments interested in beginning their own pollution prevention projects. This section provides information from real activities that may be or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land, and water pollutant releases.

The use of pollution prevention technologies and environmental controls can substantially reduce the volume and concentration of the contaminants released/discharged into the surrounding environment. In some cases, these pollution prevention approaches may be economically beneficial to the agricultural production industries because they decrease the amount of chemicals needed, and therefore the cost of maintaining operations.

Waste minimization generally encompasses any source reduction or recycling that results in either the reduction of total volume or the toxicity of hazardous waste. Source reduction is a reduction of waste generation at the source, usually within a process. Source reduction can include process modifications, feedstock (raw material) substitution, housekeeping and management processes, and increases in efficiency of machinery and equipment. Source reduction includes any activity that reduces the amount of waste that exits a process. Recycling refers to the use or reuse of a waste as an effective substitute for a commercial product or as an ingredient or feedstock in an industrial process.

It should be noted that as individual practices, these pollution prevention and waste minimization practices can significantly reduce the environmental impacts of agricultural operations. However, to get the full effect of the practices and maximize pollution prevention potential, an agricultural operation must consider its individual practices in the context of a system. The practices, ranging from preparing the soil for planting to harvest and post-harvest activities, combine to form an integrated system in which each practice interacts with the others and is affected by the others. That is, outputs from one practice may be inputs into one of the other practices, in effect creating a closed-loop system that both maximizes profits and minimizes environmental impacts. By considering their establishments as systems, operators will be better able to evaluate and implement pollution prevention or waste minimization opportunities.

III.A. Crop Production: Operations, Impacts, and Pollution Prevention Opportunities

The production of crops generally includes the following activities:

- Preparing the site/soil for crops
- Planting/tending crops
- Applying and storing nutrients
- Pest control
- Irrigating crops
- Harvesting crops and post-harvesting activities
- Crop field residue destruction
- Maintaining equipment and vehicles
- Fuel use and fueling activities
- Maintaining the site

The additional activities of planning and management are required for all of the above processes to occur. Exhibit 20 presents the raw material inputs and pollution outputs from each of these processes.

Exhibit 20. Crop Production Activities, Raw Material Inputs, and Potential Pollution Outputs

Activity	Raw Material Input	Potential Pollution Output
Preparing the site/soil, including tilling, drainage and erosion control structures, and adjusting soil pH	– Mulch, seeds, and water – Alkaline material – Water	– Air emissions (e.g., smoke and dust) – Sediment, nutrient and pesticide runoff from soil erosion – Spilled material or excessively applied material
Planting/tending	– Seed, seedlings	– Air emissions (e.g., dust, emissions from planting equipment) – Sediment, nutrient, pesticide runoff from soil erosion – Plants, branches, leaves, etc.
Applying and storing nutrients (e.g., fertilizers, manure, biosolids)	– Organic nutrients – Chemicals – Water	– Runoff and leaching of unused or misapplied nutrients – Chemical air emissions – Odor
Applying pesticides and pest control	– Pesticides (including insecticides, rodenticides, fungicides, and herbicides)	– Runoff and leaching of unused or misapplied pesticides – Chemical air emissions
Irrigating (not including nutrient application)	– Water – Chemicals	– Air emissions – Potential runoff and leaching of materials (e.g., manure, chemicals, pesticides) from saturated areas
Harvesting/post-harvesting activities, including harvesting; washing, processing, packaging, loading, and transporting products; and destroying crop residue	– Water – Corrugated cardboard – Paper – Plastic and fabric packaging materials	– Unusable or spilled products – Worker exposure to pesticides – Organic- and pesticide-contaminated wastewater – Discarded packaging materials

Exhibit 20. Crop Production Activities, Raw Material Inputs, and Potential Pollution Outputs

Activity	Raw Material Input	Potential Pollution Output
Maintaining and repairing agricultural machinery and vehicles	– Oil – Lubricating fluid – Fuel – Coolants – Solvents – Tires – Batteries – Equipment parts	– Used oil – Spent fluids – Spent batteries – Metal machining wastes – Spent organic solvents – Tires – Air, surface water, and soil pollution resulting from spills and/or releases of fluids – Groundwater pollution resulting from spills or releases of fluids and discharges to Class V wells
Fuel use and fueling activities	– Fuel	– Air emissions from machinery – Air, water, soil, and groundwater pollution resulting from spills
Maintaining the site:		
(1) Providing water, including drinking water and water used for personal hygiene	– Water	– Contaminated water supply
(2) Managing PCBs (i.e., PCBs in generators and equipment)	– PCB-containing oils and equipment	– Spills or releases of PCBs
(3) Renovation/demolition	– Asbestos – Lead	– Airborne asbestos fibers – Lead-based paint, dust, and chips – Soil contamination

III.A.1. Preparing the Site/Soil for Crops

Prior to planting crops, the site/soil must be prepared. Site/soil preparation can involve tilling the soil or chemical cultivation, building drainage and erosion control structures, and adjusting soil pH.

Preparing the Soil by Tilling or Chemical Cultivation

Tilling aerates the soil, allows seeds/seedlings to be placed in the soil, and helps roots take hold of the soil. It also improves drainage and allows for better assimilation of nutrients and pesticides into the soil. Tillage methods generally consist of intensive/conventional, reduced tillage, and conservation tillage. The difference in the tillage methods is the amount of soil disturbed and the amount of crop residue allowed to remain during the current planting.

- Intensive/conventional tillage is sometimes conducted in two phases – primary tillage with a moldboard plow followed by secondary tillage with a power tiller or disc harrow. Intensive/conventional tillage can range from complete tillage of the entire field to tillage that allows 15 percent of the crop residue to remain.

- Reduced tillage consists of disturbing from 15 to 30 percent of the soil and crop residue.

- Conservation tillage methods are designed to reduce the loss of soil erosion caused by wind and water. Conservation tillage methods allow 30 percent or more of the soil and crop residue to remain undisturbed and thus reduce soil erosion by water and/or maintain at least 1,000 pounds per acre of flat, small grain residue to reduce soil erosion by wind. Common conservation tillage methods are no-till, strip-till, ridge-till, and mulch till.

  - No-till has minimal soil disturbance since the seed is planted with essentially no tillage of the soil and no disturbance of the crop residue.

  - Strip-till involves tillage of a narrow strip of soil and planting of the seed or seedling in that tilled area.

  - Ridge-till methods disturb a narrow strip of soil that was created during previous cultivation. The crop is planted on the ridge and the crop residue remains between each ridge.

  - Mulch-till involves disturbing the entire soil surface and then applying a crop protection product and/or cultivation[2].

In addition to tilling, soil may be prepared for planting by chemical cultivation. Chemical cultivation includes the application of a systematic herbicide to kill weeds and grasses.

[2] 1998 Crop Residual Management Survey Executive Summary, Top 10 Conservation Tillage Benefits, Conservation Tillage Information Center.

Potential Pollution Outputs and Environmental Impacts

The primary pollution output from preparing soil for planting is soil erosion. Erosion can reduce the productivity of the soil and increase the need for additional fertilizer and other inputs. Sediments and other pollutants (e.g., nutrients, pesticides) that are transported offsite may eventually enter surface waters, settle out, and cause degradation of the water quality. When it settles, the sediments fill interstitial spaces in lake bottoms or streambeds. They can eliminate essential habitat, cover food sources and spawning sites, smother bottom-dwelling organisms, and be detrimental to many species of fish. Sediment deposition also reduces the capacity of stream channels to carry water and of reservoirs to hold water. This decreased flow and storage capacity can lead to increased flooding and decreased water supplies.

Sediments can also be suspended in surface waters, which causes increased water turbidity. Water turbidity limits the depth to which light can penetrate and adversely affecting aquatic vegetation photosynthesis. Suspended sediments can also damage the gills of some fish species, causing them to suffocate. Turbid waters tend to have higher temperatures and lower dissolved oxygen concentrations. Decreased dissolved oxygen levels can kill aquatic vegetation, fish, and benthic invertebrates.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention opportunities arise from the use of reduced or conservation tillage methods, which reduce soil erosion and maintain the existing soil structure (the way the soil particles clump together into larger, almost crystalline, units). Advantages of conservation tillage include:

- ✓ Greater water retention/reduced water usage and energy used for pumping (by increasing the water retention capacity of irrigated soils, there may be opportunities to lengthen periods between irrigation events, thereby saving energy that would otherwise have been used for pumping irrigation water).
- ✓ Reduced erosion of sediment and runoff of nutrients.
- ✓ Reduced fuel use due to reduced equipment use.
- ✓ Reduced wind erosion resulting in less dust.

✓ Shading which reduces weed growth and subsequent herbicide use. The effectiveness of shading is dependent on the type of crop and distance between plants.

✓ Prevention of the growth of some molds that have a much lower overwinter survival if not incorporated into the soil.

✓ Crop residues left undisturbed provide habitats for many beneficial insects and spiders that help control crop predators (e.g., cereal leaf beetle), thereby reducing the need for insecticides. In addition, crop residues help speed the decomposition process and aid plant nutrient cycling.

One possible disadvantage of conservation tillage methods is the carryover of pests (e.g., weeds, diseases, and some insects) in the crop residue. This may result in a subsequent increased use of pesticides and increased level of pesticides in runoff.

Building Drainage and Erosion Control Structures

Erosion control practices are necessary for agricultural operations to control runoff and reduce the amount of soil erosion caused by that runoff. In areas with good drainage, crops are better able to use nutrients and chemicals and will benefit from these optimum growing conditions. When building erosion control structures, newly-graded soil surfaces may be stabilized with mulch prior to the establishment of a vegetative cover.

To establish good drainage, one or a combination of drainage and erosion control structures can be built and used depending on the site characteristics (e.g., slope, crop type, or climate). These structures include:

- *Diversions*. Diversions are vegetated channels across the slope that intercept surface runoff and redirect it along a gradient to a controlled outlet. Diversions can reduce the amount of soil/sediment and related pollutants delivered to surface waters.

- *Grassed waterways*. Grassed waterways, which are shaped or graded to specified dimensions, are used for the stable conveyance of runoff. Grassed waterways can reduce soil erosion in areas, such as gullies or ephemeral gullies, with concentrated flows.

- *Water and sediment control basins*. Water and sediment control basins are constructed to collect and store debris or sediment. They detain runoff, allowing the sediment to settle out in the basin before the water is discharged to a waterway.

- *Filter strips.* Filter strips are vegetated areas that are used to trap sediment, organic matter, and other pollutants that are carried in runoff. While filter strips require frequent maintenance and have relatively short service lives, they are generally effective in removing pollutants when a shallow sheet flow is passed through the vegetated areas.

- *Riparian buffers.* Herbaceous or forest riparian buffers are areas of grasses, shrubs, or trees placed upgrade from waterways and water bodies. These buffers prevent or minimize damage to surface waters by containing eroded sediment, chemicals, nutrients, and organics. In addition, buffers reduce the amount of these pollutants that leach into shallow groundwater.

- *Terracing and contouring.* Terracing and contouring are practices that both use sloped surfaces to reduce or control soil erosion. Terracing involves shaping an area so that it is sloped, and contouring involves moving soil in an area so that it is sloped.

- *Drainage tiles.* Surface and subsurface drainage tiles are often used to remove standing water from fields and direct them to more structured erosion control measures.

Potential Pollution Outputs and Environmental Impacts
As described above for tilling, soil erosion and its impact to surface waters is a significant environmental concern and the primary pollution from building drainage structures. Wetlands, the interface between terrestrial and aquatic systems, are particularly susceptible to impacts from runoff and soil erosion. Such impacts include damage to watershed hydrology and water quality, and the habitat for many animal and plant species.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention opportunities of drainage and erosion control structures are the minimization of soil erosion and the reduction of runoff which transports nutrients, sediments, and pesticides to the environment.

R0074297

Drainage and erosion controls can reduce the amount of sediment that is transported offsite in runoff. Any of the drainage and erosion control structures described above can be used to reduce soil erosion and transport. Additional examples of erosion control structures or activities include: field borders; grade stabilization structures; sediment retention ponds; reestablished wetlands; immediate seeding, mulch/mats, and sodding to stabilize exposed soil surfaces; wind erosion controls; and scheduled grading and shaping (e.g., construction of diversions) during dry weather.

> Preventing or controlling erosion is based on two main concepts: (1) disturb the smallest area of land possible for the shortest period of time, and (2) stabilize the disturbed soils to prevent erosion from occurring.

Adjusting the Soil pH

Adjusting the soil pH helps ensure the soil contains the proper characteristics to maximize crop production. Many crop producers add materials to soil to achieve a soil pH that maximizes crop production. Typically, alkaline materials, such as lime, lime sulfur, caustic soda, caustic potash, soda ash, magnesia, and dolomitic lime, are added to increase the pH in acidic soils.

Potential Pollution Outputs and Environmental Impacts
The adjustment of soil pH typically results in little to no pollution outputs and generally has little to no environmental impacts. However, impacts to surface waters could occur if spilled or misapplied alkaline materials are carried in runoff.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention opportunities for this activity include properly storing the materials used to adjust pH to minimize spills, and applying these materials in a manner that minimizes runoff.

III.A.2. Planting/Tending Crops

Planting involves the placement of seeds or seedlings into the soil. This activity can be conducted either by hand (in small operations) or mechanically. Tending the product involves any post-planting activities designed to maximize crop production at harvest. Tending may involve hand labor (e.g., hoeing or pruning) or machine labor.

R0074298

Potential Pollution Outputs and Environmental Impacts
Pollution outputs from planting crops include air emissions, particularly dust, and wastes such as seed bags. The planting process is often combined with other operations, such as tilling or fertilizer/pesticide application, which can pollute surface waters and groundwater from runoff and leaching, respectively. Tending activities that disturb the soil may result in soil erosion, the impacts of which are similar to those previously discussed under tilling. Tending may also produce wastes (e.g., plant branches or other parts).

Pollution Prevention/Waste Minimization Opportunities
Air emissions from planting activities can be minimized by properly maintaining farm machinery. Sections III.A.7 details how to operate and maintain farm vehicles and machinery in an environmentally responsible manner.

By buying seeds in greater bulk, farms can reduce the volume of seed bags that must be disposed of. Also, certain innovative methods of collecting and dispersing seeds are now available that eliminate the need for bags.

III.A.3. Applying Nutrients to Crops

During various phases of crop production, nutrients such as nitrogen, phosphorus, potassium, and other nutrients are applied to crops to enhance crop growth. Nutrient use has been encouraged by the adoption of high-yielding seeds that are more responsive to nutrient application. Therefore, nearly all acres planted with crops are treated with one or more sources of nutrients, such as fertilizers, manure, and/or biosolids.

Nutrients are applied directly to plants or the soil surface, incorporated or injected into the soil, or applied with irrigation water. Nutrient application methods are mechanically intensive, requiring coverage of vast areas. Fertilizers may be solids, liquids, or gasses and, depending on the state of the product, may be applied using specialized trucks, tractors pulling sprayer equipment, or pressurized tanks to apply anhydrous ammonia. Techniques used to apply fertilizer include:

- *Band placement* is used to locate the fertilizer in an optimum position relative to the seed. This increases the potential for full utilization of the fertilizer by the crop and minimizes salt injury to the developing roots.

R0074299

- *Broadcast application* refers to the practice of distributing the product uniformly over the soil surface. This method is preferred for lawns and forage and pasture crops and is the most common method used for crops. Tractors, airplanes, and helicopters are all used to broadcast fertilizers.

- *Manure injection* refers to the application of anhydrous ammonia. At normal pressure, anhydrous ammonia (NH_3) is a gas. For application as a fertilizer, it is pressurized to form a liquid. Because it is a volatile liquid, it is incorporated into the soil as a liquid under pressure to a depth of 15 to 25 cm. In the soil, NH_3 is converted to NH_4^+, which is stable. Gaseous ammonia is lost if soil pH increases much above 7, or as moisture fluctuates from field capacity. Liquid manure may be subsurface injected.

- *Addition of fertilizer to irrigation water (i.e., fertigation)* is a common practice in some areas and is usually part of a drip irrigation system that can apply water and fertilizer to a precise predetermined location.

- *Manure and biosolids* may be applied to the soil surface as a solid from a tractor-pulled box-type manure spreader as it makes passes across the field. Slurry manure and biosolids are generally applied to the soil surface by tractor-pulled or truck flail spreaders or to the subsurface by tractor or truck injection equipment. Liquid manure may be surface irrigated or subsurface injected. Manure and biosolid solids and slurries may be mechanically incorporated into the soil following application.

Potential Pollution Outputs and Environmental Impacts

There are several potential pollution outputs and environmental impacts from nutrient application and spills including runoff and leaching of nutrients which can contaminate surface water and groundwater; air emissions; and increases in the amount of soluble salts in soils. Runoff and leaching of nutrients typically occur when nutrients are applied excessively or improperly. Excessive amounts of soluble salts in the soil can prevent or delay seed germination, kill or seriously retard plant growth, and possibly render soils and groundwater unusable.

The degree of environmental impacts can depend on the application method. The surface application of fertilizer, manure, or biosolids is more likely to result in runoff than injection. Non-composted surface-applied manure will volatilize and release ammonia to the air. Spills of nutrients may also negatively impact the environment since they will be concentrated in one specific area.

Pollution Prevention/Waste Minimization Opportunities
There are several pollution prevention techniques that can be used to reduce pollution and impacts from nutrient application. These include:

✓ Application methods that prevent runoff (e.g., application by injection).

✓ Restricting application in close proximity to surface waters.

✓ Applying nutrients at agronomic (scientifically determined) rates to crops/cropland.

✓ Managing the site to eliminate erosion or reduce the runoff potential.

✓ Developing and implementing **nutrient management plans**. The primary purpose of nutrient management is to achieve the level of nutrients (e.g., nitrogen and phosphorus) required to grow the planned crop by balancing the nutrients that are already in the soil with those from other sources (e.g., manure, biosolids, commercial fertilizers) that will be applied. At a minimum, nutrient management can help prevent the application of nutrients at rates that will exceed the capacity of the soil and the planned crops to assimilate nutrients and prevent pollution.

A site-specific nutrient management plan should be developed prior to planting, reviewed annually, and updated as needed. The plan, which will direct the application of one or more nutrients to the cropland, may include:

- Soil and field maps that show setbacks and buffers, as well as wetland and groundwater maps.
- Crops and rotations.
- Soil tests.
- The calculated nutrient loading for each field.

Additional plan components may consist of manure and biosolid test results; projected manure production, storage, and treatment; commercial fertilizer needs; application rates; and the method and timing of application.

Soils, manure, and wastewater should be tested to determine nutrient content. Retesting should be completed following each significant change in the manure/biosolids source or manure waste management system.

✓ **Precision farming.** One of the more advanced technologies for improving nutrient application efficiency is known as precision farming. Typically used by larger operations, precision farming allows farmers to know their location in the field via a Global Positioning System (GPS) so that applications can be made according to a predetermined rate for that specific location. Precision farming may result in more precise applications of nutrients so there is little or no excess leached to groundwater or washed to surface waters.

III.A.4. Applying Pesticides and Pest Control

Pesticides (e.g., insecticides, herbicides, fungicides) may be applied during all phases of crop production, including during harvesting and post-harvesting activities. For crop production, pesticides prevent insects and other pests, including weeds and other unwanted plants, from harming crops. Pesticide use has been encouraged by continuous cropping, which has created favorable pest habitats in certain crops.

Pesticide application methods for crops are mechanically intensive, requiring coverage of vast areas. Pesticides are applied directly to the plant or soil surface, incorporated into the soil, or injected as a gas through fumigation. One of the most common methods of applying pesticides to crops is liquid spraying. Liquid spraying may be conducted by aircraft, tractor spray rigs, or blasters.

- Aerial methods are the most common application type with about two-thirds of all insecticides and fungicides applied in this manner.

> Citrus groves may be aerially treated 10 to 20 times per season with insecticides, fungicides, and protectant oils.

  - Helicopters are often used because the turbulence from the main rotor tends to push the pesticides down toward the crop.

R0074302

  - Fixed-wing aircraft are more commonly used in crops such as wheat and cotton.

- Tractor spray rigs are often used to apply herbicides in row crops because planting, fertilizing, and spraying can be accomplished in one pass through the field.

- Blasters are used for applying insecticides and fungicides to tree crops.

Other than the Agency's ultra-low volume exemption, concentrated pesticides must be applied according to label directions including any requirement to mix with a diluent or water. The mixing and subsequent loading into the application vehicle must be conducted in a contained area.

Biopesticides. Biopesticides (also known as biological pesticides) are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. At the end of 1998, there were approximately 175 registered biopesticide active ingredients and 700 products. Biopesticides fall into three major classes:

- *Microbial pesticides* contain a microorganism (e.g., a bacterium, fungus, virus, or protozoan) as the active ingredient. These pesticides can kill many different kinds of pests. For example, there are fungi that control weeds, other fungi that control cockroaches, and bacteria that control plant diseases. The most widely used microbial pesticides include various types of the bacterium *Bacillus thuringiensis*, or Bt. Bt acts by producing a protein that kills the larvae of specific insect pests. One kind of Bt can control specific insects in cabbage, potatoes, and other crops, while another type of Bt kills mosquitoes. Based on available information, the bacterium appears to have no adverse effects on humans or the environment. However, additional data are needed to ensure that products containing this bacterium are safe for honey bees, wasps, fish, and aquatic invertebrates.

- *Plant pesticides* are pesticidal substances that plants produce from genetic material that has been added to the plants. For example, scientists can introduce the gene for the Bt pesticidal protein into a plant's genetic material. The plant will then manufacture the substance that destroys the pest. Both the Bt protein and its genetic material are regulated by EPA; the plant itself is not regulated.

- *Biochemical pesticides* are naturally occurring substances that control pests by nontoxic mechanisms. In contrast, conventional pesticides are synthetic materials that usually kill or inactivate the pest. Biochemical pesticides include substances, such as pheromones, that interfere with the growth or mating of a pest. Because it is sometimes difficult to determine whether a natural pesticide controls the pest by a nontoxic mode of action, EPA has established a committee to determine whether a pesticide meets the criteria of a biochemical pesticide.

Some of the advantages of using biopesticides are:

- They are inherently less harmful than conventional pesticides.
- They generally affect only the target pest and closely related organisms.
- They are often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides.

To use biopesticides effectively, users should have a solid understanding of how to manage pests. When used as a component of integrated pest management (IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while still allowing crop yields to remain high.

Potential Pollution Outputs and Environmental Impacts

Environmental impacts most likely result from pesticide applications that are not conducted according to label directions. Potential pollution outputs and environmental impacts from pesticide application may include:

- Runoff or leaching of pesticides to surface water or groundwater. Pesticides incorporated into soil may leach into the groundwater. Soil fumigants will include releases to groundwater through leaching. Pesticides applied through chemigation, in which the pesticide is combined and applied with irrigation water, may be released to surface water through runoff or to groundwater through leaching.
- Air emissions. The application of pesticides using spray systems is more likely to involve releases to air. Soil fumigants will include releases to air through volatilization.

- Spills to soil and surface waters. The impacts of spills may be more significant since the spilled materials will be concentrated in one specific area.

- Potential human exposure and residue levels that exceed tolerance on animals and products. Pesticides are both suspected and known for causing immediate and delayed-onset health hazards for humans. If exposed to pesticides, humans may experience adverse effects, such as nausea, respiratory distress, or more severe symptoms up to and including death. To help reduce this potential exposure, tolerance levels have been established for residues on agricultural products. Animals and birds impacted by pesticides can experience similar illnesses or develop other types of physical distress. Following label directions for application, protective gear, and disposal will help ensure such environmental impacts do not occur.

- Pesticides that are applied to water-saturated soils or highly alkaline soils may not degrade as quickly as those applied properly or with the appropriate pH additive. When pesticides do not degrade, or do not bond with the plant or soil surface, they are more likely to be released to the environment through runoff.

- If not protected with backflow prevention devices, pesticides applied through spray systems that are connected to water supplies can siphon back to the water source and potentially contaminate drinking water systems. Also, improperly cleaned and disposed pesticide containers may cause releases to the soil and/or surface waters.

- Outputs from pesticide applications can inhibit crop production through the resurgence of pests after treatment, occurrence of secondary pest outbreaks, and development of pesticide resistance in target pests. In addition, the control of insects by broad-spectrum insecticides also destroys beneficial insect populations. Populations of many previously innocuous species may then increase rapidly and cause major economic damage.

- Crop losses have occurred when pesticides were applied improperly or drifted from a treated crop to nearby susceptible crops; when excess residues prevent crops from being planted in rotation or inhibit the growth of susceptible crops; and when excessive residues of pesticides accumulate on crops, causing the harvested products to be unmarketable.

Pollution Prevention/Waste Minimization Opportunities
Environmental impacts from pesticides are minimized by following label directions for application, and preventing or minimizing their use wherever possible. Pesticide use accounts for a substantial portion of farm production costs. By reducing their use, agricultural establishments cannot only reduce production costs, but also reduce environmental impacts of their operations.

Pesticide use and impact can also be minimized by using integrated pest management approaches, new technologies, efficient application methods, controls, and basic preventive measures. Examples of these are presented below.

✓ **Integrated pest management (IPM).** IPM is an effective and environmentally sensitive approach to pest management that relies on a combination of common sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

Crop management is a vital part of IPM because it may reduce the concentration of pests. Crop rotation can help prevent disease buildup. Rotation is particularly important when conservation tillage methods are used. For grain crops, other methods include planting of hybrid plants that are resistant to leaf blights and stalk rot, plowing under chopped corn stalks and leaves (which can kill some overwintering disease fungi, but also may promote the growth of others that live below the surface), and maintaining good drainage. An IPM plan should indicate that when a pesticide is needed, and its selection is based on persistence, toxicity, and leaching and runoff potential such that the most environmentally friendly pesticide is used.

✓ **Precision farming.** One of the more advanced technologies for improving nutrient and pesticide application efficiency is known as precision farming. Typically used by larger

R0074306

operations, precision farming allows farmers to know their location in the field via a Global Positioning System (GPS) so that applications can be made according to a predetermined rate for that specific location. Precision farming may result in more precise applications of nutrients and pesticides so there is little or no excess leached to groundwater or washed to surface waters.

✓ **Controlled droplet application (CDA).** CDA produces spray droplets that are relatively uniform in size and allows the applicator to control droplet size. In contrast, conventional spray nozzles produce droplets that vary widely from small droplets that may drift or evaporate before reaching the target, to large droplets that concentrate too much of the pesticide in one spot. CDA improves the efficiency of pesticide application, thus reducing overall pesticide use and cost. In addition, CDA may require less than one gallon of water per acre, compared with 20-30 gallons per acre with most conventional herbicide sprayers. CDA also provides time and fuel savings as well as less soil compaction. (Cornell University, Dr. Russel R. Hahn, *Controlled Droplet Application*)

✓ **Chemigation**. Another method of more efficient pesticide application is chemigation. Chemigation systems are irrigation systems that are designed for chemical application by injection with the irrigation water. The systems provide reduced water pollution by allowing prescription chemical applications to be made. If chemicals are applied frequently and only in amounts required by the irrigated crop, the presence of excessive amounts are avoided, thus preventing leaching from occurring. (University of Florida Cooperative Extension Service, 1993)

✓ **Erosion control devices.** To control pesticide losses to surface water, a farm should control erosion and reduce the volume of runoff water that leaves the field or farm. Practices such as conservation tillage, terraces, strip-cropping, and contouring reduce runoff and control erosion. Sediment basins, farm ponds, and wetlands contain or trap sediments. Keeping the chemicals in the field or trapping them in biologically active areas (e.g., ponds or wetlands) provides the opportunity for microorganisms to degrade the pesticides, eventually rendering them harmless.

✓ **Basic preventive measures**. Waste minimization strategies for pesticides include:

- Buy only the amount needed for a year or a growing season.
- Minimize the amount of product kept in storage.
- Calculate how much diluted pesticide will be needed for a job and mix only that amount.
- Apply pesticides with properly-calibrated equipment.
- Use all pesticides in accordance with label instructions.
- Purchase pesticide products packaged in such a way as to minimize disposal problems.
- Work with the state to locate a pesticide handler who can use the excess pesticide.
- Return unused product to the dealer, formulator, or manufacturer.
- Implement setbacks from wellheads for application and storage.
- Use contact pesticides that do not have to be incorporated into the soil.
- Use row banding application techniques, where appropriate, to limit the amount of pesticide applied.
- If possible, choose nonleachable pesticides labeled for the crop and pest. Nonleachable pesticides are considered those that are less likely to migrate from their target crop.

III.A.5. Irrigating Crops

Irrigation transports water to crops primarily for growth, but also to ease the shock following transplant and to keep the crops cool in arid or excessive heat conditions.

Irrigation has always been a component of crop production and provides many benefits. Over the past 150 years, the practice of irrigation has increased dramatically, increasing the number of farmable acres, producing consistent and often higher yields, and making agriculture possible in areas previously unsuitable for intensive crop production.

In addition to these recognized benefits of irrigation, other factors have contributed to the increase in its use. Investment in equipment to transport water for agricultural use has been stimulated by federal policies. Such policies have included high commodity support prices, tax incentives that include investment credits, and accelerated depreciation for equipment, water depletion allowances, and low interest rates.

In the western United States, irrigation has been encouraged by federal law, which has provided subsidized irrigation water to western growers for nearly a century. As this and other subsidy programs have declined, the number of irrigated acres has decreased. However, in the eastern states that have not received direct water subsidies in the past, the number of irrigated acres is expected to increase.

There are many different irrigation systems, all of which are designed to move water from its source to where it can be used for crop production. Irrigation water is typically obtained from pumping groundwater or surface waters from onsite sources or from offsite sources such as rivers, pipelines, canals and aqueducts that are operated by irrigation districts and private water companies. Irrigation methods may consist of flood, stationary, and traveling systems.

- Flood systems allow the water to gravity sheet flow across the cropland.

- Stationary systems include subsurface drip or trickle systems and aboveground systems, which are permanently piped and may or may not have spray heads.

- Traveling systems may be center pivot, linear-move, hard-hose, or cable-tow. Irrigation systems such as the center pivot and linear-move usually have multiple spray heads (guns). Hard-hose and cable-tow systems usually have a single spray head.

Potential Pollution Outputs and Environmental Impacts
The potential pollution outputs from irrigation include runoff and leachate contaminated with pollutants (e.g., nutrients and pesticides) and salinization. Water depletion is one of the significant environmental impacts of irrigation. Irrigation can deplete surface water supplies, not only from the removal of water from these sources to use for irrigation, but also from the reduced volume of water returning to surface water due to evaporation losses. Irrigation can also deplete groundwater supplies. Water tables have fallen, particularly in drier western states, because of large volumes of groundwater being used for irrigation. Not only has this resulted in less water for agriculture and other uses, it has also resulted in an increase in the cost of water for all users. Land subsidence of up to 10 feet has resulted in some areas because of groundwater withdrawals occurring at rates that exceeded groundwater recharge.

Irrigation contributes to the movement of nutrients and pesticides into surface waters and groundwater, particularly in sandy soils. The impacts of pollutants (e.g., nutrients, pesticides, and sediments) from irrigation-induced runoff are similar to those discussed in Section III.A.1.

Mineralization and salinization of soils are additional impacts of irrigation. Irrigation water, whether from groundwater or surface water sources, has a natural base load of dissolved mineral salts. As the water is consumed by plants or lost to the atmosphere by evaporation, the salts remain and become concentrated in the soil. This is referred to as the "concentrating effect." The total salt load carried by irrigation return flow is the sum of the salt remaining in the applied water plus any salt picked up from the irrigated land. Irrigation return flows provide the means for conveying the salts to the surface water or groundwater supplies. If the amount of salt in the return flow is low in comparison to the total stream flow, water quality may not be degraded to the extent that use is impaired. However, if the process of water diversion for irrigation and the return of salinated water is repeated many times along a surface water, water quality will be progressively degraded for downstream irrigation use as well as for other uses. In the western states, major aquifers have been depleted or destroyed through salinization, or when withdrawals exceeded recharge rates.

Pollution Prevention/Waste Minimization Opportunities
There are several pollution prevention opportunities for irrigating crops. First, minimizing the use of irrigation will reduce erosion,

runoff, groundwater depletion, and salinization. It can also save money by reducing the costs associated with irrigation. Other pollution prevention techniques include:

✓ *Using well-designed irrigation systems.* A common cause of environmental impacts from irrigation is poor system design. Poorly designed systems may apply water nonuniformly, allowing some areas to become oversaturated while others do not receive adequate water. Areas not adequately irrigated may suffer yield or quality reductions, while overirrigated areas may suffer from the leaching of chemicals.

✓ *Using efficient irrigation systems.* There are several types of efficient irrigation systems, including surge irrigation systems and drip irrigation systems.

- With surge irrigation, water is sent through the furrows between each row of crops. Rather than sending all the water at once, small amounts are sent in bursts. In this manner, erosion is reduced, more water reaches the plant, and less runoff of irrigated water occurs.

- In drip irrigation, plants are watered directly from the irrigation source. While drip irrigation conserves water, by watering only the plants' fruits and the soil immediately around them, drip irrigation can also lead to soil erosion. If drip irrigation is the sole method used, the soil between rows of crops remains dry, thus making it more susceptible to wind erosion.

The Texas Agricultural Extension Service has found irrigation efficiency for surge irrigation up to 90 percent and drip irrigation to be up to 98 percent. These systems significantly reduce the amount of irrigation water that can runoff to surface waters, thus reducing pollution. Conventional systems have a much lower efficiency rate. The efficiency of all methods can be improved by varying application volumes as water tables rise and fall.

Calculating Fuel Use Efficiency for Irrigation Pumps

The Texas Agricultural Extension Service has developed a program to determine the efficiency of various irrigation methods. The program calculates a pumping plant's fuel use efficiency performance and compares it to a given standard. The program also calculates the fuel cost per acre-inch pumped and fuel cost savings if a pumping system is brought up to the performance standard. The program can be used to evaluate the pumping performance and fuel cost for the following fuels: (1) electricity, (2) natural gas, (3) diesel, (4) gasoline, (5) propane, and (6) butane.

In addition to well-designed and efficient irrigation systems, there are many inexpensive best management practices that can be used to reduce runoff and erosion, and lower irrigation costs. These methods include the following:

- ✓ Assure all irrigation systems are in good repair, with no leaks, and that the sprinklers are adjusted to minimize misdirected spray.
- ✓ Use low-volume spray heads and stop watering if puddling and runoff is observed.
- ✓ Irrigate early in the morning or in the evening when it is generally less windy and cooler.
- ✓ Utilize efficient irrigation methods such as drip irrigation. Many existing spray systems can be changed to function as drip systems.
- ✓ Install check valves to prevent downhill sprinkler heads from draining after the system has been shut off. This keeps water in the pipes for the next sprinkling. Follow manufacturer's instructions.
- ✓ Install "rainguards" that measure rainfall and stop operation of the irrigation controller during rainfall.
- ✓ If nutrients are irrigated, calculate the discharge rate of the system and irrigate only at desired loading.
- ✓ Replace worn irrigation nozzles (increased orifice size) that may result in over application.

III.A.6. Harvesting Crops and Post-Harvesting Activities

Harvesting crops involves digging, cutting, picking, or other methods of removing the crops from the ground, stalks, vines, or trees. Small fruits and other food crops (e.g., strawberries, melons) are typically harvested by hand, though may be harvested by machine. Field crops (e.g., corn, barley, oats) are typically harvested by machine. For specific crops, such as sugar cane, pre-harvest burning may be conducted to improve access to the crop.

Post-harvesting activities include washing and processes products; packaging, loading, and transporting products; and destroying crop residue (if appropriate).

- *Washing, processing, and packaging products.* Crops may be washed at the agricultural establishment or at the processing plant. Fresh agricultural crops may be washed at the agricultural establishment and then shipped directly to distribution centers or sales outlets. Agricultural crops destined for use as processed foods (e.g., canned fruits and vegetables or snack foods), are likely to undergo extensive washing and processing at the processing plant. Unusable crops can either be picked up manually or separated out from the usable stock after the washing process.

  Following processing, crops are packaged and prepared for delivery to the appropriate customer. Crops such as tobacco require drying during the onsite curing processing. Crops may be packaged using various materials, including corrugated cardboard, paper, and plastic/fabric packaging materials.

- *Loading and transporting products.* While the loading operation will vary between establishments, individually packaged crops (e.g., berries), are commonly loaded by forklift or by hand, while bulk packaged crops (e.g., potatoes and apples) may be loaded by conveyor. Crops are then transported typically by truck or rail to their final destination.

- *Destroying crop residue.* Post-harvest crop residue destruction is a practice used for specific crops, particularly in certain areas of the United States. For example, rice and wheat stubble are often burned in the southeast and northwest respectively after harvest is complete.

R0074313

Potential Pollution Outputs and Environmental Impacts
The potential pollution outputs of harvesting and post-harvesting activities include air emissions from harvesting equipment and crop residue burning; unusable or spilled crop; wastewater potentially contaminated with organic wastes and pesticides from crop washing; wastewater and waste product from processing; and damaged or unusable packaging materials. If discharged to surface waters, wastewater from crop washing can potentially cause BOD contamination. Damaged or unusable packaging and unusable/spilled crop may be managed as solid waste. Hydraulic lifts or conveyors used in the loading process may leak oil, resulting in soil contamination.

Pollution Prevention/Waste Minimization Opportunities
There are several pollution prevention and waste minimization opportunities for harvesting and post-harvesting activities. These include:

✓ *Maintaining harvesting machinery and vehicles*. Section III.A.7. *Maintaining and Repairing Agricultural Machinery and Vehicles* discusses various methods of keeping an environmentally responsible farm vehicle.

✓ *Using unusable product as nutrients*. Unusable products can be washed to remove pesticides and then composted for future use as nutrients. This can prevent the disposal of these products as solid wastes and réduce the amount of commercial fertilizers used.

✓ *Minimizing water use for product washing*. Minimizing the amount of water used for product washing can reduce potential BOD contamination and reduce water costs. There are several types of equipment that can be used to minimize water use including control faucets and sprayers. These faucets and sprayers control the flow of water, using significantly less water than the faucets that supply a continuous flow of water. Other simple techniques to minimize water use include the following:

- Installing a time sequence sprayer that can minimize the amount of water being used.

- Using a high-pressure, low-flow nozzle during cleaning to significantly reduce water use.

- Installing sideboards or splash guards to prevent spillage.

- Shutting the water off during breaks.

✓ *Prevent contamination from oil leaks.* Place catch pans underneath hydraulic lifts or conveyors to collect oil leaks and prevent soil contamination. This oil can then be recycled.

✓ *Prevent product spills.* The use of sideboards on conveyors or other equipment designed to transport products from the ground into the vehicle can be used to prevent product spills. Additionally, catch pans or containers underneath loading areas can be used to collect any unusable products left on the ground. These products can then be composted, if appropriate.

III.A.7. Maintaining and Repairing Agricultural Machinery and Vehicles

Day-to-day maintenance and repair activities keep agricultural machinery and vehicles safe and reliable. Maintenance activities include oil and filter changes, battery replacement, and repairs, including metal machining.

Potential Pollution Outputs and Environmental Impacts

The wastes from maintenance and repair activities can include used oil, spent fluids, spent batteries, metal machining wastes, spent organic solvents, and tires. These wastes have the potential to be released to the environment if not handled properly, stored in secure areas with secondary containment, protected from exposure to weather, and properly disposed of. If released to the environment, the impact of these releases can be contamination of surface waters, groundwater, and soils, as well as toxic releases to the atmosphere. Groundwater pollution can also result from discharges of wastes to Class V wells.

> **Proper Disposal of Oil-Based Fluids.** Spent petroleum-based fluids and solids should be sent to a recycling center whenever possible. Solvents that are hazardous waste must not be mixed with used oil or, under RCRA regulations, the entire mixture may be considered hazardous waste. Non-listed hazardous wastes can be mixed with waste oil, and as long as the resulting mixture is not hazardous, can be handled as waste oil. All used drip pans and containers should be properly labeled.

R0074315

Pollution Prevention/Waste Minimization Opportunities

Preventive maintenance programs can minimize waste generation, increase equipment life, and minimize the probability of significant impacts and accidents. Where the wastes cannot be eliminated, safe handling and recycling can minimize environmental impacts. The following presents pollution prevention/waste minimization opportunities for each type of waste.

Used Oil. The impact of oil changes can be minimized by preventing releases of used oil to the environment, and recycling or reusing used oil whenever possible. Spills can be prevented by using containment around used oil containers, keeping floor drains closed when oil is being drained, and by training employees on spill prevention techniques. Oil that is contained rather than released can be recycled, thus saving the farm money, and protecting the environment.

Recycling used oil requires equipment like a drip table with a used oil collection bucket to collect oil dripping from parts. Drip pans can be placed under machinery and vehicles awaiting repairs to capture any leaking fluids. By using catch pans or buckets, rather than absorbent materials to contain leaks or spills of used oil, the used oil can be more easily recycled. To encourage recycling, the publication "How To Set Up A Local Program To Recycle Used Oil" is available at no cost from the RCRA/Superfund Hotline at 1-800-424-9346 or 1-703-412-9810.

Spent Fluids. Farm machinery and vehicles require regular changing of fluids, including oil, coolant, and others. To minimize releases to the environment, these fluids should be drained and replaced in areas where there are no connections to storm drains or municipal sewers. Minor spills should be cleaned up prior to reaching drains. Used fluid should be collected and stored in separate containers. Fluids can often be recycled. For example, brake fluid, transmission fluid, and gear oil are recyclable. Some liquids are able to be legally mixed with used motor oil which, in turn, can be reclaimed.

During the process of engine maintenance, spills of fluids are likely to occur. The "dry shop" principle encourages spills to be cleaned immediately so that spilled fluid will not evaporate to air, be transported to soil, or be discharged to waterways or sewers. The following techniques help prevent and minimize the impact of spills:

- ✓ Collect leaking or dripping fluids in designated drip pans or containers. Keep all fluids separated so they may be properly recycled.

- ✓ Keep a designated drip pan under the vehicle while unclipping hoses, unscrewing filters, or removing other parts. The drip pan prevents splattering of fluids and keeps chemicals from penetrating the shop floor or outside area where the maintenance is occurring.

- ✓ Immediately transfer used fluids to proper containers. Never leave drip pans or other open containers unattended.

Radiator fluids are often acceptable to antifreeze recyclers. This includes fluids used to flush out radiators during cleaning. Reusing the flushing fluid minimizes waste discharges. If a licensed recycler does not accept the spent flushing fluids, consider changing to another brand of fluid that can be recycled.

Batteries. Farm operators have three options for managing used batteries: recycling through a supplier, recycling directly though a battery reclamation facility, or direct disposal. Most suppliers now accept spent batteries at the time of new battery purchase. While some waste batteries must be handled as hazardous waste, lead acid batteries are not considered hazardous waste as long as they are recycled. In general, recycling batteries may reduce the amount of hazardous waste stored at a farm, and thus reduce the farm's responsibilities under RCRA.

The following best management practices are recommended to prevent used batteries from impacting the environment prior to disposal:

- ✓ Place on pallets and label by battery type (e.g., lead-acid, nickel, and cadmium).

- ✓ Protect them from the weather with a tarp, roof, or other means.

- ✓ Store them on an open rack or in a watertight secondary containment unit to prevent leaks.

- ✓ Inspect them for cracks and leaks as they come to the farm. If a battery is dropped, treat it as if it is cracked. Acid residue from cracked or leaking batteries is likely to be hazardous waste under RCRA because it is likely to demonstrate the characteristic of corrosivity, and may contain lead and other metals.

✓ Neutralize acid spills and dispose of the resulting waste as hazardous if it still exhibits a characteristic of a hazardous waste.

✓ Avoid skin contact with leaking or damaged batteries.

Machine Shop Wastes. The major hazardous wastes from metal machining are waste cutting oils, spent machine coolant, and degreasing solvents. Scrap metal can also be a component of hazardous waste produced at a machine shop. Material substitution and recycling are the two best means to reduce the volume of these wastes.

The preferred method of reducing the amount of waste cutting oils and degreasing solvents is to substitute with water-soluble cutting oils. If non-water-soluble oils must be used, recycling waste cutting oil reduces the potential environmental impact. Machine coolant can be recycled, either by an outside recycler, or through a number of in-house systems. Coolant recycling is most easily implemented when a standardized type of coolant is used throughout the shop. Reuse and recycling of solvents also is easily achieved, although it is generally done by a permitted recycler. Most shops collect scrap metals from machining operations and sell these to metal recyclers. Metal chips which have been removed from the coolant by filtration can be included in the scrap metal collection. Wastes should be carefully segregated to facilitate reuse and recycling.

III.A.8. Fuel Use and Fueling Activities

Fuel is used to operate agricultural machinery, equipment, and vehicles that are used throughout almost every step of crop production, including preparing the site/soil, planting and tending the crops, applying nutrients and pesticides, irrigating and harvesting the crops, and post-harvesting activities. Agricultural machinery and vehicles are typically fueled using an aboveground fueling dispenser that is connected to an aboveground or underground fuel tank.

Potential Pollution Outputs and Environmental Impacts
Agricultural machinery and vehicles that use fuel most likely emit pollutants to the atmosphere. The activity of fueling itself can emit air

R0074318

pollutants, and spills of fuel can cause water, soil and groundwater contamination. Underground fueling systems that are not monitored or maintained properly can leak into the surrounding soils and eventually contaminate groundwater.

Pollution Prevention/Waste Minimization Opportunities
Properly maintaining fuel tanks, lines, and fueling systems can substantially reduce the probability of accidental fuel spills or leaks. All leaking pipe joints, nozzle connections, and any damage to the fueling hose (e.g., kinks, crushing, breaks in the carcass, bulges, blistering, soft spots at the coupling, deep cracks or cuts, spots wet with fuel, or excessive wear) should be fixed immediately to reduce the amount of pollution to the environment. Spill and overflow protection devices can be installed to prevent fuel spills and secondary containment can be used to contain spills or leaks. Additional pollution prevention techniques for fueling include the following:

✓ Inspect fueling equipment daily to ensure that all components are in satisfactory condition. While refueling, check for leaks.

✓ If refueling occurs at night, make sure it is carried out in a well-lighted area.

✓ Never refuel during maintenance as it might provide a source of ignition to fuel vapors.

✓ Do not leave a fuel nozzle unattended during fueling or wedge or tie the nozzle trigger in the open position.

✓ Discourage topping off of fuel tanks.

III.A.9. Maintaining the Facility

Providing Drinking Water

As part of maintaining the physical site, an owner often is responsible for providing and maintaining a safe source of drinking water for those individuals who live or work at the site. Water provided from a surface water supply or groundwater supply may be considered a public water system and, as such, is subject to federal regulations. To be

> A public water system is a system that receives water from a well, river, reservoir, or other sources, and serves piped water to at least 15 service connections or regularly serves an average of 25 people each day for at least 60 days.

R0074319

subject to the Safe Drinking Water Act, the system must meet set criteria such that it is classified as one of the following water systems: community, non-transient non-community, or transient non-community. To ensure the drinking water source, whether surface or groundwater, is not contaminated, the regulations require the owner of the public water system to conduct periodic monitoring and analyses.

Potential Pollution Outputs and Environmental Impacts
Surface water supplies may become contaminated through runoff. Groundwater supplies may become contaminated through a variety of sources, including runoff and leaching, improperly grouted wellheads, improperly constructed or sited wellheads, or faulty onsite septic systems. Potential environmental impacts from contaminated drinking water include a wide variety of health effects for those who ingest it. Depending on the contaminant, the water may cause short-term illnesses and may also lead to long-term health effects.

Pollution Prevention/Waste Minimization Opportunities
The primary concern with drinking water is to ensure it does not become contaminated. The previous sections of this chapter discussed the pollution prevention methods associated with crop production that can help ensure that surface water or groundwater does not become contaminated, and thus result in contaminated drinking water.

Managing Equipment Containing PCBs
Facility maintenance includes managing equipment that may contain PCBs, such as generators, electrical transformers and their bushings, capacitors, reclosers, regulators, electric light ballasts, and oil switches. Facilities must ensure through activities related to the management of PCBs (e.g., inspections, proper storage) that human food or animal feed are not exposed to PCBs.

Potential Pollution Outputs and Environmental Impacts
The potential pollution outputs are spills or leaks of PCB-containing oil from this equipment and hazardous air emissions in the event of an electrical fire. These releases can result in air, water, and soil contamination. While the regulations do not establish a specific distance limit, any item containing PCBs is considered to pose an unacceptable exposure risk to food or feed if PCBs released in any form have the potential to reach/contaminate food or feed.

Pollution Prevention/Waste Minimization Opportunities
There are several techniques that can be used to prevent releases of PCBs to the environment and contamination of food or feed. These

include replacing the PCB-containing equipment; replacing the PCB-containing oil with oil that does not contain PCBs; providing secondary containment of the equipment so that spills cannot contaminate the soil or groundwater; and relocating the equipment to a location that does not present an exposure risk to food or feed. PCB-containing equipment should be inspected regularly for leaks and any deterioration that may cause an electrical fire.

Renovating and Demolishing Structures
Asbestos and lead-based paint may be present in structures that are being renovated or demolished. While EPA banned the use of many asbestos-containing materials in the 1970s, buildings built before this are likely to have asbestos-containing materials. Used as insulation and a fire retardant, asbestos and asbestos-containing materials can be found in a variety of building construction materials, including pipe and furnace insulation materials, asbestos shingles, millboard, textured paint and other coating materials, and floor tiles. It is also found in vehicle brake linings. Lead-based paint can typically be found on the interiors and exteriors of buildings constructed prior to 1978. This is because EPA banned the manufacture and use of lead-based paint and lead-based paint products in 1978.

Potential Pollution Outputs and Environmental Impacts
The renovation and demolition of structures can impact the environment as materials that may have previously been trapped within or on buildings become exposed to the environment. When encapsulated, asbestos fibers do not impact human health or the environment. However, during renovation or demolition, asbestos fibers may be released. If inhaled or ingested, asbestos fibers can cause respiratory damage.

Lead is a known carcinogen through any exposure pathway and may result in significant health effects. As with asbestos, lead-based paint that remains intact and is not chipping or otherwise deteriorating, does not present health problems. However, when it does become damaged, it should be properly removed, contained, and disposed of to prevent exposure. The activity of paint removal has the potential to impact human health and the environment as lead-containing fibers, dust, and paint chips are released. Paint chips and dust can cause indoor air contamination during renovation, and soil contamination from demolition or improper disposal. In addition, lead-based paint chips and dust, if ingested, can create severe, long-term health effects, especially for children.

Pollution Prevention/Waste Minimization Opportunities
The potential impact can be mitigated by assuring any asbestos is encapsulated within the building structure while the building is being used, and properly contained during construction and demolition.

III.B. Greenhouses and Nurseries: Operations, Impacts, and Pollution Prevention Opportunities

This section provides an overview of commonly employed operations and maintenance activities at greenhouses and nurseries. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the major sources pollution outputs and environmental impacts from producing greenhouse and nursery products. General pollution prevention and waste minimization opportunities are also discussed in the context of each operation.

Facilities that are engaged in greenhouse and nursery operations (e.g., horticulture), are responsible for growing and selling greenhouse and nursery products. Many of the activities related to horticulture production are quite similar to those necessary for production of crops. As a result, the material inputs, pollution outputs, and potential environmental impacts are very similar to those discussed throughout Section III.A.

While this section focuses on those activities for operations that fall under NAICS code 0114 (SIC code 018), many of these activities also take place under other parts of NAICS code 011 - Crop Production (SIC code 01). In contrast to food crops, horticultural production may include maintenance of plants and trees for two or more growing seasons. While food crops are harvested to be consumed, horticulture products are often sold live. Furthermore, horticulture production includes activities that take place both indoors and in the open air.

This section describes the following horticultural production activities:

- Preparing soil/growing media for horticulture crops
- Planting horticulture crops
- Applying nutrients to horticulture crops
- Applying pesticides and pest control for horticulture crops
- Irrigating horticulture crops
- Tending and harvesting horticulture crops
- Constructing and maintaining greenhouses
- Transporting products
- Maintaining and repairing equipment

- Fuel use and fueling equipment

Exhibit 21 presents material inputs and pollution outputs from each of these processes.

Exhibit 21. Greenhouse and Nursery Production Activities, Raw Material Inputs, and Pollution Outputs

Activity	Raw Material Input	Pollution Output
Preparing soil/growing media	– Soil, peat, or other synthetic growing media – Lime	– Air emissions (e.g., dust) – Sediment, nutrient, and pesticides runoff from soil erosion
Planting	– Seeds, seedlings	– Air emissions (e.g., dust) – Sediment, nutrient, and pesticide runoff from soil erosion – Plants, branches, leaves, etc.
Applying nutrients	– Organic nutrients – Commercial nutrients – Water	– Runoff and leaching of unused or misapplied nutrients – Chemical air emissions
Applying pesticides and pest control	– Pesticides (including insecticides, rodenticides, fungicides, and herbicides)	– Runoff and leaching of unused or misapplied nutrients – Chemical air emissions
Irrigating (not including nutrient application)	– Water – Chemicals	– Runoff contaminated with sediments, salts, pesticides, and nutrients
Tending and harvesting		– Plant and tree clippings
Constructing and maintaining greenhouses	– Construction materials – Fuel for heating and cooling – Boiler chemicals	– Construction wastes – Air emissions – Storm water runoff from increased impervious area – Spills of boiler chemicals
Packaging, loading, and transporting horticulture crops	– Plastic, burlap or paper packaging materials	– Dead plants – Waste packaging materials

Exhibit 21. Greenhouse and Nursery Production Activities, Raw Material Inputs, and Pollution Outputs

Activity	Raw Material Input	Pollution Output
Maintaining and repairing equipment	– Oil – Lubricating fluids – Fuel – Coolants – Solvents – Tires – Batteries – Equipment parts	– Used oil – Spent fluids – Spent batteries – Metal machining wastes – Spent organic solvents – Tires – Air, water, soil, and groundwater pollution resulting from spilled and/or spent fluids
Fuel use and fueling activities	– Fuel	– Air emissions from machinery – Air, water, soil, and groundwater pollution resulting from spills

III.B.1. Preparing Soil/Growing Media for Horticulture Crops

Prior to planting, the soil or growing media[3] must be prepared for growing horticulture crops. For horticulture crops grown outdoors, soil preparation generally involves tilling and the application of nutrients, primarily commercial fertilizer. Tilling aerates the soil, allows seedlings to be placed in the soil, and helps roots take hold of the soil. It also improves drainage and allows for better assimilation of nutrients (i.e., fertilizers) and pesticides into the soil. For greenhouse crops, proper soil or media preparation is key for fostering plant growth. Due to the relatively shallow depth and limited volume of greenhouse containers, soil must be amended to provide the physical and chemical properties necessary for plant growth.[4] Materials are added to the soil that promote improved aeration, drainage, and water holding capacity. These materials can include peat and peat-like materials, wood residues, rice hulls, sand, vermiculite, calcined clays, expanded polystyrene, urea formaldehydes, and bagasse (a waste byproduct of the sugar industry that is often composted to promote aeration). In addition, soil pH is often

[3] Note that many indoor growing operations use non-soil media consisting of peat moss, compost, lime, and other material, rather than soil in order to provide a more porous growth environment in a relatively small volume container.

[4] *Texas Greenhouse Management Handbook*, Dr. Don Wilkerson, Texas Agricultural Extension Service, http://aggie-horticulture.tamu.edu/greenhouse/guides/green/green.html.

adjusted by adding ground limestone, hydrated lime, or dolomitic lime to suit the plants being grown.[5]

Potential Pollution Outputs and Environmental Impacts

The major environmental impacts of soil/growing media preparation in horticulture operations is runoff that carries pollutants (e.g., soils/growing media, nutrients, pH adjusting agents, pesticides) to groundwater or surface waters.

For outdoor operations, the primary pollution output is runoff contaminated with pollutants (e.g., sediments, nutrients, and pesticides) caused by soil erosion. Soil erosion causes damage both onsite and offsite at horticulture operations. Onsite erosion can reduce the productivity of the operation and increase the need for fertilizer and other inputs. Pollutants (e.g., sediments, nutrients, and pesticides) that are transported offsite by runoff may be deposited in surface waters, leading to reduced oxygen content, increased algae growth, and overall degradation of water quality.

Indoor operations can also be sources of water pollution. Runoff that comes in contact with spills of soil/soil media, improperly managed outdoor bulk soil/media piles, or discharges of floor washdown water can transport sediments and other pollutants to surface waters. Spilled or excessively applied lime also has the potential to contaminate groundwater or surface waters.

Pollution Prevention/Waste Minimization Opportunities

When preparing soil for outdoor operations, runoff can be reduced by planting and maintaining buffer strips of grass and sod. These strips can slow runoff and trap sediment, reducing soil loss and potentially preventing water contamination. Horticulture operations that maintain grass strips between rows of plants or trees have been shown to maintain 30 percent to 50 percent more soil than those that maintain only bare soil.[6]

[5] *Effect of pH on Pesticide Stability and Efficacy,* Winand K. Hock, Penn State University, http://pmep.cce.cornell.edu/facts-slides-self/facts/gen-peapp-ph.html.

[6] *Best Management Practices for Field Production of Nursery Stock*, North Carolina State University Biological and Agricultural Engineering Extension Service, http://www.bae.ncsu.edu/programs/extension/ag-env/nursery/.

R0074325

Unnecessary application of materials that could potentially leach into and pollute nearby water sources can be prevented through frequent soil testing prior to application. Spills can be prevented by assuring the integrity of the containers in which the materials are kept. Containers should be routinely repaired and replaced if perforated.

III.B.2. Planting Horticulture Crops

Horticulture crops are planted after the soil/soil media is prepared. Planting involves the placement of seeds or seedlings into the soil/soil media. Planting is typically done by hand for greenhouse operations, while planting may be done either by hand or mechanically for nursery operations.

Potential Pollution Outputs and Environmental Impacts
The major inputs in planting horticulture crops are the seeds and energy used to plant them. The pollutant outputs include air emissions from any planting equipment.

Pollution Prevention/Waste Minimization Opportunities
Pollution prevention opportunities during the planting process for horticulture operations are similar to those discussed in Section III.A.2.

III.B.3. Applying Nutrients to Horticulture Crops

During all phases of the crop production process, nutrients (e.g., fertilizer, manure, biosolids) can be applied to horticulture crops. Nutrients enhance crop growth by providing essential nitrogen, phosphorus, potassium, and micro-nutrients. Nutrients can be applied directly to the plant or soil surface, incorporated into the soil, or applied with irrigation water through chemigation.

Most greenhouse operations use liquid fertilizers, supplemented by granular or slow release fertilizers which are added to the growing medium. While the frequency of fertilizer application may vary, many operations continuously fertilize through irrigation systems. For outdoor operations, nutrient application is often more mechanically intensive, requiring coverage of large areas. Nearly all acres planted are treated with one or more types of nutrients (e.g., fertilizers, manure, or biosolids). Depending on the timing of the seed planting, the application may occur simultaneously.

For outdoor operations, fertilizers may be applied in solid, liquid, or gas form. Depending on the state of the product, nutrients may be applied using specialized trucks to apply dry product, tractors to pull sprayer equipment for liquids, and pressurized tanks to apply anhydrous ammonia. Techniques used to apply fertilizer include the following:

- *Band placement* is used to locate the fertilizer in an optimum position relative to the seed. This minimizes salt injury to the developing roots.

- *Broadcast application* refers to the practice of distributing the product uniformly over the soil surface. Tractors, airplanes and helicopters are used to broadcast fertilizers.

- *Injection* refers to the application of anhydrous ammonia. At normal pressure, anhydrous ammonia (NH_3) is a gas. For application as a fertilizer, it is pressurized to form a liquid. Because it is a volatile liquid, it is incorporated into the soil as a liquid under pressure to a depth of 15 to 25 cm. In the soil, NH_3 is converted to NH_4^+, which is stable. Gaseous ammonia is lost if soil pH increases much above 7, or as moisture fluctuates from field capacity.

- *Addition of fertilizer to irrigation water* (known as fertigation), is usually part of a drip irrigation system that can apply water and fertilizer to a precise predetermined location.

- *Manure and biosolids* may be applied to the soil surface as a solid from a tractor-pulled box-type manure spreader as it makes passes across the field. Slurry manure and biosolids are generally applied to the soil surface by tractor-pulled or truck flail spreaders or subsurface by tractor or truck injection equipment. Liquid manure may be surface irrigated or subsurface injected. Manure and biosolid solids and slurries may be mechanically incorporated into the soil following application.

Potential Pollution Outputs and Environmental Impacts
There are several potential pollution outputs and environmental impacts from nutrient application and spills including runoff and leaching of improperly or excessively applied nutrients which can contaminate surface water and groundwater; air emissions; and increases in the amount of soluble salts in soils. Excessive amounts of soluble salts in the soil can prevent or delay seed germination, kill or seriously retard plant growth, and possibly render soils and groundwater unusable.

The degree of environmental impacts depends on the application method. The surface application of fertilizer, manure, or biosolids is more likely to result in runoff than injection. Non-composted surface-applied manure will volatilize and release ammonia to the air. Spills of nutrients may also negatively impact the environment since they will be concentrated in one specific area.

Pollution Prevention/Waste Minimization Opportunities
There are several pollution prevention techniques that can be used to reduce pollution and impacts from nutrient application. These include:

- ✓ Application methods that prevent runoff (e.g., application by injection).
- ✓ Restricting application in close proximity to surface waters.
- ✓ Applying nutrients at agronomic rates to crops/cropland.
- ✓ Managing the site to eliminate erosion or reduce the runoff potential.
- ✓ Developing and implementing **nutrient management plans**. The primary purpose of nutrient management is to achieve the level of nutrients (e.g., nitrogen and phosphorus) required to grow the planned crop by balancing the nutrients that are already in the soil with those from other sources (e.g., manure, biosolids, commercial fertilizers) that will be applied. At a minimum, nutrient management can help prevent the application of nutrients at rates that will exceed the capacity of the soil and the planned crops to assimilate nutrients and prevent pollution. More information on nutrient management plans is presented in Section III.A.3.

III.B.4. Applying Pesticides and Pest Control for Horticulture Crops

The pesticides commonly used in horticulture operations include insecticides, fungicides, and herbicides. For large nursery operations, pesticides are often applied through liquid spraying. As described in Section III.A.4., liquid spraying may be conducted by aircraft, tractor spray rigs, or blasters.

- Aerial methods are the most common spray applications, with about two-thirds of all insecticides and fungicides applied in this manner. Trees and shrubs may be aerially treated several times per season with insecticides, fungicides, and protectant oils. Helicopters are often used because the turbulence from the main rotor tends to push the pesticides down toward the plant.

- Tractor spray rigs provide an advantage where horticulture crops are grown in rows because planting, fertilizing and spraying can be accomplished in one pass through the field.

- Blasters can be used for applying insecticides and fungicides to trees.

Potential Pollution Outputs and Environmental Impacts
The potential environmental impacts from pesticide application are runoff or leaching to surface water or groundwater, spills to surface waters, potential human exposure, and soil contamination that could leave land unproductive. These environmental impacts may all occur if pesticides are not applied according to the label directions. Impacts from pesticide application to horticulture crops are similar to those discussed in Section III.A.4.

Pollution Prevention/Waste Minimization Opportunities
As discussed previously in Section III.A.4, the best way to prevent environmental impacts from pesticide use is follow label directions for application and prevent or minimize their use wherever possible. Pesticide use accounts for a significant portion of horticulture production costs. By reducing their use, horticulture operations cannot only reduce production costs, but also reduce environmental impacts from their operations. Pesticide use can be minimized by using integrated pest management approaches, new technologies, efficient application methods, controls, and basic preventive measures. Pollution prevention opportunities for reducing or minimizing impacts from application of pesticides are discussed in Section III.A.4.

III.B.5. Irrigating Horticulture Crops

Irrigation transports water to horticulture crops to nourish the crops, ease the shock to the plants following transplant, and keep the crops cool in arid or excessive heat conditions. There are many different irrigation systems, all of which are designed to move water from its source to where it can be used for crop production. Irrigation water is obtained from onsite groundwater and surface water sources, as well as offsite sources such as rivers, pipelines, canals and aqueducts that are operated by irrigation districts and private water companies.

All greenhouse crops are irrigated on a regular basis (since they are enclosed and do not receive water from rainfall events). Water is generally applied to the upper surface of the soil/growing media by using overhead sprinklers, drip or trickle irrigation systems, hand-held hoses, or a combination of methods. The advantage of drip or trickle systems is that they minimize water use, leaching of nutrients in the growth media, and reduce the probability of root rot in excessively moist soil. Overhead sprinklers and hand water irrigation methods are often less expensive to implement, but use more water per plant.[7]

Potential Pollution Outputs and Environmental Impacts
For indoor operations, the primary pollution outputs are wastewater and runoff that contains nutrients and pesticides. For outdoor horticulture operations, the pollution outputs from irrigation include runoff and leaching of nutrients and pesticides, salinization, and groundwater depletion. The impacts of pollutants (e.g., nutrients, pesticides, and sediments) from irrigation-induced runoff are similar to those discussed in Section III.A.5.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention opportunity for irrigation is the use of irrigation methods which efficiently apply water, thereby reducing water use and the potential for runoff. One efficient application method is drip irrigation. Drip irrigation gradually applies water directly to the soil surface over extended periods of time (i.e., 1, 2, or 5 gallons per hour), resulting in less water loss due to evaporation or runoff. If nutrients are applied using drip irrigation, the amount of fertilizer used can also be reduced if the nutrients are applied at the utilization rate of the plant. In addition to the environmental benefits, drip irrigation tends to cause roots to concentrate within the limited wetted soil area, thus creating a more concentrated root ball. More concentrated root balls make the plants easier to ship and increase their ability to survive through the sale and planting process.[8] Section III.A.5 describes other potential pollution prevention opportunities associated with irrigation.

---

[7] *Texas Greenhouse Management Handbook*, Dr. Don Wilkerson, Texas Agricultural Extension Service, http://aggie-horticulture.tamu.edu/greenhouse/guides/green/green.html.

[8] *Best Management Practices for Field Production of Nursery Stock*, North Carolina State University Biological and Agricultural Engineering Extension Service, http://www.bae.ncsu.edu/programs/extension/ag-env/nursery/.

III.B.6. Tending and Harvesting Horticulture Crops

Horticulture crops must be maintained from planting through the point of sale. Each plant may be tended for one or several growing seasons. Tending horticulture crops involves applying water, nutrients, and pesticides; transplanting crops from small to larger pots or from pots to outside areas; and pruning trees and shrubs to enhance plant health and make them more aesthetically pleasing.

Harvesting of horticulture crops involves digging, cutting, or other methods of safely removing product from the ground, stalks, vines, or trees. Harvesting must be done with care to protect the plant and assure that it remains alive through the point of sale. For flowers, small plants, and greenhouse-grown vegetables, harvesting is generally done manually. For larger trees and shrubs, harvesting may be done by hand or by machine.

Potential Pollution Outputs and Environmental Impacts
The primary pollution outputs from tending and harvesting horticulture crops are plant clippings (e.g., branches, leaves, and flowers) that have been removed during the tending/pruning activities.

Pollution Prevention/Waste Minimization Opportunities
There are several pollution prevention and waste minimization opportunities for tending and harvesting activities. These include:

- *Maintaining harvesting machinery and vehicles*. Section III.A.7. *Maintaining and Repairing Agricultural Machinery and Vehicles* discusses various methods of keeping an environmentally responsible farm vehicle.

- *Composting plant clippings*. Plant clippings can be composted, while tree clippings can be used as drying material to compost the plant clippings. Tree clippings can also be ground as mulch and reused in the fields or greenhouse. By placing wood waste under covered structures or tarps, operators can also reduce the decomposition and leaching from wood waste piles.[9]

[9] *Environmental Guidelines for Greenhouse Growers - Site Planning*, British Columbia Ministry of Agriculture and Food, 1998, http://www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/greenhse/grnhse.htm.

III.B.7. Constructing and Maintaining Greenhouses

Greenhouse construction and design can influence how effectively horticulture crops grow, as well as the operation's ability to minimize environmental impacts. Greenhouse construction includes building the structure and ensuring that it meets the operational requirements of the horticulture operation.

Greenhouse maintenance involves maintaining the structural integrity as well as the appropriate climate conditions. Activities may include operating and maintaining boilers that provide heat during cold weather; operating fans to keep crops and workers cool during warm weather; and general maintenance of the greenhouse itself.

Potential Pollution Outputs and Environmental Impacts
The potential pollutant outputs from greenhouse construction include increased potential for storm water runoff during construction; air emissions from construction equipment; and construction wastes primarily consisting of packaging materials, steel or aluminum parts, and waste concrete. Boilers used for heating greenhouse can produce air emissions and potential spills of boiler chemicals can impact the environment.

Pollution Prevention/Waste Minimization Opportunities
Many pollution prevention opportunities begin at the design and construction stage. Pollution prevention opportunities in greenhouse design include:

✓ Locating storage facilities for fuel, wood waste, fertilizer, or pesticides far away and contained from any watercourse.

✓ Locating well water sites on the highest elevation on the property and as far as possible from areas where fertilizer, pesticides, and petroleum products are stored or handled.

✓ Designing the greenhouse so that it can accommodate efficient drip irrigation systems.

✓ Planning facilities that can separate and disinfect irrigation or wash water so that the water can be reused.

✓ Installing closed systems that minimize or prevent leaching from irrigation systems.

- ✓ Constructing foundations and floors that permit recovery of leachate, such as lined soil zones and concrete floors.
- ✓ Selecting efficient watering systems.
- ✓ For outdoor areas, using well-drained gravel keeping impervious pavement to a minimum.[10]

Implementing these activities in the design and construction stage helps facilitate their implementation throughout the production process.

III.B.8. Packaging, Loading, and Transporting Products

Horticulture crops must be packaged, loaded, and transported by truck or rail to their destinations. Packaging materials may include plastic, burlap, or paper.

Potential Pollution Outputs and Environmental Impacts
The primary pollution outputs include damaged or dead plants and discarded packaging materials, all of which may be managed as solid waste. Hydraulic lifts or conveyors used in the loading process may leak oil, resulting in soil contamination.

Pollution Prevention/Waste Minimization Opportunities
Pollution prevention opportunities for packaging include reducing the volume of packaging used and recycling any waste packaging materials when possible. Pollution prevention ideas for reducing emissions from transport vehicles are similar to those discussed in Section III.A.7.

III.B.9. Maintaining and Repairing Machinery and Vehicles at Greenhouses/Nurseries

Horticulture operations operate and maintain heavy equipment that is used for preparing soil, maintaining the crops, and transporting products for sale. Day-to-day maintenance and repair activities keep machinery and vehicles safe and reliable. Maintenance activities include oil and filter changes, battery replacement, and repairs including metal machining.

[10] *Environmental Guidelines for Greenhouse Growers - Site Planning*, British Columbia Ministry of Agriculture and Food, 1998, http://www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/ gréenhse/grnhse.htm.

Potential Pollution Outputs and Environmental Impacts
The wastes from maintenance and repair activities can include used oil, spent fluids, spent batteries, metal machining wastes, spent organic solvents, and tires. These wastes have the potential to be released to the environment if not handled properly, stored in secure areas with secondary containment, protected from exposure to weather, and properly disposed of. If released to the environment, the impact of these releases can be contamination of surface waters, groundwater, and soils, as well as toxic releases to the atmosphere. Groundwater pollution can also result from discharges of wastes to Class V wells.

Pollution Prevention/Waste Minimization Opportunities
Preventive maintenance programs can minimize waste generation, increase equipment life, and minimize the probability of significant impacts and accidents. Where the wastes cannot be eliminated, safe handling and recycling can minimize environmental impacts. Pollution prevention/waste minimization opportunities for these wastes are similar to those discussed previously in Section III.A.7.

III.B.10. Fuel Use and Fueling Activities at Greenhouses/Nurseries

Fuel is used to operate agricultural machinery, equipment, and vehicles that are used for horticulture crop production, including preparing the site/soil, planting crops, applying nutrients and pesticides, irrigating, and post-harvesting activities. Agricultural machinery and vehicles are typically fueled using an aboveground fueling dispenser that is connected to an aboveground or underground fuel tank.

Potential Pollution Outputs and Environmental Impacts
Agricultural machinery and vehicles that use fuel most likely emit pollutants to the atmosphere. The activity of fueling itself can emit air pollutants, and spills of fuel can cause water, soil and groundwater contamination. Underground fueling systems that are not monitored or maintained properly can leak into the surrounding soils and eventually contaminate groundwater.

Pollution Prevention/Waste Minimization Opportunities
Properly maintaining fuel tanks, lines, and fueling systems can substantially reduce the probability of accidental fuel spills or leaks. All leaking pipe joints, nozzle connections, and any damage to the fueling hose (e.g., kinks, crushing, breaks in the carcass, bulges, blistering, soft spots at the coupling, deep cracks or cuts, spots wet with fuel, or excessive wear) should be fixed immediately to reduce

the amount of pollution to the environment. Spill and overflow protection devices can be installed to prevent fuel spills and secondary containment can be used to contain spills or leaks. Additional pollution prevention techniques to prevent fuel spills and methods to more efficiently refuel are discussed in Section III.A.8.

III.C. Forestry Production Industry: Operations, Impacts, and Pollution Prevention Opportunities

Nearly 500 million acres of forest land are managed for the production of timber in the United States. This section provides an overview of commonly employed operations and maintenance activities in the forestry industry. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the major sources of environmental impacts from forestry. It also presents an overview of pollution prevention and waste minimization opportunities within the industry.

Summary of General Potential Pollution Outputs and Environmental Impacts for the Forestry Production Industry

EPA's National Summary of Water Quality Conditions (1998) lists silviculture nonpoint source pollution as contributing to 7 percent of impaired river miles, 7 percent of impaired acres of lakes, and 3 percent of impaired square miles of estuaries. Forestry activities can contribute to nonpoint source pollution and water quality degradation through erosion, removal of streamside vegetation, destruction of habitat, and the use of pesticides and nutrients, primarily commercial fertilizers. Habitat destruction can impact various animals, including endangered species such as the spotted owl. Eroded forest soils potentially are carried to surface waters where sedimentation occurs and stream life is negatively impacted. The removal of streamside vegetation increases the potential for erosion and also eliminates shading of the waterbody. Turbidity from erosion and reduced shade result in higher water temperatures and lower dissolved oxygen concentration. Pesticides and fertilizers can be carried in runoff to waterbodies affecting water quality.

Summary of General Pollution Prevention/Waste Minimization Opportunities for the Forestry Production Industry

Best management practices applied to forestry operations can be classified as 1) prevention measures as part of planning, policy and management; and 2) reduction measures applied to the land as an integral part of the silvicultural activity. Prevention through management decision involves the incorporation

R0074335

of environmental protection into organizational policy and in the planning, design and scheduling of forestry activities. At this stage, location and design of logging access roads, intermediate activities, harvesting methods, and reforestation decisions should be made to prevent or minimize the aggravation of inherent pollution hazards.

The reduction measures to control erosion and sediment runoff generally utilize some physical, biological, or chemical method or technique. Reduction measures modify and reduce the unavoidable disturbances caused by an activity, for example, revegetation of cleared areas, mulching of roadcuts and fills, and removal of debris from watercourses. Reduction measures also include the construction of berms, rip-rapping, baffles, drop structures, catch basins, cross-drains, and slope stabilization on road sites. Because of the widespread nature of sediment runoff, erosion control measures must be a principal thrust of the water quality management program on each forestry management unit.

In areas where nutrients, pesticides, and other chemicals cause particular problems on surface waters or groundwater, further control measures may be necessary. These measures could relate to the application (timing methods and amount), utilization, and management of fertilizers, pesticides, and fire retardant chemicals. Particular attention should be taken to keep chemicals away from streams. Care must be exercised to ensure that thermal problems are not created in streams by excessive removal of shade canopy. Attention to proper forest management, engineering, and harvesting principles can substantially reduce pollution attributed to forestry.

The following considerations should be part of the pre-harvest planning stage: threatened and endangered species and sensitive habitats, wetland areas, streamside management area/width, cumulative effects analysis, timing of operation (i.e., to avoid moisture), and identification of landslide potential and other high risk areas.

Operations of the Forestry Production Industry

This section describes the following forestry production activities:

- Road construction and use
- Timber harvesting
- Forest Regeneration
- Site preparation
- Prescribed burning
- Application of chemicals

Exhibit 22 presents raw material inputs and pollution outputs from each of these forestry production activities.

Exhibit 22. Forestry Production Activities, Raw Material Inputs, and Pollution Outputs

Activity	Raw Material Input	Pollution Output
Road construction and use	– Fuel and oil used in construction equipment	– Sediment in runoff from soil erosion – Air emissions
Timber harvesting	– Fuel and oil used in harvesting, chipping, loading, and hauling equipment	– Sediment and organic debris in runoff from soil erosion – Thermal pollution – On-site leaks (i.e., hydraulic fluid) – Air emissions
Forest regeneration	– Fuel used in planting equipment – Commercial fertilizers	– Sediment in runoff from soil erosion – Nutrient in runoff from fertilizer application – Air emissions
Site preparation	– Fuel and oil used in mechanical equipment – Chemical herbicides	– Sediment in runoff from soil erosion – Chemicals in runoff from herbicide application – Air emissions
Prescribed burning	– Fuel to start fire	– Sediment in runoff from soil erosion – Air emissions (smoke)
Application of chemicals	– Fertilizers – Pesticides – Water – Fuel used in application equipment	– Chemical air emissions – Runoff contaminated with chemicals

III.C.1. Road Construction and Use

Building the road system to allow for harvesting involves clearing the roadway of trees, grading soil, placing culverts for stream crossings, construction, and surfacing. Following road construction, the forest becomes accessible for the

R0074337

logger to fall the trees and transport them to a landing where they will then be loaded and transported to the mill.

There are several types of roads used in timber harvesting. The cheapest and easiest road is the skid trail which is usually nothing more than a dirt path used by the skidders to get the trees to the landing area. Skid trails must be located outside of the Streamside Management Zone (SMZ) and must use a bridge or culvert of acceptable design to cross perennial or intermittent streams. The road from the landing to the main road is usually better than a skid trail because it must support the trucks that haul the wood to the mill. Some wood product companies build roads designed to last for many years. However, these type of roads are too expensive for most landowners to construct.

Rolling dips, water bars, cross-drains, water turnouts, and culverts are used to control runoff and erosion, and allow vehicles to cross intermittent or perennial streams.

Abandonment of roads, watercourse crossings, and landings must be planned and conducted in a manner that provides for permanent maintenance-free drainage to soil resources; minimizes concentration of runoff, soil erosion, and slope instability; prevents unnecessary damage to soil resources; promotes regeneration and protects the quality and beneficial uses of water.

Potential Pollution Outputs and Environmental Impacts
The primary pollution outputs during road construction and use may include air emissions from road construction equipment and machinery used for harvesting and soil erosion. Roads are considered to be the major source of erosion from forested lands, contributing up to 90 percent of the total sediment production from forestry operations. Erosion potential from roads is accelerated by increasing slope gradients on cut-and-fill slopes, intercepting subsurface water flow, and concentrating overland flow on the road surface and in channels. Roads with steep gradients, deep cut-and-fill sections, poor drainage, erodible soils, and road-stream crossings contribute to most of this sediment load, with road-stream crossings being the most frequent sources of erosion and sediment. Soil loss tends to be greatest during and immediately after road construction because of the unstabilized road bed and disturbance by passage of heavy trucks and equipment.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention methods in road construction and use are designed to reduce erosion of soil and minimize delivery of

sediment to surface waters. Proper road design and construction can prevent road fill and road backslope failure, which can result in mass movements and severe sedimentation. Proper road drainage prevents concentration of water on road surfaces, thereby preventing road saturation that can lead to rutting, road slumping, and channel washout. Proper road drainage during logging operations is especially important because that is the time when erosion is greatly accelerated by continuous road use.

Surface protection of the roadbed and cut-and-fill slopes can:

- ✓ Minimize soil losses during storms.
- ✓ Reduce frost heave erosion production.
- ✓ Restrain downslope movement of soil slumps.
- ✓ Minimize erosion from softened roadbeds.

Although there are many commonly practiced techniques to minimize erosion during the construction process, the most meaningful are related to how well the work is planned, scheduled, and controlled by the road builder and those responsible for determining that work satisfies design requirements and land management resource objectives. Most erosion from road construction occurs within a few years of disturbance. Therefore, erosion control practices that provide immediate results (such as mulching or hay bales) should be applied as soon as possible to minimize potential erosion.

Drainage of the road prism, road fills in stream channels, and road fills on steep slopes are the elements of greatest concern in road management. Roads used for active timber hauling usually require the most maintenance, and mainline roads typically require more maintenance than spur roads. Use of roads during wet or thaw periods can result in a badly rutted surface, impaired drainage, and excessive sediment leading to waterbodies. Inactive roads, not being used for timber hauling, are often overlooked and receive little maintenance.

The following pollution prevention practices can be used for road construction and use:

- ✓ Follow the design developed during preharvest planning to minimize erosion by properly timing and limiting ground disturbance operations.

- ✓ Design skid trail grades to be 15 percent or less. Do not locate and construct roads with fills on slopes greater than 60 percent.

- ✓ Avoid construction during fish egg incubation periods on streams with important spawning areas.

- ✓ Compact the road base at the proper moisture content, surfacing, and grading to give the designed road surface drainage shaping. Compact the fill to minimize erosion and ensure road stability.

- ✓ Use straw bales, straw mulch, grass-seeding, hydromulch, and other erosion control and revegetation techniques to complete the construction project. These methods are used to protect freshly disturbed soils until vegetation can be established.

- ✓ Use turnouts, wing ditches, and dips to disperse runoff and reduce road surface drainage from flowing directly into watercourses.

- ✓ Install surface drainage controls to remove storm water from the roadbed before the flow gains enough volume and velocity to erode the surface. Route discharge from drainage structures onto the forest floor so that water will disperse and infiltrate.

- ✓ Install appropriate sediment control structures to trap suspended sediment transported by runoff and prevent its discharge into the aquatic environment.

- ✓ Revegetate or stabilize disturbed areas, especially at stream crossings.

- ✓ Protect access points to the site that lead from a paved public right-of-way with stone, wood chips, corduroy logs, wooden mats, or other material to prevent soil or mud from being tracked onto the paved road.

- ✓ Construct bridges and install culverts during periods when streamflow is low. Excavation for a bridge or a large culvert should not be performed in flowing water. The water should be diverted around the work site during construction with a cofferdam or stream diversion.

✓ When soil moisture conditions are excessive, promptly suspend earthwork operations and take measures to weatherproof the partially completed work.

✓ Locate burn bays away from water and drainage courses.

✓ Maintain road surfaces by mowing, patching, or resurfacing as necessary. Clear road inlet and outlet ditches, catch basins, and culverts of obstructions. Blade and reshape the road surface to conserve existing surface material to allow normal surface runoff.

III.C.2. Timber Harvesting

Timber harvesting includes felling trees, preparing them by limbing, cutting them into desired lengths, and moving them to a central, accessible location for transport out of the forested area. The timber is removed (skidded or yarded) to a temporary storage site or landing by one of three basic methods: tractor/skidder (on skid trails), groundlead or highlead cable, or various skyline cable methods. Balloons and helicopters are also used to a limited extent in some areas.

The most common methods of harvesting in the United States are clearcutting, shelterwood, selection, and partial cutting.

- *Clearcutting* is the harvesting of all trees in an area in one cut to create a new even-aged stand. The area harvested is large enough to create an open condition. Economically, clearcutting is most efficient for the logger because all trees are removed, and the feller and skidder operator are not continually confronted with avoiding trees spared from harvest. However, because of the large volumes of material per unit area removed during clearcutting, more trips are required by the skidder, causing the greatest disturbance to the forest litter and underlying forest soil of all harvesting systems.

- *In shelterwood harvesting*, a mature stand is removed in a series of cuts. Regeneration of a new stand occurs under the cover of a partial forest canopy. The final harvest cut removes the sheltering canopy and permits the new existing stand to develop in the open as an even-aged stand.

- *Selection harvesting* involves the removal of mature or immature trees either alone or in groups at somewhat regular time intervals from a forest stand. The objective of this harvesting system is the development and maintenance of an uneven-aged stand with trees of different ages or sizes intermingled singly or in groups. Individual (single) tree selection involves the removal of individual trees, while group selection may remove several adjacent trees covering a small fraction of an acre or larger numbers of trees covering areas as large as one or two acres. Group selection is distinguished from clearcutting in that the intent of group selection is ultimately to create a balance of age or size classes in a mosaic of small contiguous groups throughout the forest stand.

Potential Pollution Outputs and Environmental Impacts

The most detrimental effects of harvesting, which include soil disturbance, soil compaction, and direct disturbance of stream channels, are related to the movement of vehicles and machinery in the forest area, and the skidding and loading of trees or logs. These effects can be enhanced or minimized depending on logging operation planning, soil and cover type, slope, and the construction and use of haul roads, skid trails, and landings for access to and movement of logs. Thus, harvesting method used directly affects the amount of erosion, including the amount of sediment and organic debris that are transported into streams from the forest floor.

Harvesting can also increase stream water temperatures (i.e., thermal pollution) due to the removal of the canopy over streams, with the greatest potential impacts occurring in small streams. Temperature is a significant aspect of water quality. In some cases, it may strongly influence dissolved oxygen concentrations and bacterial populations in streams.

As with all harvesting methods, clearcutting can cause irreversible adverse impacts to the environment and can destroy an area's ecological integrity. These impacts include:

- The removal of forest canopy, which destroys the habitat for many rainforest-dependent insects and bacteria.

- The elimination of fish and wildlife species due to soil erosion and habitat loss.

- The destruction of buffer zones which reduce the severity of flooding by absorbing and holding water.

- The removal of forest carbon sinks, leading to global warming through the increased human-induced and natural carbon dioxide build-up in the atmosphere.

- The destruction of aesthetic values and recreational opportunities.

- Increased streamflow from removal of vegetation (resulting in reduction in transpiration and evaporation functions), fish passage barriers (i.e., improperly placed culverts), and cumulative effects within the watershed.

Pollution Prevention/Waste Minimization Opportunities

The primary pollution prevention methods in timber harvesting are designed to minimize sedimentation resulting from the siting and operation of timber harvesting, and to manage petroleum products properly. Logging practices that protect water quality and soil productivity can reduce total mileage of roads and skid trails, lower equipment maintenance costs, and provide better road protection and lower road maintenance. Careful logging can disturb soil surfaces as little as 8 percent, while careless logging practices can disturb soils as much as 40 percent. Higher bulk densities and lower porosity of skid road soils due to compaction by rubber-tired skidders result in reduced soil infiltration capacity and corresponding increases in runoff and erosion.

Locating landings for both groundskidding and cable yarding harvesting systems according to preharvest planning minimizes erosion and sediment delivery to surface waters. However, final siting of landings may need to be adjusted in the field based on site characteristics.

Landings and loading decks can become very compacted and puddled and are therefore a source of runoff and erosion. Practices that prevent or disperse runoff from these areas before the runoff reaches watercourses will minimize sediment delivery to surface waters. Also, any chemicals or petroleum products spilled in harvest areas can be highly mobile, adversely affecting the water quality of nearby surface waters. Appropriate spill prevention and containment procedures are therefore necessary to prevent petroleum products from entering surface waters. Designation of appropriate areas for petroleum storage will also minimize water quality impacts due to spills or leakage.

The following pollution prevention practices can be used during timber harvesting operations.

Harvesting Practices

✓ Harvest trees so that they fall away from watercourses, whenever possible, keeping logging debris from the channel, except where debris placement is specifically prescribed for fish or wildlife habitat.

✓ Any tree accidentally dropped in a waterway should be immediately removed.

Practices for Landings

✓ Landings should be no larger than necessary to safely and efficiently store logs and load trucks.

✓ The slope of landing fills should not exceed 40 percent, and woody or organic debris should not be incorporated into fills.

✓ If landings are to be used during wet periods, protect the surface with a suitable material such as wooden matting or gravel surfacing.

✓ Install drainage structures for the landings such as water bars, culverts, and ditches to avoid sedimentation. Disperse landing drainage over sideslopes. Provide filtration or settling if water is concentrated in a ditch.

✓ Upon completion of harvest, clean up landing, regrade, and revegetate.

✓ Locate landings for cable yarding where slope profiles provide favorable deflection conditions so that the yarding equipment used does not cause yarding corridor gouge or soil plowing, which concentrates drainage or causes slope instability.

Groundskidding Practices

✓ Skid uphill to log landings whenever possible. Skid with ends of logs raised to reduce rutting and gouging.

✓ Skid perpendicular to the slope (along the contour), and avoid skidding on slopes greater than 40 percent.

✓ Avoid skid trail layouts that concentrate runoff into draws, ephemeral drainages, or watercourses.

✓ Suspend groundskidding during wet periods, when excessive rutting and churning of the soil begins, or when runoff from skid trails is turbid and no longer infiltrates within a short distance from the skid trail. Further limitation of groundskidding of logs, or use of cable yarding, may be needed on slopes where there are sensitive soils and/or during wet periods.

✓ Retire skid trails by installing water bars or other erosion control and drainage devices, removing culverts, and revegetating.

Cable Yarding Practices

✓ Use cabling systems or other systems when groundskidding would expose excess mineral soil and induce erosion and sedimentation.

✓ Avoid cable yarding in or across watercourses.

✓ Yard logs uphill rather than downhill.

Petroleum Management Practices

✓ Service equipment where spilled fuel and oil cannot reach watercourses, and drain all petroleum products and radiator water into containers. Dispose of wastes and containers in accordance with proper waste disposal procedures. Waste oil, filters, grease cartridges, and other petroleum-contaminated materials should not be left as refuse in the forest.

- ✓ Take precautions to prevent leakage and spills. Fuel trucks and pickup-mounted fuel tanks must not have leaks.

- ✓ Develop a spill contingency plan that provides for immediate spill containment and cleanup, and notification of proper authorities.

III.C.3. Site Preparation

Site preparation is a management activity designed to increase productivity of a tract by controlling competing vegetation and debris that could slow seedling growth. It includes removal or deadening of unwanted vegetation prior to planting trees. Site preparation is accomplished by conducting prescribed burning, using herbicides, or disking (or otherwise altering) the soil.

Potential Pollution Outputs and Environmental Impacts
The pollution outputs may include air emissions from the machinery used, soil erosion during and after site preparation, and chemicals in runoff. Mechanical site preparation by large tractors that shear, disk, drum-chop, or root-rake a site may result in considerable soil disturbance over large areas and has a high potential to degrade water quality. Site preparation techniques that result in the removal of vegetation and litter cover, soil compaction, exposure or disturbance of the mineral soil, and increased storm flows due to decreased infiltration and percolation, can contribute to increases in stream sediment loads. However, erosion rates decrease over time as vegetative cover grows back. Prescribed burning and herbicides are other methods used to prepare sites that may also have potential negative effects on water quality.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention methods in site preparation are designed to minimize sediment runoff caused by soil-disturbing machinery and chemicals in runoff from herbicide applications.

Leaving the forest floor litter layer intact during site preparation operations for regeneration minimizes mineral soil disturbance and detachment, thereby minimizing erosion and sedimentation. Maintenance of an unbroken litter layer prevents raindrop detachment, maintains infiltration, and slows runoff. Mechanical site preparation can potentially impact water quality in areas that have steep slopes and erodible soils, and where the prepared site is located near a waterbody. Use of mechanical site preparation treatments that expose mineral soils on steep slopes can greatly increase erosion and landslide potential. Alternative methods, such as drum chopping, herbicide application, or prescribed burning, disturb the soil surface less than mechanical practices.

The pollution prevention practices that can be used during site preparation operations include:

✓ Mechanical site preparation should not be applied on slopes greater than 30 percent.

✓ Mechanical site preparation should not be conducted in streamside management areas. Also avoid mechanical site preparation operations during periods of saturated soil conditions that may cause rutting or accelerate soil erosion.

✓ Avoid working downhill or uphill. Always work along the contour. Site preparation often involves soil disturbance and can cause extensive erosion if done in a way that increases runoff potential. Leave strips of undisturbed soil to help catch any runoff on steep slopes.

✓ When moving slash and debris into rows, avoid pulling up topsoil with the debris. Many sites are degraded by the removal of topsoil. Make sure that the dozer operator monitors the operation closely and modifies his/her approach if soil begins to build up in the rows.

✓ Use haystack piling where possible instead of windrows.

✓ Locate windrows and piles away from drainages to prevent movement of materials during high-runoff conditions.

✓ Do not place slash in natural drainages, and remove any slash that accidentally enters drainages.

✓ Provide filter strips of sufficient width to protect drainages that do not have streamside management areas from sedimentation by the 10-year storm event.

III.C.4. Forest Regeneration

Forest regeneration refers to the re-establishment of a forest cover on areas from which trees have been removed by some past occurrence, such as wildfire, timber harvesting, or temporary conversion to some other use than the growing of trees. When trees have been absent from a site for a number of years, regeneration must generally be achieved through seeding and planting. Regeneration of a harvested area includes both the natural regenerative process and man's activities in preparing the site and subsequent planting or seeding. The method of regeneration is determined largely by the silvical characteristics of the tree species involved, site limitations, economic considerations, and the land manager's desire for forest composition. In some plant communities, natural regeneration under any of the harvesting systems may also occur by regrowth from roots or stumps.

Preparation, as well as protection of an area, is sometimes needed for regrowth of a stand. Where site preparation for regrowth is needed, major activities may include (1) debris removal to reduce fire hazard and allow use of equipment for subsequent operations, (2) reduction or removal of brush or shrub cover and undesirable tree species, and (3) cultivation of the soils.

Potential Pollution Outputs and Environmental Impacts
The pollution outputs may include air emissions from machinery used for regeneration, sediment runoff caused by soil-disturbing machinery, and nutrient runoff from fertilizer applications.

When used indiscriminately for site preparation, fire, chemicals, and soil-disturbing machinery increase the potential for erosion and sedimentation and other pollution to occur. The impacts from sediment pollution as well as pollution from nutrients in runoff would be similar to those discussed in Sections III.A.1 and III.A.3, respectively. The time required before such pollution occurs is variable depending upon climatic factors, soil productivity and its influence on the rate of plant growth, the species planted or seeded, and the operational schedule. In some areas, the time span may be a single growing season, while in others, it may cover several years.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention methods in forest regeneration are designed to minimize sediment runoff caused by soil-disturbing machinery and nutrient runoff from fertilizer applications. Regeneration of harvested forest lands not only is important in terms of restocking a valuable resource, but also is important to provide

water quality protection from disturbed soils. Tree roots stabilize disturbed soils by holding the soil in place and aiding soil aggregation, decreasing slope failure potential. The presence of vegetation on disturbed soils also slows storm runoff, which in turn decreases erosion.

Mechanical planting using machines that scrape or plow the soil surface can produce erosion rills, increasing surface runoff and erosion. Natural regeneration, hand planting, and direct seeding minimize soil disturbance, especially on steep slopes with erodible soils. Fertilizers are occasionally introduced into forests to promote growth. Impacts of fertilizer application in forested areas could be significantly reduced by avoiding application techniques that could result in direct deposition into waterbodies and by maintaining a buffer area along the streambank.

The pollution prevention practices that can be used for forest regeneration operations include the following:

✓ Distribute seedlings evenly across the site.

✓ Order seedlings well in advance of planting time to ensure their availability.

✓ Hand plant highly erodible sites, steep slopes, and lands adjacent to stream channels.

✓ Operate planting machines along the contour to avoid ditch formation.

✓ Apply fertilizers during maximum plant uptake periods to minimize leaching. Base fertilizer type and application rate on soil and/or foliar analysis.

✓ For aerial spray applications of chemicals, maintain and mark a buffer area of at least 50 feet (or as specified on the label) around all watercourses and waterbodies to avoid drift or accidental application of chemicals directly to surface water.

III.C.5. Prescribed Burning

Prescribed burning is used to prepare sites for regeneration, reduce uncontrolled fire hazard due to accumulation of litter and undergrowth, control low value hardwoods and unwanted shrub species, improve wildlife habitat, provide disease control, and improve accessibility. Fire is used deliberately under conditions where the area to be burned is predetermined and the intensity of fire is controlled.

Potential Pollution Outputs and Environmental Impacts
The pollution outputs may include air emissions (smoke) from the fire and soil erosion after the prescribed burning. Prescribed burning of slash can increase erosion by eliminating protective cover and altering soil properties. The degree of erosion following a prescribed burn depends on soil erodibility, slope, precipitation timing, precipitation volume and intensity, fire severity, cover remaining on the soil, and speed of revegetation. Burning may also increase storm runoff in areas where all vegetation is killed. Such increases are partially attributable to decreased evapotranspiration rates and reduced canopy interception of precipitation. Erosion resulting from prescribed burning is generally less than that resulting from roads and skid trails and from site preparation that causes intense soil disturbance. However, significant erosion can occur during prescribed burning if the slash being burned is collected or piled, causing soil to be moved and incorporated into the slash. The impacts of erosion and sediment runoff would be similar to those discussed in Section III.A.1.

Air emissions (smoke) from prescribed burning can have adverse effects on smoke sensitive areas such as airports, resorts or recreation areas, schools, hospitals, stock barns and holding pens, etc. Smoke can cause reduced visibility or smoke irritation to livestock and humans which may cause material loss and adverse health effects.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention methods in prescribed burning are designed to minimize sediment runoff caused by removal of surface cover and smoke from fire. Prescribed burning is usually the least expensive method of obtaining several specific goals in forest management. However, it should be planned well in advance to assure success. Aerial photographs can be very helpful. Areas that will benefit most from a prescribed burn should be selected and priorities should be set. High priority will probably be protection of unmerchantable size stands. Burning stands can facilitate regeneration and reduce site preparation costs.

If recommended burning techniques and weather conditions are followed, most prescribed burning will not create smoke problems.

First, land managers should determine if any smoke sensitive areas are near the burn. These are places where reduced visibility or smoke irritation to livestock and humans could cause material loss and adverse health effects. Examples of smoke sensitive areas are: airports, heavily traveled highways, communities, resorts or recreation areas, schools, hospitals, factories, stock barns and holding pens.

Prescribed burning should not be implemented if any sensitive area is within three fourths of a mile downwind of the burn. Different wind direction should be sought in these type of situations. Also, burning should not be conducted if the area already has air pollution or a visibility problem. Burning should be carried out only when the vertical dispersion is good (from fire weather forecast).

The pollution prevention practices that can be used during prescribed burning operations include the following:

- ✓ Carefully plan burning to adhere to weather, time of year, and fuel conditions that will help achieve the desired results and minimize impacts on water quality.
- ✓ Intense prescribed fire for site preparation should not be conducted in the streamside management areas.
- ✓ Piling and burning for slash removal purposes should not be conducted in the streamside management areas.
- ✓ Avoid construction of firelines in the streamside management areas.
- ✓ In prescriptions for burns, avoid conditions requiring extensive blading of firelines by heavy equipment.
- ✓ Use natural or in-place barriers (e.g., roads, streams, lakes, wetlands) as an acceptable way to minimize the need for fireline construction in situations where artificial construction of firelines will result in excessive erosion and sedimentation.
- ✓ Construct firelines in a manner that minimizes erosion and sedimentation and prevents runoff from directly entering watercourses.
- ✓ Revegetate firelines with adapted herbaceous species.

- ✓ Execute the burn with a trained crew and avoid intense burning.

- ✓ Avoid burning on steep slopes with high erosion hazard areas or highly erodible soils.

III.C.6. Application of Chemicals

Chemicals are becoming more and more a part of forestry. Commercial fertilizers are applied to sizeable areas of forests as a means of stimulating growth of new plantations or established stands of trees. Herbicides are used widely for site preparation and stand improvement. Insecticides are used less extensively, but still comprise the major defense against damaging insects in forests.

Potential Pollution Outputs and Environmental Impacts
The potential outputs from application of forest chemicals may include runoff contaminated with chemicals associated with fertilizer and pesticide application, and chemical air emissions. Fertilizer loss may occur when fertilizers are improperly applied during the course of a silvicultural operation. Soluble forms of fertilizers may reach surface or groundwater through runoff, seepage, and/or percolation. Insoluble forms may be adsorbed on soil particles and reach surface water through erosion processes. Nutrients may also reach surface water by direct washoff of slash, debris, and recently applied fertilizer. Excessive nutrients can lead to imbalance in the natural life cycles of water bodies.

Pesticides, when applied during forest management operations, may be insoluble or soluble. Pesticides when applied aerially and in a broadcast manner may directly enter the surface waters. These chemicals then follow approximately the same pattern as nutrients. Pesticides, applied by the above methods, in a manner inconsistent with the label, may result in acute toxicity problems in water bodies.

Pollution Prevention/Waste Minimization Opportunities
The primary pollution prevention methods in operations associated with the application of chemicals are designed to minimize runoff contaminated with chemicals from fertilizer and pesticide application, and chemical air emissions. Nutrient pollution from fertilization on forest lands is controlled by using techniques which avoid direct application to surface waters. Also involved are the elimination of excessive applications, the selection of the proper fertilizer

R0074352

formulation, and the proper timing and method of application. The key factors in the selection of the type of fertilizer and the method of application which are most appropriate for pollution control are local soil nutrient deficiencies, the physical condition of the soil, the plant species requirements, cost factors, weather conditions, access, and topography.

The most common mechanism of pesticide pollution is direct transport by runoff. However, the mechanisms of leaching or subsurface flows may be important in areas of highly porous geologic materials, permeable soils, or high water tables. Practices that control erosion and runoff also reduce loss of applied pesticides. In addition to these practices, a number of other frequently used options exist. These options involve manipulation of the pesticide itself such as form, timing of application, etc. These can be used alone or in conjunction with the erosion and runoff control measures.

The pollution prevention practices that can be used during the application of forest chemicals include the following:

✓ For aerial spray applications, maintain and mark a buffer area of at least 50 feet around all watercourses and waterbodies to avoid drift or accidental application of chemicals directly to surface water. Also use nozzles and spray equipment that will reduce pesticide drift. With broadcast applications, use thickening agents, lower pressures, and larger nozzle sizes to keep the pesticide spray where it is applied.

✓ Apply pesticides and fertilizers during favorable weather conditions.

✓ Always use pesticides in accordance with label instructions, and adhere to all federal and state policies and regulations governing pesticide use. The pesticide label may specify: whether users must be trained and certified in the proper use of the pesticide; allowable use rates; safe handling, storage, and disposal requirements; and whether the pesticide can only be used under the provision of an approved Pesticide State Management Plan. Management measures and practices for pesticides should be consistent with and/or complement those in the approved Pesticide State Management Plans.

- ✓ Locate mixing and loading areas, and clean all mixing and loading equipment thoroughly after each use, in a location where pesticide residues will not enter streams or other waterbodies.
- ✓ Dispose of pesticide wastes and containers according to state and federal laws.
- ✓ Take precautions to prevent leaks and/or spills.
- ✓ Develop a spill contingency plan that provides for immediate spill containment and cleanup, and notification of proper authorities.
- ✓ Apply slow-release fertilizers, when possible.
- ✓ Apply fertilizers during maximum plant uptake periods to minimize leaching.
- ✓ Base fertilizer type and application rate on soil and/or foliar analysis.
- ✓ Consider the use of pesticides as part of an overall program to control pest problems.
- ✓ Base selection of pesticide on site factors and pesticide characteristics.
- ✓ Check all application equipment carefully, particularly for leaking hoses and connections and plugged or worn nozzles. Calibrate spray equipment periodically to achieve uniform pesticide distribution and rate.

IV. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulatory requirements.

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations (CFR) and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute. For specific agricultural information, contact The National Agricultural Compliance Assistance Center at (888) 663-2155 or visit the website at http://www.epa.gov/agriculture.

IV.A. General Description of Major Statutes

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either "toxic" pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and "indirect" dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and 1 territory to administer the NPDES program), contain industry-specific, technology-based and water quality-based limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges
In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR §122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products;

R0074357

SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA § 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands

Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in Section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. EPA's authority under Section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the Section 404 program to the states.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed *through the Ground Water and Drinking Water resource center, at (202) 260-7786.*

Oil Pollution Prevention Regulation
Section 311(b) of the CWA prohibits the discharge of oil, in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of Section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990 Congress passed the Oil Pollution Act which amended Section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. 40 CFR § 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with DPCC plans, required by the state, provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to 1 million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past 5 years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. FRPs that meet EPA's requirements can be combined with U.S. Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA. Superfund, and EPCRA Hotline, at (800) 424-9346. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added Section 6217 (16 U.S.C. § 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The Section 6217 program is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Administration (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under Section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds at http://www.epa.gov/owow or from the Watershed Information Network at http://www.epa.gov/win. The NOAA website at http://www.nos.noaa.gov/ocrm/czm/ also contains additional information on coastal zone management.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is often state/tribe-enforced, since EPA has authorized many states/tribes to administer the program. Currently, EPA shares the UIC permit program responsibility in seven states and completely runs the program in 10 states and on all tribal lands.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1) delineating the source water protection area, (2) conducting a contaminant source inventory, (3) determining the susceptibility of the public water supply to contamination from the inventories sources, and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at http://www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR 262.34) without a permit or interim status.

Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit. Subtitle C permits for treatment, storage, or disposal facilities contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating certain emergency

response activities and for appointing Local Emergency Planning Committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA § 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA § 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA § 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR 302) or an EPCRA extremely hazardous substance.

- **EPCRA § 311 and § 312** requires a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA § 313** requires certain covered facilities, including SIC codes 20 through 39 and others, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under §110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and will become effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (*see* 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of sources that emit any of

188 HAPs, and to develop regulations for these categories of sources. To date, EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996. Methyl bromide, a common pesticide, has been identified as a significant stratospheric ozone depleting chemical. The production and importation of methyl bromide, therefore, is currently being phased out in the United States and internationally. As specified in the Federal Register of June 1, 1999 (Volume 64, Number 104) and in 40 CFR Part 82, methyl bromide production and importation will be reduced from 1991 levels by 25% in 1999, by 50% in 2001, by 70% in 2003, and completely phased out by 2005. Some uses of methyl bromide, such as the production, importation, and consumption of methyl bromide to fumigate commodities entering or leaving the United States or any state (or political subdivision thereof) for purposes of compliance with Animal and Plant Health Inspection Service requirements or with any international, federal, state, or local sanitation or food protection standard, will be exempt from this rule. After 2005, exceptions may also be made for critical agricultural uses. The United States EPA and the United

Nations Environmental Programme have identified alternatives to using methyl bromide in agriculture. Information on methyl bromide phase-out, including alternatives can be found at the EPA Methyl Bromide Phase-Out Web Site: (http://www.epa.gov/docs/ozone/mbr/mbrqa.html).

EPA's Clean Air Technology Center, at (919) 541-0800 and at the Center's homepage at www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996 and at http://www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Hotline, at (800) 535-0202 and at http://www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA §112(r); and information on air toxics can be accessed through the Unified Air Toxics website at http://www.epa.gov/ttn/uatw. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration
Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enforcement authority for facilities/persons that are not in compliance with FIFRA.

Product Registration
Under §3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the United States must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site, i.e., where the product may be used, and the amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process

often requires either the citation or submission of extensive environmental, health and safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under §408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA § 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be requested to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA § 3(c)(2)(B) and § 4.

Use Restrictions
As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration
Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (§ 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions
A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR.163.10 through 163.12). Under the Federal Food,

Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension
EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order that makes the suspension immediately effective.

Imports and Exports
Under FIFRA § 17(a), pesticides not registered in the United States and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified in 40 CFR § 168.65, 168.75, and 168.85.

Under FIFRA §17(c), imported pesticides and devices must comply with United States pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA §17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. United States Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to United States Customs when the shipment arrives in the United States. NOA forms can be obtained from contacts in the EPA Regional Offices or www.epa.gov/oppfead1/international/noalist.htm.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs' homepage at www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture Division at http://es.epa.gov/oeca/main/offices/division/ag.html, or The National Agriculture Compliance Assistance Center toll-free at (888) 663-2155 or http://www.epa.gov/agriculture. Other sources include the National Pesticide Telecommunications Network toll-free at (800) 858-7378 and the National Antimicrobial Information Network toll-free at (800) 447-6349.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA § 6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under § 6 authority are asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs).

Under TSCA § 8(e), EPA requires the producers and importers (and others) of chemicals to report information on a chemicals' production, use, exposure, and risks. Companies producing and importing chemicals can be required to report unpublished health and safety studies on listed chemicals and to collect and record any allegations of adverse reactions or any information indicating that a substance may pose a substantial risk to humans or the environment.

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

IV.B. Industry-Specific Requirements for Agricultural Production Industries: Crops, Greenhouses/Nurseries, and Forestry

The agricultural production industries discussed in this notebook are regulated by several different federal, state, and local agencies. EPA has traditionally relied on delegation to states to meet environmental standards, in many cases without regard to the methods used to achieve certain performance standards. This has resulted in some states with more stringent air, water, and hazardous waste requirements than the federal minimum requirements. This document does not attempt to discuss state standards, but rather highlights relevant federal laws and proposals that affect the agricultural production industries of crops, greenhouses/nurseries, and forestry.

Clean Water Act

Under the CWA, there are five program areas that potentially affect agricultural establishments and businesses. These include: point source discharges, storm water discharges, nonpoint source pollution, wetland regulation, and sludge management. Key provisions addressing each of these areas are summarized below:

- **Point Source Discharges**: The CWA establishes a permitting program known as the NPDES program for "point sources" of pollution. The term "point source" includes facilities from which pollutants are or may be discharged to waters of the United States and is further defined at 40 CFR Part 122. If granted, the permit will place limits and conditions on the proposed discharges based on the performance of available control technologies and on any applicable (more stringent) water quality considerations. Usually the permit also will require specific compliance measures, establish schedules, and specify monitoring and reporting requirements.
  - **Concentrated Animal Feeding Operations (CAFOs):** The CWA defines CAFOs as point sources. Therefore, CAFOs are subject to the NPDES permitting program. See 40 CFR Part

R0074373

122.23 and 40 CFR 122 Appendix B. A CAFO is prohibited from discharging pollutants to waters of the U.S. unless it has obtained an NPDES permit for the discharge.

- Definition of an AFO – An AFO is defined in EPA regulations as a lot or facility where (1) animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and (2) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.
- Definition of a CAFO – CAFOs are a subset of all AFOs. Whether an AFO is a CAFO under the regulations depends on the number of animals confined at the facility. A CAFO is defined as follows:

(1) More than 1,000 AUs are confined at the facility [40 CFR 122, Appendix B (a)]; **OR**

(2) ***From 301 to 1,000 AUs*** are confined at the facility ***and***:

- Pollutants are discharged into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device; or
- Pollutants are discharged directly into waters of the U.S. that originate outside of and pass over, across, or through the facility or come into direct contact with the confined animals. [40 CFR 122, Appendix B (b)] ***OR***

(3) The facility has been **designated as a CAFO** by the permitting authority on a ***case-by-case basis*** [40 CFR 122.23(c)], based on the permitting authority's determination that the operation is a "significant contributor of pollution." In making this determination, the permitting authority considers the following factors:

- Size of the operation;
- Amount of waste reaching waters of the United States;

R0074374

- Location of the operation relative to waters of the U.S.;
- The means of conveyance of animal wastes and process wastewater into waters of the United States;
- The slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of animal wastes and process wastewater into waters of the U.S.; and
- Other relevant factors (e.g.,waste handling and storage, land application timing, methods, rates and areas, etc.).

A permit application shall not be required from a concentrated animal feeding designated under the case-by-case authority until after the Director has conducted an on-site inspection and determined that the operation should and could be regulated under the NPDES permit program.

No animal feeding operation with less than the number of animals set forth in 40 CFR 122, Appendix B shall be designated as a concentrated animal feeding operation unless either (1) pollutants are discharged into waters of the U.S. through a manmade ditch, flushing system, or other similar means, or (2) pollutants are discharged directly into waters of the U.S. which originate outside of the facility and pass over, across, or through the facility, or otherwise come into direct contact with the animals confined in the operation.

The NPDES permit regulations [40 CFR 122, Appendix B] contain an exemption for any AFO from being defined as a CAFO if it discharges

> A 25-year, 24-hour rainfall event means the maximum precipitation event with a probable occurrence of once in 25 years, as defined by the National Weather Service in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments, or equivalent regional or state rainfall probability information developed therefrom [40 CFR Part 412.11(e)]

only in the event of a 25 year, 24-hour, or larger, storm event. To be eligible for an exemption, the facility must demonstrate to the permitting authority that it has not had a discharge. It must also demonstrate that the entire facility is designed, constructed, and operated to contain a storm event of this magnitude in addition to process wastewater. An operation that qualifies for this exemption from being defined as a CAFO may still be designated as a CAFO by the permitting authority on a case-by-case basis.

- **Storm Water Discharges:** Under 40 CFR §122.2, the definition of "point source" excludes agricultural storm water runoff. Thus, such runoff is not subject to the storm water permit application regulations at 40 CFR §122.26. Non-agricultural storm water discharges, however, are regulated if the discharge results from construction over 5 acres or certain other types of industrial activity such as landfills, automobile junk yards, vehicle maintenance facilities, etc.

  – **Concentrated Aquatic Animal Production Facilities:** Under 40 CFR Part 122.24, a *concentrated aquatic animal production facility* is defined and designated as a point source subject to the NPDES permit program.

    ▸ Definition of concentrated aquatic animal production facility (40 CFR Part 122 Appendix C) -- A *concentrated aquatic animal production facility* is a hatchery, fish farm, or other facility that meets one of the following criteria:

    (1) A facility that contains, grows, or holds cold water fish species or other cold water aquatic animals in ponds, raceways, or similar structures which discharge at least 30 days per year. The term does not include (a) facilities which produce less than 9,090 harvest weight kilograms (approximately 20,000 pounds) of aquatic animals per year, and (b) facilities which feed less than 2,272 kilograms (approximately 5,000 pounds) of food during the calendar month of maximum feeding. Cold water aquatic animals include, but are not limited to, the *salmonidae* family (e.g., trout and salmon).

    (2) A facility that contains, grows, or holds warm water fish species or other warm water aquatic animals in

R0074376

ponds, raceways, or similar structures which discharge at least 30 days per year. The term does not include (a) facilities which produce 45,454 harvest weight kilograms (approximately 100,000 pounds) of aquatic animals per year or (b) closed ponds which discharge only during periods of excess runoff. Warm water aquatic animals include, but are not limited to, the *Ameiuridae*, *Centrarchidae*, and *Cyprinidae* families of fish (e.g., respectively catfish, sunfish, and minnows).

Designated facility -- A facility that does not otherwise meet the criteria in 40 CFR Part 122 Appendix C (described above) may be *designated* as a concentrated aquatic animal production facility if EPA or an authorized state determines the production facility is a significant contributor of pollution to waters of the U.S. No permit is required for such a designated facility until the EPA or state officials have conducted an onsite inspection and determined that the facility should be regulated under the NPDES permit program.

- **Aquaculture Projects**: Under 40 CFR Part 122.25(b), *aquaculture* means a defined, managed water area that uses discharges of pollutants to maintain or produce harvestable freshwater, estuarine, or marine plants or animals. Discharges into approved aquaculture projects are not required to meet effluent limitations that might otherwise apply. The entire aquaculture project (discharges into and out of the project) is addressed in an NPDES permit.

- **Exemption for Irrigation Return Flows:** Under 40 CFR Part 122.3(f), return flows from irrigated agriculture do not require NPDES permits.

- **Wastewater Guidelines for Point Source Silviculture Activities:** Under 40 CFR §122.27, silvicultural point sources are subject to the NPDES permit program. Such silviculture point sources include discrete conveyances related to rock crushing, gravel washing, log sorting or log storage facilities operated in connection with silvicultural activities and from which pollutants are discharged into waters of the U.S. The term does not include nonpoint source silviculture activities such as nursery operations, site preparation, reforestation, thinning, prescribed burning, pest and fire control, harvesting operations, surface drainage, or road construction and maintenance from which there is natural runoff.

- **Nonpoint Source Pollution:** Under the CWA §319 Nonpoint Source (NPS) Management Program and 40 CFR §130.6, states (tribes, and territories) establish programs to manage NPS pollution, including runoff and leaching of fertilizers and pesticides, and irrigation return flows. These NPS management programs must identify: (a) best management practices (BMPs) to be used in reducing NPS pollution loadings; (b) programs to be used to assure implementation of BMPs; (c) a schedule for program implementation with specific milestones; and (d) sources of federal or other funding that will be used each year for the support of the state's NPS pollution management program. Congress provides grant funds to the states annually for the administration of these management programs.

- **Discharges to Publicly Owned Treatment Works (POTWs):** Under 40 CFR Part 403, facilities, including agricultural establishments, may discharge certain substances to a POTW if the facility has received prior written permission from the POTW and has completed any required pretreatment. Facilities must check with their POTWs for information about permitted discharges and for conditions and limitations.

- **Discharges of Designated Hazardous Substances.** Under 40 CFR Parts 116-117, facilities, including agricultural establishments, must immediately notify the National Response Center (1-800-424-8802) and their state agency of any unauthorized discharge of a designated hazardous substance into (1) navigable waters, (2) the shorelines of navigable waters, or (3) contiguous zones, IF the quantity discharged in any 24-hour period equals or exceeds the reportable quantity. A *designated hazardous substance* is any chemical listed in Section 311 of the Clean Water Act. The *reportable quantity* is the amount of the hazardous substance that EPA has determined might cause harm. The list of hazardous substances along with each chemical's reportable quantity is found in 40 CFR Parts 116 and 117. Ammonia and several pesticides are on the list.

- **Discharges of Oil.** Under 40 CFR Part 110, facilities must immediately notify EPA's National Response Center (1-800-424-8802) of any unauthorized discharge of a *harmful quantity of oil* (including petroleum, fuel oil, sludge, oil refuse, or oil mixed with other wastes) into (1) navigable waters, (2) the shorelines of navigable waters, or (3) contiguous zones and beyond. A discharge of oil is considered harmful if it violates applicable water quality standards, causes a sludge or emulsion to be deposited under the surface of the water or on adjoining shorelines, or causes a film or sheen on, or discoloration of, the water or adjoining shorelines. In practice, any quantity of oil or a petroleum product is a harmful quantity, since even small amounts will cause a film or sheen on surface water.

– **Oil Spill Prevention Control and Countermeasure (SPCC) Program**: Under 40 CFR Part 112, facilities, including agricultural establishments, must comply with EPA's SPCC program when they store oil at their facility. SPCC requirements apply to non-transportation related onshore and offshore facilities of specified size engaged in storing, processing, refining, transferring or consuming oil products, which due to their location, could potentially discharge oil into waters of the U.S. or adjoining shorelines.

  Facilities must comply with the SPCC program: (1) if they have a single aboveground container with an oil storage capacity of more than 660 gallons, multiple aboveground containers with a combined oil storage capacity of more than 1,320 gallons, or a total underground oil storage capacity of more than 42,000 gallons *and* (2) if there is a reasonable expectation that a discharge (spill, leak, or overfill) from the tank will release harmful quantities of oil into navigable waters or adjoining shorelines. The requirements are triggered by tank capacity, regardless of whether tanks are completely filled.

  Facilities subject to the SPCC requirements must prepare an SPCC plan. This plan must include: (1) *prevention* measures that keep oil releases from occurring, (2) *control* measures installed to prevent oil releases from reaching navigable waters, and (3) *countermeasures* to contain, clean up, and mitigate the effects of any oil release that reaches navigable waters. Each plan must be unique to the facility and must be signed by a registered professional engineer.

- **Wetlands on Agricultural Lands**: Swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes are common names for wetlands. Wetlands provide a habitat for threatened and endangered species as well as a diversity of other plant, wildlife, and fish species. In addition to providing habitat, wetlands serve other functions, including stabilizing shorelines; storing flood waters; filtering sediments, nutrients, and toxic chemicals from water; and providing an area for the recharge and discharge of groundwater. It is important to note that not all wetlands will be obvious to the untrained observer. For example, an area can appear dry during much of the year and still be classified as a wetland. Your local Natural Resources Conservation Service (NRCS) office can help to identify and delineate wetlands on your property.

NRCS, formerly the Soil Conservation Service, is the lead agency for identifying wetlands on *agricultural lands*. According to NRCS, agricultural lands means those lands intensively used and managed for the production of food or fiber to the extent that the natural vegetation has been removed and therefore does not provide reliable indicators of wetland vegetation. Areas that meet this definition may include intensively used and managed cropland, hayland, pastureland, orchards, vineyards, and areas that support wetland crops (e.g., cranberries, taro, watercress, rice). Lands not included in the definition of *agricultural lands* include rangelands, forest lands, woodlots, and tree farms.

- ***Exemption to Section 404 Permit Requirements***. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. The 404 permit program requires a permit for point source discharges of dredged and fill material into waters of the United States. However, many normal established farming activities (e.g., plowing, cultivating, minor drainage, and harvesting), silviculture, and ranching activities that involve discharges of dredged or fill materials into U.S. waters are **exempt from Section 404 permits** and do **NOT** require a permit (33 CFR §323.4). In order to be exempt, the activity must be part of an ongoing operation and cannot be associated with bringing a wetland into agricultural production or converting an agricultural wetland to a non-wetland area.

  If not covered by the above exemption, a permit is required before discharging dredged or fill material into U.S. waters, including most wetlands (33 CFR Part 323). The Army Corps of Engineers (Corps) reviews Section 404 permit applications to determine if a project is the least environmentally damaging and practicable alternative.

- **POTW Sludge Management - Land Application of Biosolids**. Land application is the application of biosolids to land to either condition the soil or fertilize crops or other vegetation grown in the soil. Biosolids are a primarily organic solid product produced by wastewater treatment processes that can be beneficially recycled.

  EPA regulates the land application of biosolids under 40 CFR Part 503. As described in *A Plain English Guide to the EPA Part 503 Biosolids Rule* (EPA/832/R-93-003, September 1994), the Part 503 rule includes general provisions, and requirements for land application, surface disposal, pathogen and vector attraction reduction, and incineration. For each regulated use or disposal practice, a Part 503 standard includes general requirements, pollutant limits, management practices, operational standards, and requirements for the frequency of monitoring, recordkeeping, and reporting. For the most part, the requirements of the Part 503 rule are ***self-implementing*** and must be followed even without the issuance of a permit covering biosolids use or disposal requirements.

- **Total Maximum Daily Load (TMDL) program**. There are still waters in the nation that do not meet the CWA national goal of "fishable, swimmable" despite the fact that nationally required levels of pollution control technology have been implemented by many pollution sources. The TMDL program, established under Section 303(d) of the Clean Water Act, focuses on identifying and allocating pollutant loads to these waterbodies. The goal of a TMDL is the attainment of water quality standards.

  A TMDL identifies the amount a pollutant needs to be reduced to meet water quality standards, allocates pollutant load reductions among pollutant sources in a watershed, and provides the basis for taking actions needed to restore a waterbody. It can identify the need for point source and nonpoint source controls.

  Under this provision, States are required to (1) identify and list waterbodies where State water quality standards are not being met following the application of technology-based point source pollution controls; and (2) establish TMDLs for these waters. EPA must review and approve (or disapprove) State lists and TMDLs. If state actions are not adequate, EPA must prepare lists and TMDLs. TMDLs are to be implemented using existing federal, state, and local authorities and voluntary programs.

TMDLs should address all significant pollutants which cause or threaten to cause waterbody use impairment, including:

- Point sources (e.g., sewage treatment plant discharges)
- Nonpoint sources (e.g., runoff from fields, streets, range, or forest land)
- Naturally occurring sources (e.g., runoff from undisturbed lands)

A TMDL is the sum of the individual wasteload allocations for point sources, load allocations for nonpoint sources and natural background pollutants, and an appropriate margin of safety. TMDLs may address individual pollutants or groups of pollutants, as long as they clearly identify the links between: (1) the waterbody use impairment or threat of concern, (2) the causes of the impairment or threat, and (3) the load reductions or actions needed to remedy or prevent the impairment.

TMDLs may be based on readily available information and studies. In some cases, complex studies or models are needed to understand how pollutants are causing waterbody impairment. In many cases, simple analytical efforts provide an adequate basis for pollutant assessment and implementation planning.

Where inadequate information is available to draw precise links between these factors, TMDLs may be developed through a phased approach. The phased approach enables states to use available information to establish interim targets, begin to implement needed controls and restoration actions, monitor waterbody response to these actions, and plan for TMDL review and revision in the future. Phased approach TMDLs are particularly appropriate to address nonpoint source issues.

Numerous TMDLs are under development in many states and TMDLs are likely to impact agricultural activities by prompting states and stakeholders to mitigate water pollution caused by agricultural sources (assuming agriculture-related industries are identified as significant contributors to water quality impairment).

Coastal Zone Act Reauthorization Amendments of 1990

The Coastal Nonpoint Pollution Control Program, which is implemented under the authority of Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Administration (NOAA).

The Section 6217 program requires the 29 states and territories with NOAA-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. These programs are intended to serve as an update and expansion of existing state programs focused on nonpoint source pollution affecting coastal areas. These submitted programs must include: (1) management measures that are in conformity with applicable federal guidance and (2) state-developed management measures as necessary to achieve and maintain applicable water quality standards.

On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*. The federal guidance specifies management measures for the following agricultural sources: (1) erosion from cropland, (2) confined animal facilities, (3) the application of nutrients to croplands, (4) the application of pesticides to cropland, (5) grazing management, and (6) irrigation of cropland.

Once approved, the programs are implemented through state nonpoint source programs (under CWA §319) and state coastal zone management programs (authorized under §306 of the Coastal Zone Management Act). Agricultural establishments located in coastal states should determine whether their land is included in the state's coastal management area. If so, they must comply with their state's applicable coastal nonpoint programs. Currently, all state coastal nonpoint management programs have been conditionally approved and have begun to be implemented.

Coastal Zone Management Act

The 1996 amendments to the Coastal Zone Management Act that may affect agriculture-related industries include those that relate to aquaculture in the coastal zone. Eligible states may now receive grants for developing a coordinated process among state agencies to regulate and issue permits for aquaculture facilities in the coastal zone. States may also receive grants for adopting procedures and policies to evaluate facilities in the coastal zone that will enable the states to formulate, administer, and implement strategic plans for marine aquaculture. Each state that receives such grants will make its own determination as part of its coastal management plan on how to specifically use the funds. Therefore, persons engaged in aquaculture productivity in the coastal zone may be eligible for technical or financial assistance under their state's plan.

Safe Drinking Water Act

The SDWA, which has been amended twice since 1974, protects the water supply through water quality regulations and source protection, such as

R0074383

underground injection control (UIC) regulations. SDWA requirements apply to all public water systems (PWSs). Currently, 54 of 56 states and territories have been delegated primacy to run the drinking water program.

- **Public Water Systems**. Under 40 CFR Parts 141-143, facilities that operate a PWS or receive water from a PWS and provide treatment to it are subject to SDWA regulations. Prior to 1996, SDWA defined a PWS as "a system for the provision to the public of piped water *for human consumption* if such system has at least 15 service connections or regularly serves at least 25 individuals." The 1996 Amendments expanded the means of delivering water to include not only pipes, but also other constructed conveyances such as ditches and waterways.

  While there are three categories of PWSs, an agricultural establishment will most likely operate a non-transient, non-community system. This type of system serves at least 25 people for over 6 months of the year, but the people generally do not live at the facility. All PWSs must comply with the national primary drinking water regulations (40 CFR 141). Under 40 CFR Part 141 Subpart G, EPA has established drinking water standards for numerous pesticides.

  Establishments that operate a non-transient, non-community system, in general, will need to: (1) monitor for the contaminants the state has established for that type of system, (2) keep records of the monitoring results, (3) report results from all tests and analyses to the state/tribe on a set schedule, (4) take immediate action to correct any violations in the allowable contaminant levels, (5) make a public announcement of any violations to warn people about potential adverse effects and to describe the steps taken to remedy the problem, and (6) keep records of actions taken to correct violations.

- **Comprehensive State Ground Water Protection Program**. Under the SDWA §1429, states/tribes are allowed to establish a Comprehensive State Ground Water Protection Program to protect underground sources of drinking water. Under this program, a state/tribe can require facilities, including agricultural establishments, to use designated best management practices (BMPs) to help prevent contamination of groundwater by nitrates, phosphates, pesticides, microorganisms, or petroleum products. These requirements generally apply only to facilities that are subject to the public water system supervision program. Persons applying pesticides or fertilizers must know the location of all the public water supply source areas in the vicinity that are protected by state/tribal (and sometimes local) requirements.

- **Source Water Protection Program**. Under the SDWA, states are required to develop comprehensive Source Water Assessment Programs (SWAP). The statutorily defined goals for SWAPs are to provide for the protection and benefit of public water systems and for the support of monitoring flexibility. These programs plan to identify the areas that supply public tap water, inventory contaminants and assess water system susceptibility to contamination, and inform the public of the result.

- **Wellhead Protection Program**. Under the SDWA §1428, if a facility, has an onsite water source (e.g., well) that qualifies as a PWS, it must take the steps required by the state/tribe to protect the wellhead from contaminants. A wellhead protection area is the surface and subsurface area surrounding a water well or wellfield supplying a PWS through which contaminants are reasonably likely to move toward and reach such water well or wellfield.

  Since drinking water standards (40 CFR Part 141 Subpart G) exist for numerous pesticides, which may be used in various agriculture-related activities, some state/tribe and local wellhead and source water protection programs restrict the use of agricultural chemicals in designated wellhead protection areas. In addition, persons applying pesticides or fertilizers must know the location of all the public water supply source areas in the vicinity that are protected by state/tribal (and sometimes local) requirements, and the requirements for mixing, loading, and applying agricultural chemicals within any designated wellhead or source water protection areas.

- **Sole Source Aquifer Protection Program**. Under the SDWA §1424 and 40 CFR Part 149 Subpart B, EPA can establish requirements for protecting sole source aquifers. EPA designates an aquifer as a ***sole source aquifer*** if it supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer and no alternative drinking water sources are feasible. The Sole Source Aquifer program prohibits federal financial assistance (any grant, contract, loan guarantee, or otherwise) for any project, including agricultural projects, that may result in contamination to the aquifer and create a hazard to public heath. Currently, only a few aquifers have been designated as protected sole source aquifers.

- **Underground Injection Control (UIC) Program**. The UIC program (40 CFR Parts 144 and 146-148) is a permit program that protects underground sources of drinking water by regulating five classes of injection wells (I - V). *Underground injection* means depositing fluids beneath the surface of the ground by injecting them into a hole (any hole that is deeper than it is wide). *Fluids* means any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.

If a facility disposes of (or formerly disposed of) waste fluids onsite in an injection well, it triggers the UIC requirements. In general, a facility may not inject contaminants into any well if the contaminant could cause a violation of any primary drinking water regulation or endanger an underground source of water if the activity would adversely affect the public health. Most deep well underground injections are prohibited without a UIC permit. No Class I, II, or III injection well may be constructed or opened before a permit has been issued. UIC permits include design, operating, inspection, and monitoring requirements. In many states/tribes, EPA has authorized the state/tribal agency to administer the program.

Class V Wells. Owners/operators of Class V wells (shallow wells that inject fluids above an underground source of water) must not construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation (40 CFR Part 142) or may otherwise adversely affect the health of persons. Examples of Class V wells potentially applicable to agricultural establishments include, but are not limited to:

- Drainage wells, such as agricultural drainage wells, primarily used for storm runoff.

- Cesspools with open bottoms (and sometimes perforated sides) and septic system wells used to inject waste or effluent from multiple dwellings or businesses (the UIC requirements do not apply to single family residential septic system or cesspool wells or to non-residential septic system or cesspool wells that are used solely for the disposal of sanitary wastes and have the capacity to serve fewer than 20 persons per day).

- Dry wells used for waste injection.

- Recharge wells used to replenish aquifers.

- Injection wells associated with the recovery of geothermal energy for heating, aquaculture, and production of electric power.
- Floor drains in maintenance shops/work areas.

> ***Agricultural drainage wells*** typically drain water from low-lying farm land, but some serve to recharge aquifers from which irrigation water is withdrawn. These wells are usually constructed in areas with poor soil drainage, but where underlying geologic formations allow rapid infiltration of water. Sometimes abandoned water supply wells are adapted for use in agricultural drainage. Agricultural drainage wells typically receive field drainage from saturated topsoil and subsoil, and from precipitation, snowmelt, floodwaters, irrigation return flow, and animal feedlots. The types of pollutants injected into these wells include (1) pesticide runoff, (2) nitrate, nitrite, and salts, such as those of calcium, magnesium, sodium, potassium, chloride, sulfate, and carbonate from fertilizer runoff, (3) salts and metals (i.e., iron, lead, cadmium, and mercury) from biosolid sludges and compost, (4) microbes (i.e., bacteria and viruses) from animal waste runoff, and (5) petroleum contaminants, such as fuel and oil, from runoff from roads or equipment maintenance areas.

If a facility has a Class V well, it must furnish inventory information about the well to the appropriate state/tribal agency. If at any time EPA or the state/tribal agency learns that a Class V well may cause a violation of primary drinking water regulations (40 CFR Part 142) or may be otherwise adversely affecting the health of persons, it may require the injector to obtain an individual UIC permit, or order the injector to take such actions (including, where required, closure of the injection well) as may be necessary to prevent the violation.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) was enacted to address problems related to hazardous and solid waste management. RCRA gives EPA the authority to establish a list of solid and hazardous wastes and to establish standards and regulations for the treatment, storage, and disposal of these wastes. Regulations in Subtitle C of RCRA address the identification, generation, transportation, treatment, storage, and disposal of hazardous wastes. These regulations are found in 40 CFR Part 124 and 40 CFR Parts 260-279. Under RCRA, persons who generate waste must determine whether the waste is defined as solid waste or hazardous waste. Solid wastes are considered hazardous wastes if they are listed by EPA as hazardous or if they exhibit characteristics of a hazardous waste: toxicity, ignitability, corrosivity, or reactivity.

Most agriculture-related activities do not generate significant amounts of hazardous waste. Generally, the activities potentially subject to RCRA involve the use of pesticides and fertilizers, and the use and maintenance of different types of machinery.

Hazardous Waste Generator Categories. Facilities that generate hazardous waste can be classified into one of three hazardous waste generator categories as defined in 40 CFR Part 262:

- ***Conditionally exempt small quantity generator (CESQG).*** A facility is classified as a CESQG if it generates no more than 220 lbs (100 kg) of hazardous waste in a calendar month. There is no time limit for accumulating ≤2,200 lbs of hazardous waste onsite. However, CESQGs cannot store more than 2,200 lbs (1,000 kg) of hazardous waste onsite at any time. In addition, CESQGs cannot accumulate onsite more than 2.2 lbs (1 kg) of acutely hazardous waste or more than 220 lbs spill residue from acutely hazardous waste for any period of time.

- ***Small quantity generator (SQG).*** A facility is classified as a SQG if it generates >220 lbs (100 kg) and <2,200 lbs (1,000 kg) of hazardous waste in a calendar month. SQGs can accumulate onsite no more than 13,200 lbs (6,000 kg) of hazardous waste. SQGs can store hazardous waste onsite for up to 180 days (or up to 270 days if the waste treatment/disposal facility is more than 200 miles away).

- ***Large quantity generator (LQG).*** A facility is classified as a LQG if it generates > 2,200 lbs (1,000 kg) of hazardous waste in a calendar month. While there is no limit on the amount of hazardous waste that LQGs can accumulate onsite, they can only store it onsite for up to 90 days.

If a facility is a CESQG and generates ≤2.2 lbs (1 kg) of acutely hazardous waste; or ≤220 lbs (100 kg) of acutely hazardous waste spill residues in a calendar month, and never stores more than that amount for any period of time, it may manage the acutely hazardous waste according to CESQG requirements. If it generates more than 2.2 lbs (1 kg) of acutely hazardous waste or >220 lbs (100 kg) of acutely hazardous waste spill residues in a calendar month, the facility must manage it according to LQG requirements.

The hazardous wastes that must be measured are those: (1) accumulated at the facility for any period of time before disposal or recycling, (2) packaged and transported away from the facility, (3) placed directly into a treatment or disposal unit at the facility, or (4) generated as still bottoms or sludges *and* removed from product storage tanks.

Requirements for CESQGs. Based on the quantity of hazardous waste generated per month, most agricultural establishments will qualify as CESQGs. As CESQGs, facilities must comply with three basic waste management requirements:

(1) Identify all hazardous waste generated.

(2) Do not generate per month more than 220 lbs (100 kg) of hazardous waste; more than 2.2 lbs (1 kg) of acutely hazardous waste; or more than 220 lbs (100 kg) of acutely hazardous waste spill residues; and never store onsite more than 2,200 lbs (1,000 kg) of hazardous waste; 2.2 lbs of acutely hazardous waste; or 220 lbs of acutely hazardous waste spill residues for any period of time.

(3) Ensure proper treatment and disposal of the waste. This means ensuring that the disposal facility is one of the following:

- A state or federally regulated hazardous waste management treatment, storage, or disposal facility.
- A facility permitted, licensed, or registered by a state to manage municipal or industrial solid waste.
- A facility that uses, reuses, or legitimately recycles the waste (or treats the waste before use, reuse, or recycling).
- A universal waste handler or destination facility subject to the requirements for universal wastes.

CESQGs are allowed to transport their own wastes to the treatment or storage facility, unlike SQGs and LQGs who are required to use a licensed, certified transporter. While there are no specific RCRA requirements for CESQGs who transport their own wastes, the U.S. Department of Transportation (DOT) requires all transporters of hazardous waste to comply with all applicable DOT regulations. Specifically, DOT regulations require all transporters, including CESQGs, transporting hazardous waste that qualifies as a DOT hazardous material to comply with EPA hazardous waste transporter requirements found in 40 CFR Part 263. CESQGs are not required by federal hazardous waste laws to train their employees on waste handling or emergency preparedness.

Requirements for SQGs and LQGs. Facilities determined to be SQGs or LQGs must meet many requirements under the RCRA regulations. These requirements, found in 40 CFR 260-279, include identifying hazardous waste; obtaining an EPA identification numbers; meeting requirements for waste accumulation and storage limits; container management; conducting personnel training; preparing a manifest; ensuring proper hazardous waste packaging, labeling, and placarding; reporting and recordkeeping; and contingency planning, emergency procedures, and accident prevention.

Notes: Facilities that fall into different generator categories during different months may choose to simplify compliance by satisfying the more stringent requirements all the time.

Specific Provisions. RCRA regulations include several specific provisions addressing agriculture-related materials and activities. Key provisions are briefly summarized below:

- ***Exemption for Certain Solid Wastes Used as Fertilizers.*** Under 40 CFR §261.4(b), solid wastes generated by (1) growing and harvesting of agricultural crops, or (2) raising animals (including animal manure), and that are returned to the soils as fertilizers are excluded from regulation as hazardous waste.

- ***Exemption for Certain Hazardous Waste Pesticides.*** Under 40 CFR §262.70, farmers who generate any amount of hazardous waste pesticides from their own use are excluded from the generator, treatment/storage/disposal facility, land disposal, and permit requirements under RCRA Subtitle C, provided that the farmer: (1) disposes of the waste pesticide in a manner consistent with the label on the pesticide container; (2) triple rinses each empty container in accordance with requirements at 40 CFR §261.7(b)(3); and (3) disposes of the rinsate on his own farm in accordance with the instructions on the label. If the label does not include disposal instruction, or no instructions are available from the pesticide manufacturer, the waste pesticide and rinsate must be disposed of in accordance with Subtitle C hazardous waste requirements. (Also see 40 CFR Part 165 - FIFRA).

- ***Exemption for Commercial Fertilizers.*** Under 40 CFR §266.20, commercial fertilizers produced for general public (including agricultural) use that contain recyclable materials are not presently subject to regulation provided they meet the applicable land disposal restriction (LDR) standards for each recyclable material they contain. For example, zinc-containing fertilizers containing K061 (emission control dust from the primary production of steel in electric furnaces) are not subject to regulation.

- ***Fertilizers Made from Hazardous Wastes***. Under 40 CFR Parts 266 and 268, EPA regulates fertilizers containing hazardous wastes as ingredients. Hazardous wastes may be used as ingredients in fertilizers under certain conditions, since such wastes can be a beneficial component of legitimate fertilizers. EPA has established standards that specify limits on the levels of heavy metals and other contents used as fertilizer ingredients. These standards are based on treatment, by the best technology currently available, to reduce the toxicity and mobility of all the contents of the hazardous waste components. These standards are based on waste management considerations and do not include consideration of the potential agronomic or dietary risk.

- ***Food Chain Crops Grown on Hazardous Waste Land Treatment Units***. Under 40 CFR Part 264.276, food chain crops (including feed for animals consumed by humans) may be grown in or on hazardous waste land treatment units under certain conditions and only with a permit. The permit for a facility will list the specific food-chain crops that may be grown. To obtain a permit, the owner/operator of the facility wishing to grow the food-chain crops must demonstrate -- prior to the planting of such crops -- that there is no substantial risk to human health caused by the growth of such crops in or on the treatment zone.

- ***Solid Waste Disposal Criteria***. Under RCRA Subtitle D, 40 CFR 257.3 establishes solid waste disposal criteria addressing floodplains, endangered species, groundwater protection, application to land used for food chain crops, disease vectors, air pollution, and safety. These criteria are largely guidelines used by states in developing solid waste regulations, which control the disposal of waste on a farmer's property.

- ***Land Application of Fertilizers Derived from Drinking Water Sludge***. Under 40 CFR Part 257, EPA regulates the land application of solid wastes, including drinking water sludge applied as fertilizer. These requirements include: (1) cadmium limits on land used for the production of food-chain crops (tobacco, human food, and animal feed) or alternative less stringent cadmium limits on land used solely for production of animal feed; (2) polychlorinated biphenyls (PCBs) limits on land used for producing animal feed, including pasture crops for animals raised for milk; and (3) minimization of disease vectors, such as rodents, flies, and mosquitoes, at the site of application through incorporation of the fertilizer into soil so as to impede the vectors' access to the sludge.

- ***Pesticides That Are Universal Wastes.*** Under 40 CFR Part 273, EPA has established a separate set of requirements for three types of wastes called *universal wastes.* Universal wastes include certain batteries, certain pesticides, and mercury thermostats. Pesticides designated as universal wastes include (1) recalled pesticides that are stocks of a suspended or canceled pesticide and part of a voluntary or mandatory recall under FIFRA §19(b); (2) recalled pesticides that are stocks of a suspended or canceled pesticide, or a pesticide that is not in compliance with FIFRA, that are part of a voluntary recall [see FIFRA §19(b)(2)] by the registrant; and (3) stocks of other unused pesticide products that are collected and managed as part of a waste pesticide collection program.

  The Universal Waste rule is *optional* for states/tribe to adopt. In those states/tribes that have not adopted the Universal Waste rule, these wastes must be disposed of in accordance with the hazardous (or acutely hazardous) waste requirements (see 40 CFR Part 262).

- ***Exemption for Small Quantities of Used Oil.*** Under 40 CFR §279.20, agricultural establishments that generate an average of 25 gallons or less of used oil per month over a calendar year from vehicles or machinery used on the establishment are not subject to the requirements of 40 CFR Part 279.

- ***Exemption for "Farm Tanks" and Tanks of 110 Gallons or Less.*** Under the underground storage tank (UST) regulations (RCRA Subtitle I, 40 CFR §280.12), "farm tanks" of 1,100 gallons or less capacity used for storing motor fuel for non-commercial purposes are not regulated as underground storage tanks. *"Farm tanks"* include tanks located on a tract of land devoted to the production of crops or raising animals (including fish) and associated residences and improvements. Also under 40 CFR §280.10, the UST program does not apply to UST systems of 110 gallons or less capacity, or that contain a *de minimis* concentration of a regulated substance.

  Even with the above exemptions, keep in mind that many agricultural establishments may be subject to the UST program (40 CFR Part 280). The UST regulations apply to facilities that store either petroleum products or hazardous substances (except hazardous wastes) identified under CERCLA. UST regulations address design standards, leak detection, operating practices, response to releases, financial responsibility for releases, and closure standards.

Comprehensive Environmental Response, Compensation, and Liability Act

Under CERCLA, there are a limited number of statutory and regulatory requirements that potentially affect agricultural businesses. The key provisions are summarized below:

- **Emergency Release Notification Requirements**. Under CERCLA §103(a), facilities are required to notify the National Response Center about any release of a CERCLA hazardous substance in quantities equal to or greater than its reportable quantity (RQ). Releases include discharges into the air, soil, surface water, or groundwater. Any release at or above the RQ must be reported regardless of whether there is a potential for offsite exposure.
  - ***Hazardous Substances.*** The term "hazardous substance" is defined in CERCLA §101(14) and these substances (more than 700) are listed at 40 CFR Part 302, Table 302.4. Several agricultural chemicals are on the CERCLA hazardous substance list, including many pesticides, anhydrous ammonia, and ethylene glycol.
  - ***Reportable Quantities***. For each hazardous substance, EPA has designated a RQ of 1, 10, 100, 1,000, or 5,000 pounds. RQs are listed in 40 CFR Part 355, Appendices A and B and 40 CFR Part 302, Table 302.4.
  - ***When No Notification is Required***. There are several types of releases that are excluded from the requirements of CERCLA release notification. Two of these releases, excluded under CERCLA §§101(22) and 103(e), include the normal application of fertilizer and the application of pesticide products registered under FIFRA. *Keep in mind that spills, leaks, or other accidental or unintended releases of fertilizers and pesticides are subject to the reporting requirements.*

- **Facility Notification and Recordkeeping Requirements - Exemption for Agricultural Producers**. Under CERCLA §§103(c) and (d), certain facilities must notify EPA of their existence and the owners/operators must keep records. However, CERCLA §103(e) exempts agricultural producers who store and handle FIFRA-registered pesticides from the facility notification and recordkeeping

R0074393

requirements. CERCLA does not define the term *agricultural producer*.

- **Liability for Damages**. Under CERCLA §107(a), an owner/operator of a facility that has CERCLA hazardous substances onsite may be liable for cleanup costs, response costs, and natural resource damages associated with a release or threatened release of hazardous substances. Agricultural establishments are potentially liable under this section, and that liability extends to past practices.

Emergency Planning and Community Right-to-Know Act

A summary of the potential applicability of specific sections of EPCRA on the agricultural sector follows below.

- **Emergency Planning and Notification**. Under EPCRA §302, owners or operators of any facility, including agricultural establishments, that have *extremely hazardous substances* (40 CFR Part 355 Appendices A and B) present in excess of the *threshold planning quantity* must notify in writing their state emergency response commission (SERC) and their local emergency planning committee (LEPC) that they are subject to EPCRA planning requirements. Under EPCRA §303, they must also notify the LEPC of the name of a person at their facility whom the LEPC may contact in regard to planning issues related to these extremely hazardous substances. They must also inform the LEPC promptly of any relevant changes, and when requested, must provide information to the LEPC necessary for emergency planning.

  Ammonia, several agricultural pesticides, and certain fuels are included on the list of extremely hazardous substances found in 40 CFR Part 355 Appendices A and B. If a listed substance is a solid, two different planning quantities are listed (e.g., 500 lbs/10,000 lbs). The smaller amount (e.g., 500 lbs.) applies if the substance is in powder form, such as a soluble or wettable powder, or if it is in solution or molten form. The larger quantity (10,000 lbs.) applies for most other forms of the substance. If the extremely hazardous substance is part of a mixture or solution, then the amount is calculated by multiplying its percent by weight times the total weight of the mixture or solution. If the percent by weight is less than one percent, the calculation is not required (40 CFR Part 355.30).

  ✓ Ammonia -- The quantity of anhydrous ammonia that triggers the planning requirement is 500 pounds.

- ✓ Pesticides -- Examples of pesticides on the list with the quantity in pounds that triggers the planning requirement include: ethion (1,000), nicotine (100), dichlorvos (1,000), parathion (100), chlordane (1,000), methyl bromide (1,000), ethylene oxide (1,000), fenitrothion (500), phorate (10), zinc phosphide (500), aluminum phosphide (500), terbufos (100), phosphamidon (100), demeton (500), ethoprop (1,000), and disulfoton (500).

- ✓ Solid Pesticides -- Examples of pesticides with dual quantities that trigger the planning requirements include: coumaphos (100/10,000), strychnine (100/10,000), dimethoate (500/10,000), warfarin (500/10,000), azinphos-methyl (10/10,000), methyl parathion (100/10,000), phosmet (10/10,000), methidathion (500/10,000), carbofuran (10/10,000), paraquat (10/10,000), methiocarb (500/10,000), methamidophos (100/10,000), methomyl (500/10,000), fenamiphos (10/10,000), and oxamyl (100/10,000).

- **§304 Emergency Release Notification**. Under 40 CFR 355, facilities must *immediately* notify the SERC and LEPC of releases of EPCRA extremely hazardous substances and CERCLA hazardous substances when the release equals or exceeds the reportable quantity within a 24-hour period and has the *potential* for offsite exposure. There are two notifications required: the initial notification and the written followup notification.

  Exemption for Substances Used in Agricultural Operations. Only facilities that produce, use or store *hazardous chemicals* are subject to EPCRA release reporting. EPCRA §311(e) excludes from the definition of *hazardous chemicals* those substances used in routine agricultural operations. The exemption covers fertilizers and pesticides used in routine agricultural operations and fuels for operating farm equipment (including to transport crops to market). If all the hazardous chemicals present at the facility do not fall within this exemption, the facility must report all releases of any EPCRA extremely hazardous substance or CERCLA hazardous substance. Additionally, spills, leaks, or other accidental or unintended releases of fertilizers and pesticides are subject to the EPCRA release reporting requirements.

- **§311 and §312 Hazardous Chemical Inventory and Reporting**. Under EPCRA §311 and §312, facilities must inventory the hazardous chemicals present onsite in amounts equal to or in excess of the threshold planning quantities, and meet two reporting requirements:

- A one-time notification of the presence of hazardous chemicals onsite in excess of threshold levels (EPCRA §311) to the SERC, LEPC, and the local fire department; and

- An annual notification (Tier I or Tier II report) to the SERC, LEPC, and the local fire department detailing the locations and hazards associated with the hazardous chemicals found on facility grounds (EPCRA §312).

Exemption for Substances Used in Agricultural Operations. As mentioned above, the term "hazardous chemical," as defined in EPCRA §311(e), *excludes* substances used in routine agricultural operations.

Clean Air Act

Agriculture-related industries generally do not include those industry sectors considered to be major sources of air pollution. Nevertheless, some agriculture-related activities are potentially subject to regulation under the CAA. The provisions identified below summarize the CAA requirements applicable to certain agriculture-related activities:

- **Risk Management Program.** Under §112(r) of the Clean Air Act, EPA has promulgated the Risk Management Program Rule. The rule's main goals are to prevent accidental releases of regulated substances and to reduce the severity of those releases that do occur by requiring facilities to develop risk management programs. A facility's risk management program must incorporate three elements: a hazard assessment, a prevention program, and an emergency response program. These programs are to be summarized in a risk management plan (RMP) that will be made available to state and local government agencies and the public.

  Under 40 CFR Part 68, facilities that have more than the threshold quantity of any of the listed regulated substances in a single process are required to comply with the regulation. *Process* means any regulated activity involving a regulated substance, including manufacturing, storing, distributing, or handling a regulated substance or using it in any other way. Any group of interconnected vessels (including piping), or separate vessels located close enough together to be involved in a single accident, are considered a single process. Transportation is not included.

Listed regulated substances are acutely toxic substances, flammable gases, volatile liquids, and highly explosive substances listed by EPA in the Risk Management Program rule. The *threshold quantity* is the amount of a regulated substance that triggers the development of a RMP. The list of regulated substances and their corresponding threshold quantities are found at 40 CFR Part 68. Examples of threshold quantities of listed regulated substances include: formaldehyde -- 15,000 pounds; ethylene oxide -- 10,000 pounds; methyl isocyanate -- 10,000 pounds; anhydrous ammonia -- 10,000 pounds; and mixtures containing ammonia in a concentration of 20 percent or greater -- 20,000 pounds.

Exception: Ammonia that farmers are holding for use as fertilizer is not a regulated substance under the risk management program. Farmers are not responsible for preparing a risk management plan if ammonia held for use as a fertilizer is the only listed regulated substance that they have in more than threshold quantities. However, ammonia that is on a farm for any other use, such as for distribution or as a coolant/refrigerant, is not exempt.

Three program levels. The risk management planning regulation (40 CFR Part 68) defines the activities facilities must undertake to address the risks posed by regulated substances in covered processes. To ensure that individual processes are subject to appropriate requirements that match their size and the risks they may pose, EPA has classified them into 3 categories ("programs"):

- **Program 1** requirements apply to processes for which a worst-case release, as evaluated in the hazard assessment, would not affect the public. These are processes that have **not** had an accidental release that caused serious offsite consequences.

- **Program 2** requirements apply to less complex operations that do **not** involve chemical processing.

- **Program 3** requirements apply to higher risk, complex chemical processing operations and to processes already subject to the **OSHA Process Safety Management Standard (29 CFR 1910.119)**.

Risk Management Planning. Facilities with more than a threshold quantity of any of the 140 regulated substances in a single process are required to develop a risk management program and to summarize their program in a risk management plan (RMP). A facility subject to the requirements were required to submit a registration and RMP by June 21, 1999, or whenever it first exceeds the threshold for a listed regulated substance after that date.

All facilities with processes in Program 1 must carry out the following elements of risk management planning:

- An offsite consequence analysis that evaluates specific potential release scenarios, including worst-case and alternative scenarios.
- A five-year history of certain accidental releases of regulated substances from covered processes.
- A risk management plan, revised at least once every five years, that describes and documents these activities for all covered processes.

Facilities with processes in Programs 2 and 3 must also address each of the following elements:

- An integrated prevention program to manage risk. The prevention program will include identification of hazards, written operating procedures, training, maintenance, and accident investigation.
- An emergency response program.
- An overall management system to put these program elements into effect.

- **National Ambient Air Quality Standards (NAAQS)/SIPS**. Under the CAA §10, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. If the applicable SIP imposes requirements on an agricultural establishment, that facility must comply with the SIP. The most likely pollutant of concern with respect to agriculture-related businesses is particulate matter.

Federal Insecticide, Fungicide, and Rodenticide Act

For agricultural producers, FIFRA is the environmental statute that most significantly impacts day-to-day operations of pesticide use. It also imposes administrative requirements on pesticide users, including agricultural producers. A summary of major provisions applicable to agricultural producers is provided below.

- **Use restrictions:** The pesticide product label is information printed on or attached to the pesticide container. Users are legally required to follow the label. Labeling is the pesticide product label and other accompanying materials which contain directions that pesticide users are legally required to follow. Under FIFRA §12, each pesticide must be used only in a way that is consistent with its labeling.

  - As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

  - It is against the law (Endangered Species Act) to harm an endangered species. Harm includes not only acts that directly injure or kill the protected species, but also significant habitat modification or degradation that disrupts breeding, feeding, or sheltering. Pesticide users must comply with any pesticide labeling restrictions or requirements that concern the protection of endangered species or their habitats.

- **Tolerances and Exemptions** A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR.163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

  To avoid being responsible for products being over tolerance, users must be particularly careful to comply with the label instructions concerning application rate and minimum days between pesticide application and harvest (i.e., preharvest interval), slaughter, freshening, or grazing.

- **Worker Protection Standard (WPS) Requirements for Users**. The WPS for Agricultural Pesticides (40 CFR Parts 156 and 170) covers pesticides that are used in the commercial production of agricultural plants on farms, forests, nurseries, and greenhouses. The WPS requires pesticide users to take steps to reduce the risk of pesticide-related illness and injury if they or their employees may be exposed to pesticides used in the commercial production of agricultural plants.

- **Cancellation and Suspension** EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

  In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

  When EPA believes and emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order that makes the suspension immediately effective.

Toxic Substances Control Act

TSCA has a limited impact on the agricultural sector. TSCA §3, Definitions, specifies that the term chemical substance means any organic or inorganic substance of a particular molecular identity. The definition also states, as declared at subsection (2)(B)(ii), that such term does not include any pesticide (as defined in FIFRA) when manufactured, processed, or distributed in commerce for use as a pesticide. Since the majority of potentially hazardous substances used by agricultural producers are pesticides, they are regulated under FIFRA. Regulation of hazardous substances under other authorities is part of TSCA's overall scheme which allows EPA to decline to regulate a chemical under TSCA if other federal regulatory authorities (e.g., FIFRA) are sufficiently addressing the risks posed from those substances.

- **Asbestos and Asbestos-Containing Material**. Under TSCA §6 and 40 CFR Part 61, Subpart M, EPA regulates the renovation/demolition activities, notification, work practices and removal, and disposal of asbestos-containing material (ACM). ACM should be carefully monitored; however, the mere presence of asbestos in a building is not considered hazardous. ACM that becomes damaged, however, may pose a health risk since it may release asbestos fibers over time. If a material is suspected of containing asbestos and it is more than slightly damaged, or if changes need to be made to a building that might disturb it, repair or removal of the ACM by a professional is needed.

- **Asbestos Brake Pads**. Facilities that repair their own brakes should be aware of asbestos requirements. Asbestos brake pads must be removed using appropriate control measures so that no visible emissions of asbestos will be discharged to the outside air. These measures can include one of the following: (1) wetting that is generally done through the use of a brake washing solvent bath, such as those provided by a service; (2) vacuuming that is usually performed with a commercial brake vacuum specifically designed for use during brake pad changing or pad re-lining operations; or (3) combination of wetting and vacuuming.

  Asbestos brake pads and wastes must be managed by: (1) labeling equipment, (2) properly disposing of spent solvent, (3) properly disposing of used vacuum filters, and (4) sealing used brake pads. The containers or wrapped packages must be labeled using warning labels as specified by OSHA [29 CFR 1910.001 (j) (2) or 1926.58 (k)(2)(iii)].

  Asbestos waste must be disposed of as soon as practical at an EPA-approved disposal site. The asbestos containers must be labeled with the name and location of the waste generator. Vehicles used to transport the asbestos must be clearly labeled during loading and unloading. The waste shipment records must be maintained (40 CFR 61.150) so that the asbestos shipment can be tracked and substantiated.

- **Polychlorinated Biphenyls (PCBs)**. PCBs were widely used in electrical equipment manufactured from 1932 to 1978. Types of equipment potentially containing PCBs include transformers and their bushings, capacitors, reclosers, regulators, electric light ballasts, and oil switches. Any equipment containing PCBs in their dielectric fluid at concentrations of greater than 50 ppm are subject to the PCB requirements.

  Under TSCA §6 and 40 CFR Part 761, facilities must ensure through activities related to the management of PCBs (e.g., inspections for leaks, proper storage) that human food or animal feed are not exposed to PCBs. While the regulations do not establish a specific distance limit, any item containing PCBs is considered to pose an unacceptable

R0074401

exposure risk to food or feed if PCBs released in any form have the potential to reach/contaminate food or feed.

- **Lead**. Approximately 1.7 million children have blood-lead levels high enough to raise health concerns. Studies suggest that lead exposure from deteriorated residential lead-based paint, contaminated soil, and lead in dust are among the major existing sources of lead exposure among children in the U.S.

  Section 1018 of the Residential Lead-Based Paint Hazard Reduction Act of 1992 directs EPA and the Department of Housing and Urban Development (HUD) to jointly issue regulations requiring disclosure of known lead-based paint and/or lead-based paint hazards by persons selling or leasing housing constructed before the phaseout of residential lead-based paint use in 1978. Under that authority, EPA and HUD jointly issued on March 6, 1996, regulations titled *Lead; Requirements for Disclosure of Known Lead-Based Paint and/or Lead-Based Paint Hazards in Housing* (40 CFR Part 35 and 40 CFR Part 745). In these regulations, EPA and HUD established requirements for sellers/lessors of residential housing built before 1978.

  Pre-Renovation Lead Information Rule. If conducted improperly, renovations in housing with lead-based paint can create serious health hazards to workers and occupants by releasing large amounts of lead dust and debris. Under TSCA §406 and through a rule published on June 1, 1998 entitled *Lead; Requirements for Hazard Education Before Renovation of Target Housing* (40 CFR Part 745), EPA required the distribution of lead hazard information (i.e., EPA-developed pamphlet) prior to professional renovations on residential housing built before 1978.

IV.C. Proposed and Pending Regulations

Coastal Zone Act Reauthorization Amendments of 1990

Implementation of Management Measures. Under Section 6217, states/tribes must fully implement the management measures in their Coastal Nonpoint Pollution Control Programs by January 2004. States/tribes are required to perform effectiveness monitoring between 2004 and 2006 and implement other measures between 2006 and 2009.

Safe Drinking Water Act

Management of Class V Wells. EPA plans to propose additional requirements addressing the environmental risks posed by the highest risk Class V wells. This rulemaking potentially affects agricultural operations that use industrial and commercial disposal wells and large capacity cesspools.

Federal Insecticide, Fungicide, and Rodenticide Act

Pesticide Management and Disposal: Proposed Rule - issued on May 5, 1993 (FR26857). The regulations for this rule will be found in the Code of Federal Regulations (CFR) at 40 CFR Part 165 - Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticides Containers. This final rule will:

- Describe procedures for voluntary and mandatory recall actions.
- Establish criteria for acceptable storage and disposal plans which registrants may submit to EPA to become eligible for reimbursement of storage costs.
- Establish procedures for the indemnification of owners of suspended and canceled pesticides.
- Amend the Agency's responsibility for accepting for disposal suspended and canceled pesticides.

THIS PAGE LEFT INTENTIONALLY BLANK

V. COMPLIANCE AND ENFORCEMENT HISTORY

V.A. Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match air, water, waste, toxics/pesticides, EPCRA, Toxics Release Inventory (TRI), and enforcement docket records for a given facility and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, EPA is developing sector-specific measures of success for compliance assistance efforts.

V.B. Compliance and Enforcement Profile Description

This section uses inspection, violation, and enforcement data from the IDEA system to provide information about the historical compliance and enforcement activity of this sector. While other sector notebooks have used Standard Industrial Classification (SIC) data from the Toxics Release Inventory System (TRIS) to define their data sampling universes, none of the SIC codes associated with the crop production sectors identifies facilities that report to the TRI program. As such, sector-defining data have been provided from EPA data systems linked to EPA's Facility Indexing System (FINDS), which

> *Note: Many of the previously published sector notebooks contained a chapter titled "Chemical Release and Transfer Profile." The information and data for that chapter were taken primarily from EPA's Toxic Release Inventory (TRI). Because the industries discussed in this notebook do not, in general, directly report to TRI, that chapter has not been included in this sector notebook.*

tracks facilities in all media databases. This section does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census. With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Before presenting the data, the next section defines general terms and the column heads used in the data tables. The data represent a retrospective summary of inspections and enforcement actions and solely reflect EPA, state, and local compliance assurance activities that have been entered into EPA databases. To identify trends, EPA ran two data queries, one for five calendar years (March 7, 1992 to March 6, 1997) and the other for a twelve-month period (March 7, 1996 to March 6, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and state's efforts within each media program. The presented data illustrate the variations across EPA regions for certain sectors.[1] This variation may be attributable to state/local data entry variation, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

---

1 EPA Regions are as follows: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) - assigns a common facility number to EPA single-media permit records, establishing a linkage capability to the permit data. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) - is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, this creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are AFS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS. IDEA also contains information from outside sources, such as Dun and Bradstreet (DUN) and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in this section were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search - based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, or industries in which only a very small fraction of facilities report to TRI, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected - indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections - measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections - provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities With One or More Enforcement Actions - expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal state actions. A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions - describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (i.e., a facility with 3 enforcement actions counts as 3).

State Lead Actions - shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions - shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from state agencies. Many of these actions result from coordinated or joint federal/state efforts.

Enforcement to Inspection Rate - is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. The ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified - expresses the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections - four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

V.C. Compliance History for the Agricultural Production Industries: Crops, Greenhouses/Nurseries, and Forestry

Exhibit 23 provides an overview of the reported compliance and enforcement data for the agricultural production industries over the past 5 years (March 1992 to March 1997). These data are also broken out by EPA regions thereby permitting geographical comparisons.

> **Note:** It should be noted that the data presented in this section represent federal enforcement activity only. Enforcement activity conducted at the state level is not included in this analysis.

A few points evident from the data are listed below. It should also be noted that agriculture crop production (SIC code 01) and forestry (SIC code 08) are presented separately in the exhibits.

- As shown, of the 6,688 facilities identified through IDEA with crop production NAICS codes, nearly half (3,046) were inspected over the 5-year period. The total number of inspections over the same 5 years was 10,453, which means that, on average, each facility was subjected to nearly 3.5 inspections over the 5 years.

- Region 7 has the most crop production facilities with 2,391 and has conducted the most inspections (3,180). Similarly, Region 5 has the second most facilities and has conducted the second most inspections. Inspections in these regions comprise more than half (57%) of all inspections conducted.

- The 10,453 inspections conducted nationwide have resulted in 262 enforcement actions, which results in an enforcement-to-inspection rate of 0.03. This means that for every 100 inspections conducted, there are approximately 3 resulting enforcement actions.

- The average enforcement-to-inspection rate across the regions ranged from 0.01 in Region 5 to 0.08 in Regions 1 and 2.

Exhibit 24 provides an overview of the reported compliance and enforcement data for forestry SIC codes over the 5-year period by EPA region.

- Of the 97 facilities identified, approximately 25 percent (24 facilities) were inspected in the 5-year period.
- The 68 inspections conducted nationwide have resulted in 10 enforcement actions, which results in an enforcement-to-inspection rate of 0.15.

Exhibit 23. Five-Year Enforcement and Compliance Summary for the Agricultural Crop Production Industry									
A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	156	41	148	63	8	12	67%	33%	0.08
II	119	47	958	7	19	80	91%	9%	0.08
III	343	167	812	25	10	20	95%	5%	0.02
IV	809	283	1,212	40	18	28	86%	14%	0.02
V	1,491	930	2,816	32	14	18	67%	33%	0.01
VI	524	128	405	78	18	30	63%	37%	0.07
VII	2,391	1,113	3,180	45	37	54	41%	59%	0.02
VIII	142	53	129	66	3	3	0%	100%	0.02
IX	298	164	587	30	8	11	82%	18%	0.02
X	415	120	206	121	6	6	67%	33%	0.03
TOTAL	6,688	3,046	10,453	38	141	262	73%	27%	0.03

Exhibit 24: Five-Year Enforcement and Compliance Summary for the Forestry Production Industry									
A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	3	1	1	180	1	1	100%	0%	1.00
II	1	1	1	60	0	0	--	--	--
III	3	2	12	15	0	0	--	--	--
IV	13	4	4	195	1	1	0%	100%	0.25
V	4	2	22	11	1	3	100%	0%	0.14
VI	8	3	10	48	1	3	0%	100%	0.30
VII	1	1	3	20	0	0	--	--	--
VIII	2	0	0	--	0	0	--	--	--
IX	6	1	2	180	0	0	--	--	--
X	56	9	13	258	1	2	100%	0%	0.15
TOTAL	97	24	68	86	5	10	60%	40%	0.15

Comparison of Enforcement Activity Between Selected Industries

Exhibits 25 and 26 provide both the 5-year and 1-year enforcement and compliance data for most of the industries covered by the sector notebooks. These data allow the reader to compare the enforcement and compliance history of the sectors and identify trends across sectors and over the 5-year period.

- Of the industries presented, the crop production sector has the second most identified facilities with 6,688; it also has the second highest number of facilities inspected (3,046) over the 5-year period. The enforcement-to-inspection rate of 0.03 was the second lowest among all sectors.

- Forestry has the second fewest number of facilities (97) among all sectors and the fewest number of facilities inspected (24). Its enforcement-to-inspection rate of 0.15 is the second highest, next to petroleum refining (0.25).

In Exhibit 26, when compared to all sectors over the last year, the crop production sector had the fifth most facilities inspected (1,012) and the fourth most inspections conducted (1,459). The enforcement-to-inspection rate of 0.02 for the crop production sector was among the lowest rates across all sectors. From March 1996 - March 1997, forestry had the fewest number of facilities inspected and the lowest number of inspections conducted.

Exhibits 27 and 28 provide a more in-depth comparison between the crop production and forestry sectors and others by organizing inspection and enforcement data by environmental statute. Exhibit 27 provides inspection and enforcement data over the 5-year period, while Exhibit 28 provides data for the March 1996 - March 1997 only.

As shown in Exhibit 27, over the 5-year period, nearly three-quarters of all inspections conducted at crop production facilities were under the Clean Air Act. However, the CAA accounts for only 35 percent of all enforcement actions. The enforcement actions are spread out across the CAA (35%), CWA (23%), and RCRA (25%) with FIFRA/TSCA/EPCRA/Other having the lowest percentage of enforcement actions (17%). For forestry, more than half of all inspections and exactly half of all enforcement actions have come under RCRA.

For March 1996 - March 1997 (see Exhibit 28), again CAA inspections account for nearly three-quarters of all inspections for the crop production sectors. And, similarly to the 5-year history, enforcement actions are fairly evenly disbursed among the CAA (31%), CWA (34%), and RCRA (28%). It should be noted that 7 percent of all enforcement actions were taken under the FIFRA/TSCA/EPCRA/Other category although no inspections were conducted within that category. This number is possible because in many EPA regions, media inspectors are being trained to examine the facility from a multimedia viewpoint. As a result, these actions may originate from the media inspections. Regarding the forestry industry, 83 percent of all inspections were conducted under the RCRA program. However, no enforcement actions were taken based on those inspections. Two-thirds of all enforcement actions were taken under the FIFRA/TSCA/EPCRA/Other category, although no inspections were conducted under those programs (see above note).

Exhibit 25. Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Avg. Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Livestock	1,001	205	600	100	20	31	84%	16%	0.05
Crop Production	**6,688**	**3,046**	**10,453**	**38**	**141**	**262**	**73%**	**27%**	**0.03**
Forestry	**97**	**24**	**68**	**86**	**5**	**10**	**60%**	**40%**	**0.15**
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass & Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Aerospace	237	184	1,206	12	67	127	75%	25%	0.10
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Exhibit 26. One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Livestock	1,001	107	146	22	21%	2	2%	2	0.01
Crop Production	**6,688**	**1,012**	**1,459**	**866**	**86%**	**23**	**2%**	**29**	**0.02**
Forestry	**97**	**8**	**12**	7	**88%**	**2**	**25%**	**3**	**0.25**
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Aerospace	237	119	216	105	88%	8	7%	11	0.05
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*

R0074416

Exhibit 27. Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Livestock	205	600	31	38%	26%	57%	65%	3%	6%	0%	3%
Crop Production	**304**	**10,453**	**262**	**72%**	**35%**	**11%**	**23%**	**13%**	**25%**	**3%**	**17%**
Forestry	**24**	**68**	**10**	**13%**	**30%**	**25%**	**0%**	**59%**	**50%**	**3%**	**20%**
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Aerospace	184	1,206	127	34%	38%	10%	11%	54%	42%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

R0074417

Exhibit 28. One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Livestock	107	146	2	48%	0%	51%	100%	1%	0%	0%	0%
Crop Production	**1,012**	**1,459**	**29**	**71%**	**31%**	**13%**	**34%**	**16%**	**28%**	**0%**	**7%**
Forestry	**8**	**12**	**3**	**8%**	**33%**	**8%**	**0%**	**83%**	**0%**	**0%**	**67%**
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins & Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Aerospace	119	216	11	37%	36%	7%	0%	54%	55%	1%	9%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

R0074418

VI. Review of Major Legal Actions

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

Review of Major Cases

The following cases are examples of EPA's enforcement against the agricultural production industries of crops, greenhouses/nurseries, and forestry.

Cumberland Farms, Inc. In September 1996, a District Court entered a consent decree between the U.S. and Cumberland Farms, Inc., which resolves a long standing wetlands enforcement action against Cumberland Farms, Inc., for its unpermitted filling of 180 acres of wetlands in violation of the Clean Water Act between 1977 and 1990 in Halifax and Hanson, Massachusetts. Under the consent decree, Cumberland is required to deed two undeveloped tracts of land, totaling 225 acres, to the Massachusetts Division of Fisheries and Wildlife for permanent conservation. In addition, the company will establish a 30-acre wildlife and wetlands corridor on the most seriously damaged site and pay a civil $50,000 penalty. This settlement, along with others, will preserve a total of 490 acres of undeveloped habitat in the same watershed as the violations. This represents the largest permanent preservation of habitat arising from a federal enforcement in New England.

U.S. v. Tropical Fruit. Tropical Fruit, S.E., in Guayanilla, Puerto Rico, operates a plantation where it grows mangoes, bananas, and other fruits. On December 20, 1996, Region 2 issued an administrative order under CERCLA 106(a) to Tropical Fruit, S.E., and its three individual partners of that company (Avshalom Lubin, Cesar Otero Acevedo, and Pedro Toledo Gonzalez) for application of pesticides using a high pressure applicator that produced a cloud which sometimes would drift into the adjacent residential community, which is composed of minority and low income residents. The CERCLA order requires that the respondents immediately cease and desist from spraying pesticides, fungicides, and any other materials that contain hazardous substances in such a manner that these substances might drift or otherwise migrate beyond the boundaries of the farm.

Region 2 also issued an administrative complaint for violations of the Worker Protection Standard for agricultural workers under FIFRA. The complaint cited Tropical Fruit's failure to post warning signs during and after application, as well as its failure to maintain a decontamination area and a central bulletin board with pesticide safety information.

On March 26, 1997, DOJ (acting on EPA's behalf) filed a complaint against Tropical Fruit seeking an injunction requiring the firm and its partners to comply with EPA's CERCLA order and all applicable FIFRA requirements. Three of the pesticides routinely used by Tropical Fruits on its mango trees are not registered for use on mangoes; their use in this manner is in violation of FIFRA. The judicial complaint also sought penalties for violations of the CERCLA order since its issuance. Also on March 26, 1997, the court signed an interim consent order requiring Tropical Fruit to modify its pesticide application procedures to prevent these substances from drifting into the adjacent residential community. The order also requires Tropical Fruit to better protect its workers by providing extensive training, protective clothing, respirators, and decontamination equipment. Subsequently on May 21, 1997, EPA documented further violations of the CERCLA administrative order and the judicial interim consent order. On August 22, 1997, Tropical Fruit paid $10,000 in stipulated penalties for those violations.

Region 2 also has documented additional FIFRA violations by Tropical Fruit, which included the illegal importation of Cultar, an unregistered pesticide from the Middle East. In addition, the region has documented violations of RCRA UST regulations, as well as violations of CWA §404 and the associated regulations regarding discharge of dredged or fill materials into wetlands. EPA anticipates that all of these violations will be subject to further enforcement action.

Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility. Information on SEPs can be accessed via the internet at http://www.epa.gov/oeca/sep.

There was one SEP at an agricultural crop producing facility. This SEP was negotiated with Franklin Mushroom Farms, Incorporated (Franklin Farms) of Southington, CT. The complaint alleged that Franklin Farms illegally discharged pollutants to a nearby river in violation of their NPDES Permit. As part of a settlement, Franklin Farms agreed to a SEP in which they would institute water recycling/conservation methods to reduce overall pollutant loading to the river. The cost of instituting these methods was $89,900 at the time of the settlement. Franklin Farms also was required to pay a penalty of $75,000. Details on this SEP can be found by accessing http://es.epa.gov/oeca/sep/searchsep.html, selecting '01 Agriculture - Crop Production' in the *Industrial Sector of Violation* field, and choosing the *Submit Search* button.

VII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VII.A. Sector-Related Environmental Programs and Activities

There are several federal programs available to the agricultural community to assist agricultural producers in complying with environmental regulations and reducing pollution. The following examples represent some industry initiatives that promote compliance or assess methods to reduce environmental contamination.

National Agriculture Compliance Assistance Center

The U.S. Environmental Protection Agency (EPA), with the support of the Department of Agriculture (USDA), has developed a national Agriculture Compliance Assistance Center (Ag Center) to provide a base for "first-stop shopping" for the agricultural community -- one place for the development of comprehensive, easy-to-understand information about approaches to compliance that are both environmentally protective and agriculturally sound. The Ag Center, a program offered by EPA's Office of Compliance, seeks to increase compliance by helping the agricultural community identify flexible, common sense ways to comply with the many environmental requirements that affect their business. Initial efforts will focus on providing information about EPA's requirements. The Ag Center will rely heavily on existing sources of agricultural information and established distribution mechanisms. The Ag Center is designed so growers, livestock producers, other agribusinesses, and agricultural information/education providers can access its resources easily -- through telephone, fax, mail, and Internet. The Ag Center website can be accessed at http://www.epa.gov/agriculture.

Unified National Strategy for Animal Feeding Operations

As part of President Clinton's Clean Water Action Plan (CWAP), a USDA-EPA unified national strategy has been developed to minimize the water quality and public health impacts (e.g., nutrient loading, fish kills, odors) of animal feeding operations (AFOs). USDA and EPA's goal is for AFO owners and operators to take actions to minimize water pollution from confinement facilities and land application of manure. To accomplish this goal, this Strategy is based on a national performance expectation that all AFOs should

R0074421

develop and implement technically sound, economically feasible, and site-specific Comprehensive Nutrient Management Plans (CNMPs) to minimize impacts on water quality and public health.

CNMPs identify actions or priorities that will be followed to meet clearly defined nutrient management goals at an agricultural operation. They should address, as necessary, feed management, manure handling and storage, land application of manure, land management, recordkeeping, and other utilization options. While nutrients are often the major pollutants of concern, the plan should address risks from other pollutants, such as pathogens, to minimize water quality and public health impacts from AFOs. CNMPs should be site-specific and be developed and implemented to address the goals and needs of the individual owner/operator, as well as the conditions on the farm. USDA and EPA issued the final draft of this Strategy in March 1999. For more information, the complete unified national strategy can be accessed at http://www.epa.gov/owm/finafost.htm.

VII.B. EPA Programs and Activities

Section 319 Nonpoint Source Management Program
In 1987, Congress amended the Clean Water Act (CWA) to establish the §319 Nonpoint Source Management Program in recognition of the need for greater federal leadership to help focus state and local nonpoint source efforts. Under §319, states, territories, and Indian tribes receive grant money to support a wide variety of activities, including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects. For more information about the Clean Water Act §319 Program, refer to EPA's Office of Water website at http://www.epa.gov/OWOW/NPS/sec319.html.

Clean Lakes Program
EPA's Clean Lakes Program supports a variety of lake management activities including classification, assessment, study, and restoration of lakes. The program, authorized in §314 of the Clean Water Act, was established to provide technical and financial assistance to states/tribes for restoring the quality of publicly owned lakes. The Clean Lakes Program has funded approximately $145 million for grant activities since 1976 to address lake problems, but there have been no appropriations for the program since 1994. EPA has not requested funds for the Clean Lakes Program in recent years, but has encouraged states to use §319 funds to fund "eligible activities that might have been funded in previous years under Section 314." Information on the Clean Lakes Program is available at the following Internet site: http://www.epa.gov/owow/lakes/cllkspgm.html.

National Estuary Program
EPA's National Estuary Program is a national demonstration program, authorized in §320 of the Clean Water Act, that uses a comprehensive watershed management approach to address water quality and habitat problems in 17 estuaries. Nonpoint source pollution is a major contributor of contaminants in the estuary and coastal waters around the country. In this program, EPA and states/tribes develop conservation and management plans that recommend priority corrective actions to restore estuarine water quality, fish populations, and other designated uses of the waters. Information on the National Estuary Program is available at the following Internet site: http://www.epa.gov/owowwtr1/estuaries/nep.html or by contacting the National Estuary Program Office at (202) 260-1952.

Chesapeake Bay Program and The Great Lakes National Program
EPA's Chesapeake Bay Program and the Great Lakes National Program focus substantial resources on understanding the extent of nonpoint source pollution problems in their respective watersheds and supporting State implementation of nonpoint source pollution controls. Since 1984, the Chesapeake Bay Program, in particular, has supported the implementation of a substantial amount of animal waste management practices through State cost share programs funded jointly by the Bay States and EPA. Information on the Chesapeake Bay Program is available at http://www.epa.gov/owowwtr1/ecoplaces/part1/site2.html. Information on The Great Lakes National Program is available at http://www.epa.gov/glnpo/.

AgSTAR Program
The AgSTAR program is a voluntary program that promotes the use of profitable manure management systems that reduce pollution. The program, a component of President Clinton's Climate Action Plan, is based on a computer model that shows the economic value of capturing the methane naturally produced by manure.

AgSTAR, a joint program of EPA, USDA, and the Department of Energy, helps agricultural producers determine which methane recovery and use technologies will work best for them, and develops financing sources to help with start-up costs. By investing in these technologies, AgSTAR participants realize substantial returns through reduced electrical, gas, and oil bills, revenues from high quality manure by-products, and savings on manure management operational costs. Partners also reduce pollution associated with water resources, odors, and global warming. Information on AgSTAR is available at the following Internet site: http://yosemite.epa.gov/methane/home.nsf/pages/agstar.

Pesticide Environmental Stewardship Program

EPA's Pesticide Environmental Stewardship Program (PESP) is a voluntary program dedicated to protecting human health and preserving the environment by reducing the risks associated with pesticide use. The partnership is a key element of the program, which is sponsored by EPA, USDA, and FDA. Current partners include agricultural producers as well as non-agricultural interests. Partners in PESP volunteer to develop and implement a well designed pesticide management plan that will produce the safest and most effective way to use pesticides. In turn, EPA provides a liaison to assist the partner in developing comprehensive, achievable goals. Liaisons act as "customer service representatives" for EPA, providing the partner with access to information and personnel. EPA also promises to integrate the partners' stewardship plans into its agricultural policies and programs.

So far, agricultural producers have committed to a number of projects, including conducting more research into IPM techniques, developing computer prediction models for more precise pesticide applications, educating their members and the public regarding pesticide use, and working with equipment manufacturers to refine application techniques. Information on PESP is available at the following Internet site: http://www.pesp.org, or contact the PESP hotline at (800) 972-7717.

Endangered Species Protection Program

The Endangered Species Protection Program (ESPP) began in 1988. This program is largely voluntary at the present time and relies on cooperation between the U.S. Fish and Wildlife Service (FWS), EPA Regions, States, and pesticide users. EPA's Endangered Species Protection Program is designed to protect Federally-listed endangered and threatened species from exposure to pesticides. The program is intended to provide information concerning and regulation for the use of pesticides that may adversely affect the survival, reproduction and/or food supply of listed species. Due to labeling requirements, potential users will be informed prior to making a purchase that there may be local limitations on product use due to endangered species concerns. Information on the Endangered Species Protection Program is available at the following Internet site: http://www.epa.gov/oppfead1/endanger/index.htm.

Energy Star® Buildings and Green Lights® Partnership

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy-efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings— a strategy that optimizes whole-building energy-efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star® Buildings upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to $25 billion annually.

The more than 2,900 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. As of March 31, 1999, Energy Star®Buildings and Green Lights® Program participants are saving $775 million in energy bills with an annual savings of 31.75 kilowatt per square foot and annual cost savings of $0.47 per square foot. By joining, participants agree to upgrade 90 percent of their owned facilities with energy-efficient lighting and 50 percent of their owned facilities with whole-building upgrades, where profitable, over a seven-year period. Energy Star® participants first reduce their energy loads with the Green Lights® approach to building tune-ups, then focus on "right sizing" their heating and cooling equipment to match their new energy needs. EPA's Office of Air and Radiation is responsible for operating the Energy Star® Buildings and Green Lights® Program. (Contact: Energy Star Hotline, 1-888-STAR-YES (1-888-782-7937) or Maria Tikoff Vargas, Co-Director at (202) 564-9178 or visit the website at http://www.epa.gov/buildings.)

WasteWi$e Program

The WasteWiSe Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection, and the manufacturing and purchase of recycled products. As of 1998, the program had about 700 business, government, and institutional partners. Partners agree to identify and implement actions to reduce their solid wastes by setting waste reduction goals and providing EPA with yearly progress reports for a three-year period. EPA, in turn, provides partners with technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at (800) 372-9473 or Joanne Oxley, EPA Program Manager, (703) 308-0199.)

Climate Wise Program

In October 1993, President Clinton unveiled the Climate Change Action Plan (CCAP) in honor of the United States' commitment to reducing its greenhouse gas emissions to 1990 levels by the year 2000. Climate Wise, a project jointly sponsored by the U.S. Department of Energy and EPA, is one of the projects initiated under CCAP.

R0074425

Climate Wise is a partnership between government and industry that offers companies a nonregulatory approach to reducing greenhouse gas emissions. Climate Wise state and local government "allies" work with U.S. industries to develop flexible, comprehensive strategies for achieving energy efficiency and pollution prevention. They help local business identify and implement projects that often require little capital investment, but promise a high rate of return. Companies that become Climate Wise partners receive technical assistance and financing information to help them develop and implement cost-effective changes. (Contact: Climate Wise Clearinghouse at (301) 230-4736 or visit the Climate Wise website at http://www.epa.gov/climatewise/allies.htm or http://www.epa.gov/climatewise/index.htm.)

VII.C. USDA Programs and Activities

Environmental Quality Incentives Program
The Environmental Quality Incentives Program (EQIP) is a USDA funded program (led by Natural Resources Conservation Service) that was established in the 1996 Farm Bill to provide a voluntary conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. EQIP embodies four of USDA's former conservation programs, including the Agricultural Conservation Program, the Water Quality Incentives Program, the Great Plains Conservation Program, and the Colorado River Basin Salinity Control Program.

EQIP offers 5 to 10 year contracts that provide *incentive payments* and *cost-sharing* for conservation practices called for in a site-specific conservation plan that is required for all EQIP activities. *Cost-sharing* may include up to 75 percent of the costs of certain conservation practices, such as grassed waterways, filter strips, manure management facilities, capping abandoned wells, and other practices. *Incentive payments* may be made to encourage land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management. These payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the program incentive.

EQIP has an authorized budget of $1.3 billion through the year 2002. It was funded for $174 million in 1999. Total cost-share and incentive payments are limited to $10,000 per person per year and $50,000 for the length of the contract. Eligibility is limited to persons who are engaged in livestock or agricultural production. Fifty percent of the funds must be spent on livestock production. The 1996 Farm Bill prohibits owners of large confined livestock operations from being eligible for cost-share assistance for animal waste storage or treatment facilities. However, technical, educational, and financial assistance may be provided for other conservation practices on such operations. Further information relating to EQIP may be found on NRCS's website located at http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/eqipfact.html.

Conservation Reserve Program

The Conservation Reserve Program (CRP) is a highly successful conservation program administered by USDA. Since 1986, CRP has provided financial incentives to farmers and ranchers to take land out of agricultural production and plant trees, grass and other types of vegetation. The result has been reduced soil erosion, improved air and water quality, and establishment of millions of acres of wildlife habitat.

With the New Conservation Reserve Program, launched with the final rule published in the Federal Register on February 19, 1997, the Farm Service Agency (FSA) begins a renewed effort to achieve the full potential of government-farmer conservation partnerships. Only the most environmentally-sensitive land, yielding the greatest environmental benefits, will be accepted into the program.

The 36.4-million-acre congressionally mandated cap on enrollments is carried over from the previous program, meaning that the new CRP has authority to enroll only about 15 percent of the eligible cropland. To make the most of the program's potential, a new Environmental Benefits Index (EBI) was developed. The new EBI will be used to select areas and acreages offering the greatest environmental benefits.

Conservation priority areas (CPAs) are regions targeted for CRP enrollment. The four national CPAs are the Long Island Sound region, the Chesapeake Bay and surrounding areas, an area adjacent to the Great Lakes, and the Prairie Pothole region. FSA State Committees may also designate up to 10 percent of a State's remaining cropland as a State Conservation Priority Area. The NRCS is responsible for determining the relative environmental benefits of each acre offered for participation.

Continuous Sign-Up. For certain high-priority conservation practices yielding highly desirable environmental benefits, producers may sign up at any time, without waiting for an announced sign-up period. Continuous sign-up allows farmers and ranchers management flexibility in implementing certain conservation practices on their cropland. These practices are specially designed to achieve significant environmental benefits, giving participants a chance to help protect and enhance wildlife habitat, improve air quality, and improve the condition of America's waterways. Unlike the general CRP program, sign-up for these special practices is open continuously. Provided certain eligibility requirements are met, acreage is automatically accepted into the program at a per-acre rental rate not to exceed the Commodity Credit Corporation's maximum payment amount, based on site-specific soil productivity and local prevailing cash-equivalent rental rates. For more information on the CRP, see USDA's website at http://www.fsa.usda.gov/dafp/cepd/crpinfo.htm.

Conservation Reserve Enhancement Program
The Conservation Reserve Enhancement Program (CREP), a refinement of the CRP, is a state-federal conservation partnership program targeted to address *specific* state and nationally significant water quality, soil erosion and wildlife habitat issues related to agricultural use. The program uses financial incentives to encourage farmers and ranchers to voluntarily enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production. This community-based conservation program provides a flexible design of conservation practices and financial incentives to address environmental issues. For more information about CREP, refer to USDA's website at http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm.

Wetlands Reserve Program
Congress authorized the Wetlands Reserve Program (WRP) under the Food Security Act of 1985, as amended by the 1990 and 1996 Farm Bills. USDA's Natural Resources Conservation Service (NRCS) administers the program in consultation with the Farm Service Agency and other Federal agencies. WRP is a voluntary program to restore wetlands. Landowners who choose to participate in WRP may sell a conservation easement or enter into a cost-share restoration agreement with USDA to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership.

WRP offers landowners three options: *permanent easements*, *30-year easements*, and *restoration cost-share agreements* of a minimum 10-year duration. In exchange for establishing a *permanent easement*, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetland. In exchange for the *30-year easement*, the landowner receives a payment of 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The *restoration cost-share agreement* is an agreement (generally for a minimum of 10 years) to re-establish degraded or lost wetland habitat, in which USDA pays the landowner 75 percent of the cost of the restoration activity. Restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the agreement. In all instances, landowners continue to control access to their land. For more information about WRP, see NRCS's website at:

http://wl.fb-net.org/.

Conservation Farm Option
The Conservation Farm Option (CFO) is a voluntary pilot program for producers of wheat, feed grains, cotton, and rice. The program purposes include conservation of soil, water, and related resources, water quality protection and improvement, wetland restoration, protection and creation, wildlife habitat development and protection, or other similar conservation activities. Eligibility is limited to owners and producers who have contract acreage enrolled in the Agricultural Market Transition program. Participants are required to develop and implement a conservation farm plan. The plan becomes part of the CFO contract which covers a ten year period. CFO is not restricted as to what measures may be included in the conservation plan, so long as they provide environmental benefits. During the contract period the owner or producer (1) receives annual payments for implementing the CFO contract, and (2) agrees to forgo payments under the Conservation Reserve Program, the Wetlands Reserve Program, and the Environmental Quality Incentives Program in exchange for one consolidated program.

Wildlife Habitat Incentives Program
The Wildlife Habitat Incentives Program (WHIP) is a voluntary program (administered by NRCS) for people who want to develop and improve wildlife habitat primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

Under this program, NRCS helps participants prepare a wildlife habitat development plan in consultation with the local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement. This plan may or may not be part of a larger conservation plan that addresses other resource needs such as water quality and soil erosion.

USDA and the participant enter into a cost-share agreement that generally lasts between 5 to 10 years from the date the agreement is signed. Under the agreement: the landowner agrees to install and maintain WHIP practices and allow NRCS or its agent access to monitor the effectiveness of the practices; and USDA agrees to provide technical assistance and pay up to 75 percent of the cost of installing the wildlife habitat practices.

WHIP is currently budgeted for $50 million total through the year 2002. WHIP funds are distributed to States based on State wildlife habitat priorities, which may include wildlife habitat areas, targeted species and their habitats and specific practices. WHIP may be implemented in cooperation with other

Federal, State, or local agencies; conservation districts; or private conservation groups. For more information, see NRCS's website at http://www.nrcs.usda.gov.

Conservation of Private Grazing Land Initiative
The Conservation of Private Grazing Land initiative will ensure that technical, educational, and related assistance is provided to those who own private grazing lands. It is not a cost share program. This technical assistance will offer opportunities for better grazing and land management; protecting soil from erosive wind and water; using more energy-efficient ways to produce food and fiber; conserving water; providing habitat for wildlife; sustaining forage and grazing plants; using plants to sequester greenhouse gases and increase soil organic matter; and using grazing lands as a source of biomass energy and raw materials for industrial products.

The Wetland Conservation Provision (Swampbuster)
This provision, part of the 1985, 1990, and 1996 farm bills, requires all agriculture producers to protect wetlands on the farms they own or operate if they want to be eligible for USDA farm program benefits. The Swampbuster program generally allows the continuation of most ongoing farming practices as long as wetlands are not converted or wetland drainage increased. The program discourages farmers from altering wetlands by withholding Federal farm program benefits from any person who does the following:

- Plants an agricultural commodity on a converted wetland that was converted by drainage, dredging, leveling or any other means after December 23, 1985.
- Converts a wetland for the purpose of or to make agricultural commodity production after November 28, 1990.

In order to ensure farm program benefits under the Swampbuster provisions, the local NRCS office should be contacted before clearing, draining, or manipulating any wet areas on any farmland.

VII.D. Other Voluntary Initiatives

NICE^3
The U.S. Department of Energy sponsors a grant program called National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). The NICE^3 program provides funding to state and industry partnerships (large and small businesses) for projects demonstrating advances in energy efficiency and clean production technologies. The goal of the NICE^3 program is to demonstrate the performance and economics of innovative technologies in the U.S., leading to the commercialization of improved

industrial manufacturing processes. These processes should conserve energy, reduce waste, and improve industrial cost-competitiveness. Industry applicants must submit project proposals through a state energy, pollution prevention, or business development office. Awardees receive a one-time, three-year grant of up to $400,000, representing up to 50 percent of a project's total cost. In addition, up to $25,000 is available to support the state applicant's cost share. (Contact: View the website at http//www.oit.doe.gov/Access/nice3; Steve Blazek, DOE, (303) 275-4723; or Eric Hass, DOE, (303) 275-4728.)

ISO 14000

ISO 14000 is a series of internationally-accepted standards for environmental management. The series includes standards for environmental management systems (EMS), guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of over 110 country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO. Information on ISO is available at the following Internet site: http://www.iso.ch/welcome.html.

American Forest and Paper Association Sustainable Forest Initiative (SFI)

The Sustainable Forestry Initiative (SFI) program is a comprehensive system of principles, objectives and performance measures that integrates the perpetual growing and harvesting of trees with the protection of wildlife, plants, soil and water quality. AFPA members are committed to following the substance and spirit of best management practices (BMPs) on their own land and in operations they are involved in with other landowners and loggers.

VII.E. Summary of Trade Associations

There are more than 200 trade associations that deal with agricultural issues. Many of these are at the national level, while others deal specifically with regions of the country or individual states. The following identify some of the major associations addressing agricultural production.

Agricultural Retailers Association (ARA)
11701 Borman Drive, Suite 110
St. Louis, MO 63146
314-567-6655

American Farm Bureau Federation
Headquarters Office
225 Touhy Ave.
Park Ridge, IL 60068
847-685-8600

American Farm Bureau Federation
Washington DC Office
Suite 800
600 Maryland Ave. S.W.
Washington, DC 20024
202-484-3600

American Feed Industry Association
1501 Wilson Blvd., Suite 1100
Arlington, VA 22209
703-524-0810

American Oat Association
415 Shelard Parkway, Suite 101
Minneapolis, MN 55426
612-542-9817

American Society of Agronomy
677 S. Segoe Rd.
Madison, WI 53711
608-273-8080 ext.3030

American Sugarbeet Growers Association
156 15th Street, NW, Suite 1101
Washington, DC 20005
202-833-2398

American Crop Protection Association
1156 15th Street, NW, Suite 400
Washington, DC 20005
202-296-1595

American Forest & Paper Association (AF&PA)
1111 19th St., NW, Suite 800
Washington, DC 20036
202-463-2700
E-mail: INFO@afandpa.org

American Nursery & Landscape Association
1250 I Street, NW
Suite 500
Washington, DC 20005
202-789-2933

American Pulpwood Association, Inc.
600 Jefferson Plaza, Suite 350
Rockville, Maryland 20852
301-838-9385

American Soybean Association
540 Maryville Centre Drive
P.O. Box 419200
St. Louis, MO 63141
314-576-1770

Association of American Pesticide Control Officials
P.O. Box 1249
Hardwick, VT 05843
802-472-6956

R0074432

Association of American Plant Food Control Officials (AAPFCO)
Food & Drug Protection Division
North Carolina Department of Agriculture
4000 Reedy Creek Rd.
Raleigh, NC 27607
919-733-7366

Clean Water Network
1200 New York Ave, NW
Washington, DC 20005
202-287-2395

Eastern Dark-fired Tobacco Growers Association
1109 S. Main Street
PO Box 517
Springfield, TN 37172
615-384-4543

Farmworker Justice Fund
1111 19th Street, NW Suite 1000
Washington, DC 20036
202-776-1757

Garden Centers of America
1250 I Street, NW, Suite 500
Washington, DC 20005
202-789-2900

National Association of State Departments of Agriculture (NASDA)
1156 15th St., NW, Suite 1020
Washington, DC 20005
202-296-9680

National Coalition Against the Misuse of Pesticides
701 E Street, SE, Suite 200
Washington, DC 20003
202-543-5450

Burley Tobacco Growers Cooperative Association
PO Box 860
Lexington, KY 40587
606-252-3561

California Fertilizers Association
1700 I St., Suite 130
Sacramento, CA 95814
916-441-1584

Conservation Technology Information Center (CTIC)
1220 Potter Drive, Room 170
West Lafayette, IN 47906-1383
765-494-9555

Environmental Working Group
1101 Wilson Blvd.
Arlington, VA 22209
703-243-3002

Forest Landowners Association
P.O. Box 95385
Atlanta, Georgia 30347
800-325-2954

Institute for Agriculture and Trade Policy
2105 1st Avenue South
Minneapolis, MN 55404
612-870-0453

National Association of Wheat Growers
415 2nd Street, NE, Suite 300
Washington, DC 20002
202-547-7800

National Corn Growers Association
1000 Executive Parkway, Suite 105
St. Louis, MO 63141
314-275-9915

National Cotton Council
1521 New Hampshire Avenue, NW
Washington, DC 20036
202-745-7805

National Council of Farmer Coops. (NCFC)
50 F Street, NW, Suite 900
Washington, DC 20001

National Hay Association
102 Treasure Island Causeway
Suite 201
St. Petersburg, FL 33706
813-367-9702

National Sunflower Association
4023 State Street
Bismark, ND 58501
701-328-5100

Society of American Foresters
5400 Grosvenor Lane
Bethesda, MD 20814
301-897-8720
E-mail: safweb@safnet.org

United Farm Workers of America
1188 Franklin Street, Suite 203
San Francisco, CA 94109
415-674-1884

USDA's Forest Service
Auditors Building
201 14th Street, S.W.
Washington, DC 20024
202-205-1661

National Council of Agricultural Employers
1112 6th Street, NW, Suite 920
Washington, DC 20036
202-728-0300

National Grain and Feed Association
1201 New York Avenue, NW
Suite 830
Washington, DC 20005
202-289-0873

National Pest Control Association
8100 Oak Street (NPCA)
Dunn Loring, VA 22027
703-573-8330

Potato Association of America
University of Idaho
1776 Science Center Drive
Idaho Falls, ID 83402
208-529-8376

The Fertilizer Institute (TFI)
501 Second Street, NE
Washington, DC 20002

USA Rice Council
P.O. Box 740123
Houston, TX 77274
713-270-6699

VIII. CONTACTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the agricultural crop production industries, a list of contacts and publications are provided below.

Contacts[2]

Name	Organization	Telephone	Subject
Ginah Mortensen	EPA, Office of Enforcement and Compliance Assurance (OECA), Agriculture Division, Agriculture Branch	913-551-5211	Notebook Contact
Arty Williams	EPA, Office of Prevention, Pesticides and Toxic Substances (OPPT)	703-305-5239	Ground Water Pesticide Management Plan Rule
Jean Frane	EPA, OPPT	703-305-5944	Food Quality Protection Act
David Stangel	EPA, OECA	202-564-4162	Stored or Suspended Pesticides: Good Laboratory Practice Standards; Pesticide Management and Disposal
Joseph Hogue	EPA, OPPT	703-308-9072	FIFRA Restricted Use Classifications
Robert McNally	EPA, OPPT	703-308-8085	FIFRA Pesticide Tolerances
Joseph Nevola	EPA, OPPT	703-308-8037	FIFRA Pesticide Tolerances
Ellen Kramer	EPA, OPPT	703-305-6475	FIFRA Pesticide Tolerances
Robert A. Forrest	EPA, OPPT	703-308-9376	FIFRA Exemptions
Nancy Fitz	EPA, OPPT	703-305-7385	FIFRA Pesticide Management and Disposal
John MacDonald	EPA, OPPT	703-305-7370	Certification and Training

[2] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Kevin Keaney	EPA, OPPT	703-305-5557	FIFRA Worker Protection Standards
Al Havinga	EPA, OECA	202-564-4147	Livestock Issues
Carol Galloway	EPA, OECA	913-551-5008	Livestock Issues
Sharon Buck	EPA, OWOW	202-260-0306	Nonpoint Source Issues
Greg Beatty	EPA, OWM	202-260-6929	NPDES Permniting Issues
Roberta Parry	EPA, OPEI	202-260-2876	Livestock and Crop Issues
Robin Dunkins	EPA, OAQPS	919-541-5335	Air Issues
Kurt Roos	EPA, OAR	202-564-9041	Atmospheric Programs
Howard Beard	EPA, OGWDW	202-260-8796	Drinking water Issues
Tracy Back	EPA, CCSMD	202-564-7076	Compliance Assistance Centers

General Profile

1997 National Resources Inventory - Summary Report, National Resources Conservation Service, United States Department of Agriculture. December 1999.

Occupational Outlook Handbook Home Page, Bureau of Labor Statistics Home Page. December 1996.

SIC Code Profile 01 and 07, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Draft, September 30, 1994.

Newsletter: *Small and Part Time Farms*, U.S. Department of Agriculture, Fall 1996.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Enforcement and Compliance Assurance Accomplishments Report, FY 1994, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R94-003), April 1995.

Enforcement and Compliance Assurance Accomplishments Report, FY 1995, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R94-003), April 1996.

Enforcement and Compliance Assurance Accomplishments Report, FY 1996, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R-97-003), 1997.

Enforcement and Compliance Assurance Accomplishments Report, FY 1997, U.S. EPA, Office of Enforcement and Compliance Assurance (EPA/300-R-98-003), July 1998.

Occupational Outlook Handbook Home Page, Bureau of Labor Statistics Home Page. December 1996.

North American Industrial Classification System, Office of Management and Budget.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Agriculture Census, 1992 and 1997.

Operations and Pollution Prevention

Best Management Practices for Field Production of Nursery Stock, North Carolina State University Biological and Agricultural Engineering Extension Service (http://www.bae.ncsu.edu/programs/extension/ag-env/nursery/).

Biocontrol of Plant Diseases Laboratory, Agricultural Research Service, 1997 Internet search.

1998 Crop Residual Management Survey Executive Summary, Top 10 Conservation Tillage Benefits, Conservation Tillage Information Center.

Effect of pH on Pesticide Stability and Efficacy, Winand K. Hock, Penn State University (http://pmep.cce.cornell.edu/facts-slides-self/facts/gen-peapp-ph.html).

Environmental Guidelines for Greenhouse Growers - Site Planning, British Columbia Ministry (http://www.agf.gov.bc.ca/resmgmt/fppa/pubs/environ/greenhse/grnhse.htm).

Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, U.S. Environmental Protection Agency (http://www.epa.gov/OWOW/NPS/MMGI/) January 1993.

Nonpoint Source Pollution: The Nation's Largest Water Quality Problem Pointer No. 1, US EPA 1996.

NRCS Conservation Practice Standards, http://www.ncg.usda.gov/practice_stds.html.

Principles of Irrigation Management:. Water Management Guidelines for Nursery/Floral Producers, 1997, http://aggie-horticulture.tamu.edu/greenhouse/environ/wmprinc.html).

Texas Greenhouse Management Handbook, Dr. Don Wilkerson, Texas Agricultural Extension Service (http://aggie-horticulture.tamu.edu/greenhouse/guides/green/green.html) (no date).

Treating and Recycling Irrigation Runoff: Water Management Guidelines for Nursery/Floral Producers, 1997, http://aggie-horticulture.tamu.edu/greenhouse/environ/wmrecyc.html).

Water Quality and Waste Management, North Carolina Cooperative Extension, http://www2.ncsu.edu/bae/programs/extension/publicat/wqwm/index.html.

Miller, W.P., "Environmental Considerations in Land Application of By-Product Gypsum," *Agricultural Utilization of Urban and Industrial By-Products*, American Society of Agronomy, Madison, WI, 1995.

Regulatory Profile

Ag Environmental Programs, http://es.epa.gov/oeca/ag/aglaws/.

Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution, Environmental Law Institute, 1997.

1996 Farm Bill Conservation Provisions, http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/FBillLnk.html.

1996 Farm Bill Summary, http://www.usda.gov/farmbill/title0.htm.

Major Existing EPA Laws and Programs That Could Affect Producers of Agricultural Commodities, U.S. Environmental Protection Agency, Agriculture and Ecosystems Division, August 8, 1996.

Overview of the Storm Water Program, Office of Water, U.S. Environmental Protection Agency, June 1996. EPA 833-R-96-008.

U.S. EPA Permit Writers' Manual, U.S. Environmental Protection Agency, Office of Water (EPA-833-B-96-003) December 1996.

Haugrud, K. Jack. "Agriculture," Chapter 8 in *Sustainable Environmental Law, Integrating Natural Resource and Pollution Abatement Law from Resources to Recovery*, Environmental Law Institute, St. Paul, 1993.

Landfair, Stanley W. "Toxic Substances Control Act," Chapter 11 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Miller, Marshall E. "Federal Regulation of Pesticides," Chapter 13 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Other Resources

AgNIC, http://www.agnic.org/.

*Farm*A*Syst*, http://www.wisc.edu/farmasyst/index.html.

The Quality of Our Nation's Water, http://www.epa.gov/305b.

Manure Master Decision Support Tool, http://www.ftw.nrcs.usda.gov/ManureMaster/.

State Partners of the Cooperative State Research, Education, and Extension Service, http://www.reeusda.gov/statepartners/usa.htm.

Charge your order,
It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800
Order online at http://bookstore.gpo.gov

Order Processing Code: 3212

Qty	GPO Stock #	Title	Price (each)	Total
		Published in 1995		
	005-000-00512-5	Profile of the Dry Cleaning Industry, 104 pages	$6.50	
	055-000-00513-3	Profile of the Electronics and Computer Industry, 160 pages	$11.00	
	055-000-00518-4	Profile of the Fabricated Metal Products Industry, 164 pages	$11.00	
	055-000-00515-0	Profile of the Inorganic Chemical Industry, 136 pages	$9.00	
	005-000-00516-8	Profile of the Iron and Steel Industry, 128 pages	$8.00	
	055-000-00517-6	Profile of the Lumber and Wood Products Industry, 136 pages	$9.00	
	055-000-00519-2	Profile of the Metal Mining Industry, 148 pages	$10.00	
	055-000-00520-6	Profile of the Motor Vehicle Assembly Industry, 156 pages	$11.00	
	055-000-00521-4	Profile of the Nonferrous Metals Industry, 140 pages	$9.00	
	055-000-00522-2	Profile of the Non-Fuel, Non-Metal Mining Industry, 108 pages	$6.00	
	055-000-00523-1	Profile of the Organic Chemical Industry, 152 pages	$11.00	
	055-000-00524-9	Profile of the Petroleum Refining Industry, 124 pages	$11.00	
	005-000-00525-7	Profile of the Printing Industry, 124 pages	$7.50	
	055-000-00526-5	Profile of the Pulp and Paper Industry, 156 pages	$11.00	
	055-000-00527-3	Profile of the Rubber and Plastic Industry, 152 pages	$11.00	
	055-000-00528-1	Profile of the Stone, Clay, Glass and Concrete Industry, 124 pages	$7.50	
	055-000-00529-0	Profile of the Transportation Equipment Cleaning Industry, 84 pages	$5.50	
	055-000-00514-1	Profile of the Wood Furniture and Fixtures Industry, 132 pages	$8.00	
		Published in 1997		
	055-000-00570-2	Profile of the Air Transportation Industry, 90 pages	$7.50	
	055-000-00576-1	Profile of the Fossil Fuel Electric Power Generation Ind., 160 pages	$14.00	
	055-000-00571-1	Profile of the Ground Transportation Industry, 130 pages	$10.00	
	055-000-00573-7	Profile of the Metal Casting Industry, 150 pages	$13.00	
	055-000-00574-5	Profile of the Pharmaceutical Manufacturing Industry, 147 pages	$13.00	
	055-000-00575-3	Profile of the Plastic Resin & Man-made Fiber Industry, 180 pages	$15.00	
	055-000-00577-0	Profile of the Shipbuilding and Repair Industry, 120 pages	$9.50	
	055-000-00578-8	Profile of the Textile Industry, 130 pages	$10.00	
	055-000-00572-9	Profile of the Water Transportation Industry, 90 pages	$7.50	
		Published in 1998		
	055-000-00579-6	Sector Notebook Data Refresh-1997, 210 pages	$17.00	
	055-000-00619-9	Profile of the Aerospace Industry, 130 pages	$10.00	
		Published in 1999		
	055-000-00620-2	Profile of Local Government Operations, 310 pages	$25.00	
		Published in 2000		
	055-000-00635-1	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry, 200p	$18.00	
	055-000-00636-9	Profile of the Agricultural Crop Production Industry, 178 pages	$16.00	
	055-000-00633-4	Profile of the Agricultural Livestock Production Industry, 159 pages	$15.00	
	055-000-00634-2	Profile of the Oil and Gas Extraction Industry,	$16.00	

The total cost of my order is $__________. Price includes regular shipping and handling and is subject to change. International orders add 25 percent.

____
Company or personal name (please type or print)

____
Additional address/attention line

____
Street Address

____
City, State, Zip Code

____
Daytime phone including area code

Check method of payment:

☐ Check payable to Superintendent of Documents
☐ GPO Deposit Account__________________
☐ VISA ☐ MasterCard ☐ Discover/NOVUS
Credit Card # __________________________
Expiration date ______ *Thank you for your order!*

____
Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954

****Important: Please include completed order form with payment**

R0074440

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

United States
Environmental Protection
Agency

Enforcement and
Compliance Assurance
(2221-A)

EPA 310-R-00-002
September 2000

EPA

Profile of the Agricultural Livestock Production Industry

SECTOR EPA 33 NOTEBOOKS

EPA Office of Compliance Sector Notebook Project

R0074442

GENERAL INFORMATION

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by GeoLogics Corporation (Alexandria, VA), Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

Obtaining copies:

Electronic versions of all sector notebooks are available via Internet on the Enviro**ene** World Wide Web at **www.epa.gov/oeca/sector**. Enviroene is a free, public, environmental exchange system operated by EPA's Office of Enforcement and Compliance Assurance and Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization. Direct technical questions to the "Feedback" button on the bottom of the web page.

Purchase printed bound copies from the **Government Printing Office (GPO)** by consulting the order form at the back of this document or order via the Internet by visiting the on-line GPO Sales Product Catalog at **http://orders.access.gpo.gov/su_docs/sale/prf/prf.html**. Search using the exact title of the document "Profile of the XXXX Industry" or simply "Sector Notebook." When ordering, use the GPO document number found on the order form at the back of this document.

Complimentary volumes are available to certain groups or subscribers, including public and academic libraries; federal, state, tribal, and local governments; and the media from EPA's National Service Center for Environmental Publications at **(800) 490-9198.** When ordering, use the EPA publication number found on the following page.

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460
(202) 564-7017

For further information, and for answers to questions pertaining to these documents, please refer to the contact names listed on the following page.

R0074443

SECTOR NOTEBOOK CONTACTS

Questions and comments regarding the individual documents should be directed to the specialists listed below. **See the Notebook web page at: *www.epa.gov/oeca/sector* for the most recent titles and staff contacts.**

EPA Publication Number	Industry	Contact	Phone
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry	Joyce Chandler	202-564-7073
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*	Steve Hoover	202-564-7007
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry	Bob Marshall	202-564-7021
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*	Walter DeRieux	202-564-7067
EPA/310-R-95-005.	Profile of the Iron and Steel Industry	Maria Malave	202-564-7027
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry	Seth Heminway	202-564-7017
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*	Scott Throwe	202-564-7013
EPA/310-R-95-008.	Profile of the Metal Mining Industry	Maria Malave	202-564-5027
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry	Anthony Raia	202-564-6045
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry	Debbie Thomas	202-564-5041
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	202-564-2628
EPA/310-R-95-012.	Profile of the Organic Chemical Industry *	Walter DeRieux	202-564-7067
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry	Tom Ripp	202-564-7003
EPA/310-R-95-014.	Profile of the Printing Industry	Ginger Gotliffe	202-564-7072
EPA/310-R-95-015.	Profile of the Pulp and Paper Industry	Seth Heminway	202-564-7017
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry		202-564-2310
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	202-564-7013
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.	Virginia Lathrop	202-564-7057
EPA/310-R-97-001.	Profile of the Air Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-002.	Profile of the Ground Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-003.	Profile of the Water Transportation Industry	Virginia Lathrop	202-564-7057
EPA/310-R-97-004.	Profile of the Metal Casting Industry	Steve Hoover	202-564-7007
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry	Emily Chow	202-564-7071
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	202-564-7074
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	202-564-7028
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry	Anthony Raia	202-564-6045
EPA/310-R-97-009.	Profile of the Textile Industry		202-564-2310
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **	Seth Heminway	202-564-7017
EPA/310-R-98-001.	Profile of the Aerospace Industry	Anthony Raia	202-564-6045
EPA/310-R-99-006.	Profile of the Oil and Gas Extraction Industry	Dan Chadwick	202-564-7054
EPA/310-R-00-001.	Profile of the Agricultural Crop Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-002.	Profile of the Agricultural Livestock Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry	Michelle Yaras	202-564-4153

Government Series

EPA/310-R-99-001.	Profile of Local Government Operations		202-564-2310

* Spanish translations available.

** This document revises compliance, enforcement, and toxic release inventory data for all profiles published in 1995.

TABLE OF CONTENTS

LIST OF EXHIBITS

LIST OF ACRONYMS

ACM	Asbestos-Containing Material
AFS	AIRS Facility Subsystem (CAA database)
AFO	Animal Feeding Operation
ANSI	American National Standards Institute
APO	Administrative Penalty Order
AU	Animal Unit
BIF	Boiler and Industrial Furnace
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CAFO	Concentrated Animal Feeding Operation
CCAP	Climate Change Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	CERCLA Information System (CERCLA database)
CESQG	Conditionally Exempt Small Quantity Generator
CFC	Chlorofluorocarbon
CFO	Conservation Farm Option
CFR	Code of Federal Regulations
CNMP	Comprehensive Nutrient Management Plans
COD	Chemical Oxygen Demand
CPA	Conservation Priority Areas
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CZARA	Coastal Zone Act Reauthorization Amendments
DOT	United States Department of Transportation
DUN	Dun and Bradstreet
EBI	Environmental Benefits Index
EMS	Environmental Management Standards
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EQIP	Environmental Quality Incentives Program
ESPP	Endangered Species Protection Program
FDA	United States Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FQPA	Food Quality Protection Act
FSA	Farm Services Agency
FWS	Fish and Wildlife Service

LIST OF ACRONYMS (CONTINUED)

FY	Fiscal Year
HAP	Hazardous Air Pollutant (CAA)
HSWA	Hazardous and Solid Waste Amendments
HUD	United States Department of Housing and Urban Development
IDEA	Integrated Data for Enforcement Analysis
IPM	Integrated Pest Management
ISO	International Organization for Standardization
LDR	Land Disposal Restrictions (RCRA)
LEPC	Local Emergency Planning Committee
LQG	Large Quantity Generator
MACT	Maximum Achievable Control Technology (CAA)
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards (CAA)
NAICS	North American Industrial Classification System
NASS	National Agricultural Statistics Service
NCDB	National Compliance Database, Office of Prevention, Pesticides and Toxic Substances
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NICE	National Industrial Competitiveness Through Energy, Environment and Economics
NOA	Notice of Arrival
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System (CWA)
NPL	National Priorities List
NPS	Nonpoint Source Management Program
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standards (CAA)
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PCS	Permit Compliance System
PESP	Pesticide Environmental Stewardship Program
PMN	Premanufacture Notice
POTW	Publicly Owned Treatment Works
PWS	Public Water System
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System (RCRA database)

LIST OF ACRONYMS (CONTINUED)

RLEP	Ruminant Livestock Efficiency Program
RMP	Risk Management Plan
RQ	Reportable Quantity
RUP	Restricted Use Pesticides
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEP	Supplemental Environmental Project
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SPCC	Spill Prevention, Control, and Countermeasure
SQG	Small Quantity Generator
TMDL	Total Maximum Daily Load
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
USDA	U.S. Department of Agriculture
UST	Underground Storage Tank (RCRA)
WHIP	Wildlife Habitat Incentives Program
WPS	Worker Protection Standards
WRP	Wetlands Reserve Program

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are becoming an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies addressing all media for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition by the EPA Office of Compliance of the need to develop the industrial "sector-based" approach led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above alone could be the subject of a lengthy volume. However, to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be explored further based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be sent via the web page.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the relative national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers also may want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting the development of new notebooks, please contact the Office of Compliance at 202-564-2310.

II. Introduction to the Agricultural Livestock Production Industry

This section provides background information on the agricultural livestock production industry. It presents the types of facilities described within this document and defines them in terms of their North American Industrial Classification System (NAICS) codes.

Establishments that produce livestock are classified in ***NAICS code 112 (Animal Production)***. Data for the notebook, specifically in this chapter, were obtained from the U.S. Department of Agriculture (USDA) and the 1997 Agriculture Census (Ag Census). All data are the most recent publicly available data for the source cited.

> The Office of Management and Budget (OMB) has replaced the Standard Industrial Classification (SIC) system, which was used to track the flow of goods and services within the economy, with the NAICS. The NAICS, which is based on similar production processes to the SIC system, is being implemented by OMB.

It should be noted that the data on the number of livestock establishments presented in the following sections do not represent the number of animal feeding operations (AFOs) or concentrated animal feeding operations (CAFOs) in the U.S. The data simply represent numbers of livestock establishments only. Additional information on AFOs and CAFOs is presented in Section II.C.

Establishments primarily engaged in livestock production are classified in subgroups up to six digits in length, based on the total value of sales of agricultural products. An establishment would be placed in the group that represents 50 percent or more of its total sales. For example, if 51 percent of the total sales of an establishment are from sales of beef cattle, that establishment would first be classified under NAICS code 1121 (Cattle Ranching and Farming), then 11211 (Beef cattle ranching and farming, including feedlots), and finally under 112111 (Beef cattle ranching and farming).

II.A. General Overview of Agricultural Establishments

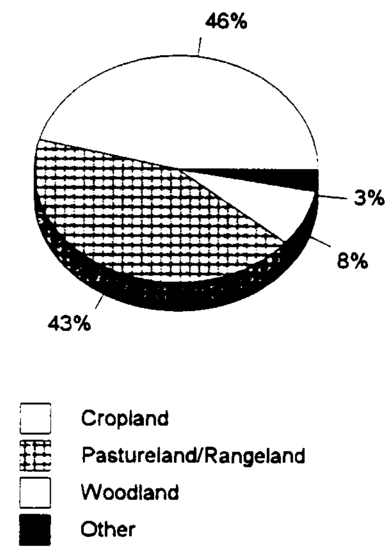
This section presents a general overview of all agricultural establishments to provide the reader with background information regarding the number and organization of such establishments and production data. The USDA's National Agricultural Statistics Service (NASS) defines an *agricultural establishment* (farm) based on production. It defines an agricultural establishment as a place which produced or sold, or normally would have

R0074453

produced or sold, $1,000 or more of agricultural products during the year. Agricultural products include all products grown by establishments under NAICS codes 111 - Crop Production and 112 - Animal Production.

According to the 1997 Ag Census, there were more than 1.9 million farms (i.e., agricultural establishments) in the United States. Of these, approximately 53 percent (1,009,487 farms) were classified as NAICS code 112 - Animal Production. The other 47 percent (902,372 farms) were classified as NAICS code 111 - Crop Production. These 1.9 million agricultural establishments represent nearly 932 million acres of land, with the average agricultural establishment consisting of 487 acres. (Note: 1 acre is approximately the size of a football field.) Both of these numbers--932 million acres and 487 acres--are smaller than those for 1992, which were 946 million acres and 491 acres, respectively.

Exhibit 1. Agricultural Land Use in the U.S. (1997 Ag Census)

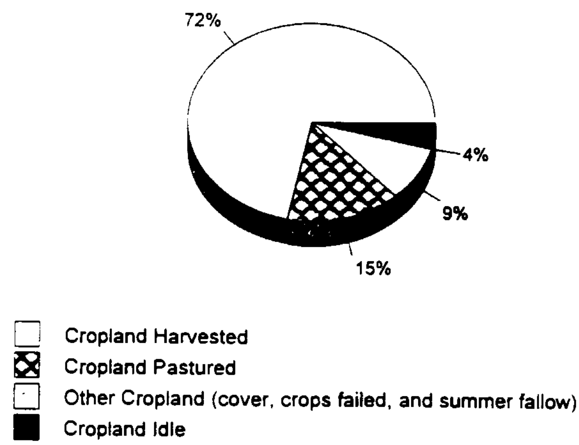


As shown in Exhibit 1, of the 932 million acres of agricultural land, the overwhelming majority (89%) consists of cropland and pastureland/rangeland.

R0074454

As presented in Exhibit 2, the 1997 Ag Census describes cropland as:

Exhibit 2. Types of Cropland
(1997 Ag Census)



- *Harvested cropland* -- Includes all acreage from which crops are harvested, such as: (1) corn, wheat, barley, oats, sorghum, soybeans, cotton, and tobacco; (2) wild or tame harvested hay, silage, and green chop; and (3) vegetables. It also includes land in orchards and vineyards; all acres in greenhouses, nurseries, Christmas trees, and sod; and any other acreage from which a crop is harvested even if the crop is considered a partial failure and the yield is very low.

- *Cropland used only for pasture or grazing* -- Includes land pastured or grazed which could be used for crops without any additional improvement, and land in planted crops that is pastured or grazed before reaching maturity.

- *Cropland used for cover crops* -- Includes land used only to grow cover crops for controlling erosion or to be plowed under for improving the soil.

- *Cropland on which all crops failed* -- Includes: (1) all land from which a crop failed (except fruit or nuts in an orchard, grove, or vineyard being maintained for production) and no other crop is harvested and which is not pastured or grazed, and (2) acreage not harvested due to low prices or labor shortages.

- *Cultivated summer fallow* -- Includes cropland left unseeded for harvest, and cultivated or treated with herbicides to control weeds and conserve moisture.

- *Idle cropland* -- Includes any other acreage which could be used for crops without any additional improvement and which is not included in one of the above categories of cropland.

The 1997 Ag Census describes pastureland and rangeland as land, other than cropland or woodland pasture, that is normally used for pasture or grazing. This land, sometimes called "meadow" or "prairie," may be composed of bunchgrass, shortgrass, buffalo grass, bluestem, bluegrass, switchgrass, desert shrubs, sagebrush, mesquite, greasewood, mountain browse, salt brush, cactus, juniper, and pinion. It also can be predominantly covered with brush or browse.

As presented in Exhibit 3, approximately 82 percent of agricultural establishments in 1997 consisted of fewer than 500 acres; only 4 percent consisted of 2,000 or more acres.

According to the 1997 Ag Census, all agricultural establishments combined to produce approximately $197 billion worth of agricultural products.

Exhibit 3. Acreage of Agricultural Establishments in the U.S. (1997 Ag Census)

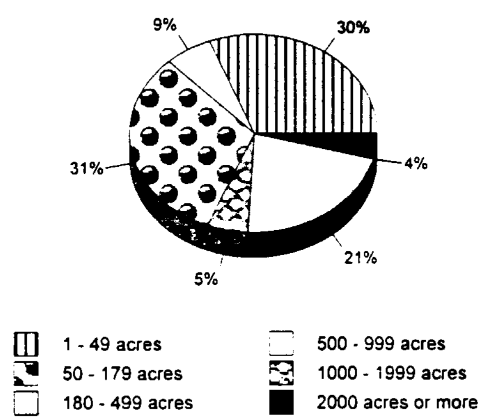
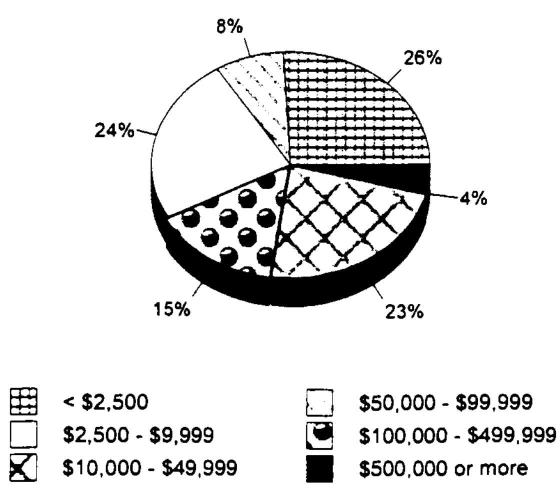


Exhibit 4. Agricultural Establishments by Value of Sales (1997 Ag Census)



The market value of the agricultural products sold was split almost evenly between crop production, including nursery and greenhouse crops (49.6%) and livestock production (50.4%).

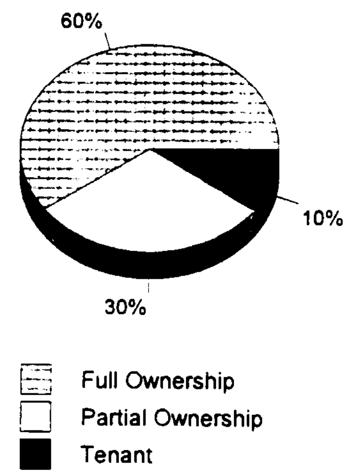
As shown in Exhibit 4, approximately 73 percent of all agricultural establishments produced less than $50,000 worth of agricultural products.

R0074456

In addition to tracking the number of agricultural establishments and the value of products sold, the Ag Census tracks and identifies other characteristics of agricultural establishments, such as ownership and organization. Exhibit 5 presents a breakdown of the ownership status of agricultural establishments in the U.S. The Ag Census basically identifies the ownership status of agricultural establishments by one of three categories:

- Full ownership, in which full owners operate only the land they own.
- Partial ownership, in which partial owners operate land they own and also land they rent from others.
- Tenant/rental arrangement, in which tenants operate only land they rent from others or work on shares for others.

Exhibit 5. Ownership Status of Agricultural Establishments in the U.S. (1997 Ag Census)



The Census further classifies agricultural establishment ownership by the person or entity who owns the establishment. There are four distinct types of organization: (1) individual or family (sole proprietorship), (2) partnership, including family partnership, (3) corporation, including family corporation, and (4) other, including cooperatives, estate or trust, and institutional. Approximately 86 percent of all establishments are owned and operated by individuals or families. Partnerships account for another 9 percent of the establishments and corporations own just more than 4 percent of the establishments. Fewer than 1 percent of all farms are owned by other organizations (1997 Ag Census).

II.B. Characterization of the Livestock Production Industry

This section provides data and information on the livestock production industry. For the purposes of this profile, livestock production includes the six categories of livestock presented in Exhibit 6. It should be noted that this profile does not include the processing of agricultural livestock products (e.g., meat processing plants, milk processing, etc.), and only discusses livestock

R0074457

production to the point of sending the livestock to the processing point (e.g., beyond the feedlot). This notebook follows the structure provided by the 1997 Ag Census, which classifies all of these livestock production operations within NAICS code 112.

Exhibit 6. 1997 NAICS Descriptions for Animal Production (NAICS 112)

Type of Establishment	NAICS Code	SIC Code	Description
Cattle ranching and farming, dairy farming	1121	0211, 0212, 0241	Establishments primarily engaged in raising cattle, milking dairy cattle, or feeding cattle for fattening.
Hog and pig farming	1122	0213	Establishments primarily engaged in raising hogs and pigs. These establishments may include farming activities, such as breeding, farrowing, and the raising of weaning pigs, feeder pigs, or market size hogs.
Poultry and egg production	1123	0251, 0252, 0253, 0254, 0259	Establishments primarily engaged in breeding, hatching, and raising poultry for meat or egg production.
Sheep and goat farming	1124	0214	Establishments primarily engaged in raising sheep, lambs, and goats, or feeding lambs for fattening.
Animal aquaculture	1125	0273, 0279, 0919, 0921	Establishments primarily engaged in the farm raising of finfish, shellfish, or any other kind of animal aquaculture. These establishments use some form of intervention in the rearing process to enhance production, such as holding in captivity, regular stocking, feeding, and protecting from predators.
Other animal production	1129	0271, 0272, 0279	Establishments primarily engaged in raising animals and insects for sale or product production (except those listed above), including bees, horses and other equines, rabbits and other fur-bearing animals and associated products (e.g., honey). Also includes those establishments for which no one animal or animal family represents one-half of production.

According to the 1997 Ag Census, there were 1,009,487 establishments producing the six categories of livestock referenced above (see Exhibit 7). Of the 1,009,487 livestock producing establishments, approximately 78 percent were classified as cattle ranching and farming.

All livestock producing establishments combined covered nearly 530 million acres of land. Based on the number of establishments and total acreage for each NAICS code, Exhibit 8 presents the average size of each type of establishment.

Exhibit 7. Number of Livestock-Producing Establishments by NAICS Code (1997 Ag Census)

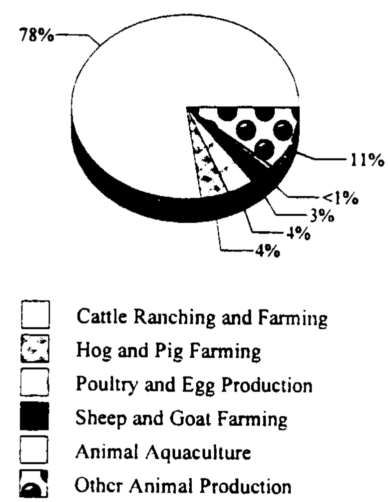
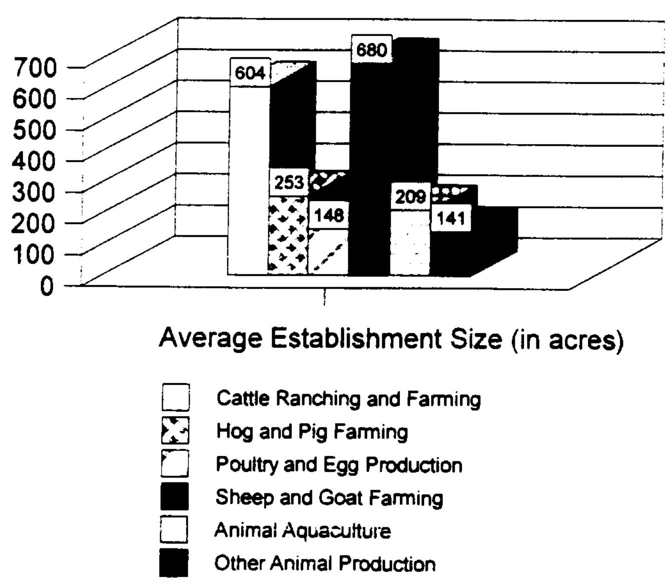


Exhibit 8. Average Establishment Size (1997 Ag Census)



R0074459

The six types of livestock producing establishments defined above accounted for approximately $99 billion worth of products sold in 1997. Exhibit 9 presents the distribution of total sales among the six types of establishments compared to the total number of establishments. EPA's *Preliminary Data Summary Feedlots Point Source Category Study* released in January 1999 contains additional detailed information for beef cattle, dairy, pork, sheep, and poultry operations.

Exhibit 9. Percentage of Establishments & Sales by Type (1997 Ag Census)

Type of Livestock Establishment	Percent of Establishments	Percent of Sales
Cattle Ranching and Farming	78	60
Hog and Pig Farming	4	14
Poultry and Egg Production	4	23
Sheep and Goat Farming	3	<1
Animal Aquaculture	<1	<1
Other Animal Production	11	2

II.B.1. Cattle Ranching and Farming

Cattle ranching and farming establishments (NAICS code 1121) comprise the overwhelming majority of all establishments categorized under NAICS code 112 by accounting for 77.9 percent of all livestock establishments. In the U.S. in 1997, there were 785,672 cattle ranching and farming establishments. Of these, approximately 89 percent (699,650 establishments) were categorized as beef cattle establishments, including feedlots. The remaining 11 percent (86,022 establishments) were categorized as dairy cattle and milk production facilities. In 1997, the average beef cattle establishment was nearly 635 acres in size. Establishments raising dairy cattle and producing milk averaged approximately 356 acres.

Cattle ranching and farming establishments accounted for approximately $60 billion of sales in 1997. Of that $60 billion, beef cattle establishments had sales of approximately $38 billion (approximately 65 percent of sales), while dairy cattle and milk production accounted for the remaining $21 billion. Exhibit 10 compares the percentage sales of each subcategory to the percentage of establishments.

Exhibit 10. Percentage of Establishments & Sales in the Cattle Ranching and Farming Industry (1997 Ag Census)

Type of Establishment	Percent of Establishments	Percent of Sales
Beef cattle ranch and farming, including feedlots	89	65
Dairy cattle and milk production	11	35

II.B.2. Hog and Pig Farming

Hog and pig farming (NAICS code 1122) comprised approximately 4.6 percent (46,353 establishments) of all the livestock producing establishments in the U.S. in 1997. These establishments accounted for nearly $14 billion in total sales, or approximately 14 percent of total livestock producing establishment sales in 1997.

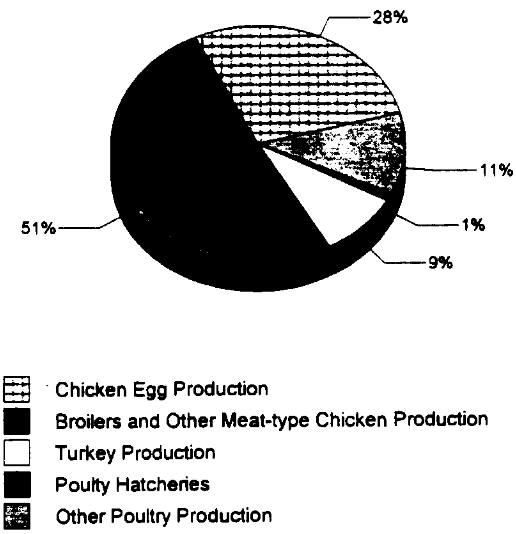
II.B.3. Poultry and Egg Production

Poultry and egg production is classified in NAICS code 1123. In 1997, this category included 36,944 establishments, or approximately 4 percent of all livestock producing establishments in the U.S. Poultry and egg production is divided into 5 subclassifications:

- Chicken egg production (NAICS code 11231)
- Broilers and other meat-type chicken production (NAICS code 11232)
- Turkey production (NAICS code 11233)
- Poultry hatcheries (NAICS code 11234)
- Other poultry production, including ducks, emus, geese, ostrich, pheasant, quail, and ratite (NAICS code 11239)

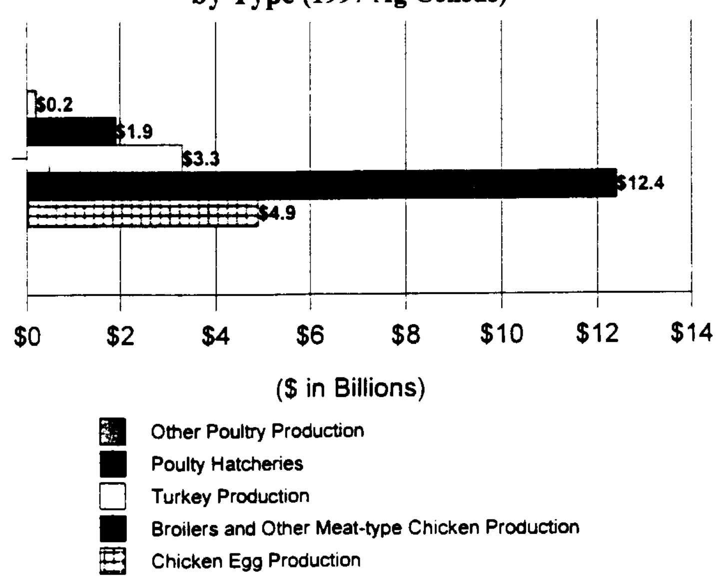
Exhibit 11 provides a breakdown of the 5 subclassifications by number of establishments. Each of these establishments averages approximately 150 acres in size.

Exhibit 11. Percent of Poultry and Egg Production Establishments by Type (1997 Ag Census)



In 1997, the poultry and egg production industry combined for nearly $23 billion in sales, which accounted for 23 percent of total livestock sales in the U.S. Sales of broilers and other meat-type chicken accounted for 54 percent of those sales (approximately $12.4 billion). Exhibit 12 presents the total sales of each of the subclassifications of the poultry and egg production industry.

Exhibit 12. Total Sales of Poultry and Egg Production Establishments by Type (1997 Ag Census)



R0074462

The poultry industry has increased its use of contractual agreements because of the high number of producers relative to the number of available buyers willing to handle raw farm products. The use of contracts has been noted to affect the organizational structure of the poultry industry raising questions about ownership responsibility as well as environmental concerns. This is particularly true when animals are produced under contracts where the contractor (processor or integrator) dictates the terms of the contract and controls the amount produced and the production practices used, but the contractee (grower) retains responsibility for increased animal waste management and disease control often without adequate compensation to meet these additional costs. In a 1993 study, USDA showed that almost 90 percent of the value of all poultry production is produced under contract, which has played a key role in the influence of integrators on the poultry sector.

II.B.4. Sheep and Goat Farming

Sheep and goat farming (NAICS code 1124) comprised 3 percent of all livestock establishments in the U.S. in 1997 and accounted for nearly 4 percent of the total acreage of livestock establishments. Of the 29,938 sheep and goat establishments, 21,084 (approximately 70 percent) are sheep farms; the remaining 8,854 are goat farms. The average sheep farm is approximately 830 acres in size. Goat farms average approximately 320 acres.

In 1997, sheep and goat farms combined for $625 million in total sales, which is less than 1 percent of total livestock producing establishment sales and the least amount of the six primary NAICS codes. Sheep accounted for $568 million in sales (approximately 91 percent) and goat sales accounted for the remaining $57 million.

II.B.5. Animal Aquaculture

Animal aquaculture (NAICS code 1125) is the smallest of the livestock producing establishments in terms of number of establishments, with only 3,079 active establishments in 1997. This accounted for fewer than 1 percent of all livestock producing establishments in the U.S. It also accounted for less than 1 percent ($800 million) of the 1997 total sales of livestock producing establishments. NAICS subdivides animal aquaculture establishments as follows:

- Finfish farming and fish hatcheries (NAICS code 112511), which is raising finfish (e.g., catfish, trout, goldfish, tropical fish, salmon, and minnows) and/or hatching fish of any kind.
- Shellfish farming (NAICS code 112512), which is raising crayfish, shrimp, oysters, clams, and/or mollusks.

- Other animal aquaculture (NAICS code 112519), which is raising animals other than finfish and shellfish, including alligators, frogs, and/or turtles.

While data for each of the specific NAICS subclassifications were not available through the 1997 Ag Census, USDA's NASS has identified at least 955 catfish producing operations. These operations are located primarily in four states--Alabama, Arkansas, Louisiana, and Mississippi. Similarly, the USDA has identified 451 trout operations located in 16 states, but primarily in North Carolina, Wisconsin, and Michigan. These trout operations had total sales in 1998 of $78.9 million. Both the number of operations and the value of total sales are down from the 1997 totals of 465 and $79.8 million, respectively.

II.B.6. Other Animal Production

Production of other animals (NAICS code 1129) occurred at 107,051 establishments in 1997, which is approximately 11 percent of all livestock producing establishments in the U.S. These establishments produce a variety of other animals including:

- Apiculture [bee farming (i.e., raising bees)] (NAICS code 11291)
- Horse and other equine production, including burros, donkeys, mules, and ponies (NAICS code 11292)
- Fur-bearing animal and rabbit production, including chinchillas, foxes, and mink (NAICS code 11293)
- All other animal production, including aviaries, bison/buffalo, cats/dogs, llamas, snakes, and worms (NAICS code 11299)

These four subclassifications accounted for just more than 2 percent of the total sales of livestock producing establishments in 1997. Exhibit 13 provides a breakdown of the 4 subclassifications by percent of establishments, as well as by percent of sales.

Exhibit 13. Percent of Establishments & Sales for the Other Animal Production Industry (1997 Ag Census)

Establishment Type	Percent of Establishments	Percent of Sales
Apiculture	4	5.9
Horse and Other Equine Production	86	42.9
Fur-bearing Animal and Rabbit Production	1	4.7
All Other Animal Production	9	46.5

II.C. Animal Feeding Operations

Many livestock establishments within NAICS code 112 are defined by EPA as either animal feeding operations (AFOs) or concentrated animal feeding operations (CAFOs). The primary factor classifying a livestock operation as an AFO or CAFO is the confinement of animals in a relatively small area devoid of sustaining vegetation. According to the USDA/EPA Unified National Strategy for AFOs, "AFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small area of land." This factor separates AFOs (and CAFOs) from the pasture and range operations. The number of animals, among other factors, separates the AFOs from the CAFOs.

EPA is currently collecting and analyzing data on livestock production facilities to determine the number of facilities which meet the definition of AFO or CAFO. This will allow the Agency to better understand the universe of the regulated community, assist compliance, and as necessary, take enforcement action. EPA is currently developing AFO guidance documents and revised regulations that address permitting, performance standards, and other issues. The following sections provide information on the regulatory definitions of both AFOs and CAFOs.

Animal Feeding Operations

What is an AFO?
The term animal feeding operation or AFO is defined in EPA regulations [40 CFR 122.23(b)(1)] as:

- A lot or facility where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period; AND

- Where crops, vegetation, forage growth, or post-harvest residues are not sustained over any portion of the lot or facility in the normal growing season.

According to EPA[1], the first part of this regulatory definition of an AFO states that animals must be kept on the lot or facility for a minimum of 45 days. If an animal is at a facility for any portion of a day, it is considered to be at the facility for a full day. However, this does not mean that the same animals must remain on the lot for 45 days; only that some animals are fed or maintained on the lot or facility 45 days out of any 12-month period. The 45 days do not have to be consecutive, and the 12-month period does not have to correspond to the calendar year. For example, June 1 to the following May 31 would constitute a 12-month period.

The second part of the regulatory definition of an AFO is meant to distinguish facilities that have feedlots (concentrated confinement areas) from those which have pasture and grazing land, which are generally not AFOs. Facilities that have feedlots with constructed floors, such as solid concrete or metal slots, satisfy this part of the definition. If a facility maintains animals in an area without vegetation, including dirt lots, the facility meets this part of the definition. Dirt lots with nominal vegetative growth along the edges while animals are present or during months when animals are kept elsewhere are also considered by EPA to meet the second part of the definition.

The NPDES permit regulations [40 CFR Part 122.23(b)(1)] give the permitting authority (EPA or NPDES-authorized States) considerable discretion in applying the AFO definition. EPA defines the AFO to include the confinement area and the storage and handling areas necessary to support the operation (e.g., waste storage areas). Grazing and winter feeding of animals in a confined area on pasture or range land are not normally considered to meet the AFO definition.

As indicated in the USDA/EPA Unified National Strategy for AFOs, discharges from areas where manure and wastewater are applied to the land can have a significant impact on water quality. These land application areas are outside the area of confined animals but can be implicated by their direct relationship to AFO waste. Discharges of CAFO wastes from land application

[1] *Guidance Manual and Example NPDES Permit for Concentrated Animal Feeding Operations (Draft)*, U.S. Environmental Protection Agency, August 6, 1999.

areas can qualify as point source discharges in certain circumstances. Accordingly, NPDES permits for CAFOs should address land application of wastes from CAFOs.

How Do You Determine the Size of an AFO?
Once the facility meets the AFO definition, its size, based upon the total numbers of animals confined, is a fundamental factor in determining whether it is a CAFO. The animal livestock industry is diverse and includes a number of different types of animals that are kept and raised in confined situations. In order to define these various livestock sectors in relative terms, the concept of an "animal unit"[2] was established in the EPA regulations [40 CFR Part 122 Appendix B]. An animal unit (AU) varies according to animal type; one animal is not necessarily equal to one AU. Each livestock type, except poultry, is assigned a multiplication factor to facilitate determining the total number of AUs at a given facility. Multiplication factors are defined in Exhibit 14.

Exhibit 14. Multiplication Factors to Calculate Animal Units

Animal Type	Multiplication Factor
Beef Cattle (slaughter and feeder)	1.0
Mature Dairy Cattle	1.4
Swine (weighing more than 55 lbs.)	0.4
Sheep	0.1
Horses	2.0
Poultry	There are currently no animal unit conversions for poultry operations. However the regulations [40 CFR 122, Appendix B] define the total number of animals (subject to waste handling technology restrictions) for specific poultry types that make these operations subject to the regulation.

These factors also are used when determining the total number of animal units at a facility with multiple animal types. Multiplication factors are applied to the total for each type of animal to determine the AU for that animal type. The AUs for each are then totaled for the facility total. A hypothetical AFO with

[2] EPA and USDA both use the concept of "animal unit," however it is important to recognize that with respect to swine and poultry, there are Agency differences in the application of this concept.

multiple animal types and the calculation to determine the total number of animals confined at the facility is presented below (see box).

Example: Animal Unit Determination for an AFO with Multiple Animal Types

Situation: An AFO is being evaluated to determine if it meets the animal unit criteria for being defined as a CAFO and subject to NPDES permitting. The facility confines 200 horses, 300 sheep, and 500 beef cattle.

Animal Unit Calculation:		
	200 Horses x 2.0 =	400 AUs
	300 Sheep x 0.1=	30 AUs
	500 Beef Cattle x 1.0 =	500 AUs
	Total	930 AUs

Under the regulations, two or more AFOs under common ownership are considered one operation if they adjoin each other or use a common waste disposal system [40 CFR 122.23(b)(2)]. For example, facilities have a common waste disposal system if the wastes are commingled (e.g., stored in the same pond or lagoon or land applied on commonly owned fields) prior to use or disposal. The collective number of animal units of the adjoining facilities is used in determining the size of the AFO. Many poultry feeding operations adjoin each other and often meet the definition of one facility.

Concentrated Animal Feeding Operations

AFOs are CAFOs if they meet the regulatory definition [40 CFR 122, Appendix B] or have been designated on a case-by-case basis [40 CFR 122.23 (c)] by the NPDES-authorized permitting authority.

AFOs <u>Defined</u> as CAFOs
According to the NPDES regulations, a specific definition must be used when determining whether an AFO is a CAFO. The definition is broken down according to the number of animals confined at the facility (see box). AFOs

AFOs are Defined as CAFOs if:

- More than 1,000 AUs are confined at the facility [40 CFR 122, Appendix B (a)]; ***or***
- From 301 to 1,000 AUs are confined at the facility and:
  - Pollutants are discharged into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device; or
  - Pollutants are discharged directly into waters of the U.S. that originate outside of and pass over, across, or through the facility or come into direct contact with the confined animals.

R0074468

with more than 1,000 AUs are CAFOs. AFOs with 301 to 1,000 AUs are defined as CAFOs only if, in addition to the number of animals confined, they also meet one of the specific criteria addressing the method of discharge (see text box).

AFOs with fewer than 300 AUs are not defined as CAFOs under the current regulations but may be designated as a CAFO.

- ***AFOs With More Than 1,000 AUs are CAFOs.*** Under existing regulations, virtually all AFOs with more than 1,000 AUs are CAFOs and should apply for an NPDES permit. For individual animal types, the regulations state the number of animals required for the facility to be defined as a CAFO. These numbers are presented in Exhibit 15. If the number of AUs for any one animal type at a facility exceeds the corresponding number, or if the cumulative number of animal types exceeds 1,000 AUs, the facility is defined as a CAFO.

Exhibit 15. Threshold Number of Animals (by Animal Type) to Meet the Definition of a CAFO with More Than 1,000 AUs

Animal Type	Number of Animals Units
Beef cattle	1,000 slaughter or feeder cattle
Dairy cattle	700 mature dairy cattle (whether milked or dry)
Swine	2,500 swine (over 25 kilos - approximately 55 lbs.)
Sheep	10,000 sheep or lambs
Horses	500 horses
Chickens	100,000 laying hens or broilers (if continuous flow watering system); 30,000 laying hens or broilers (if liquid manure system)
Turkeys	55,000 turkeys
Ducks	5,000 ducks

Source: 40 CFR Part 122, Appendix B (a)

- **AFOs With 301 to 1,000 AUs *May Be* CAFOs.** AFOs with 301 to 1,000 AUs are defined as CAFOs only if, in addition to the number of animals confined, they also meet one of the specific criteria governing "method of discharge." If the number of AUs for any one animal type exceeds the specified number [40 CFR Part 122, Appendix B(b)], or if the *cumulative* number of animal types exceeds 300 AUs, **and** only one of the "method of discharge" criteria are met, the facility is defined as a CAFO.

- **AFOs with up to 300 AUs.** An AFO with up to 300 AUs may be considered a CAFO only if designated as such by the permitting authority and if it meets the discharge criteria (see below).

AFOs Designated as CAFOs
According to the NPDES permit regulations [40 CFR 122.23 (c)], the NPDES-authorized permitting authority can, on a case-by-case basis, designate any AFO as a CAFO after determining that it is a significant contributor of pollution to waters of the United States. No AFO with fewer than 300 AUs shall be designated a CAFO unless it also meets the discharge criteria outlined in 40 CFR 122.23(c).

An AFO *cannot* be designated a CAFO on a case-by-case basis until the inspector has conducted an on-site inspection of the facility and determined that the facility is a significant contributor of pollution. The designation is based on the factors listed in 40 CFR 122.23 (c) and shown below. This determination may be based on visual observations as well as water quality monitoring. Exhibit 16 shows example case-by-case designation factors and the inspection focus related to each factor.

Exhibit 16. Example Factors for Case-by-Case CAFO Designation

Designation Factor	Inspection Focus
Size of the operation and amount of waste reaching waters of the United States	• Number of animals • Type of feedlot surface • Feedlot design capacity • Waste handling/storage system design capacity
Location of the operation relative to waters of the United States	• Location of water bodies • Location of flood plain • Proximity to surface waters • Depth to groundwater, direct hydrologic connection to surface water
Means of conveyance of animal waste and process waste waters into waters of the United States	• Identify existing or potential man-made (includes natural and artificial materials) structures that may convey waste • Direct contact between animals and surface water
Slope, vegetation, rainfall and other factors affecting the likelihood or frequency of discharge	• Slope of feedlot and surrounding land • Type of feedlot (concrete, soil, etc.) • Climate (e.g., arid or wet) • Type and condition of soils • Depth to groundwater • Drainage controls • Storage structures • Amount of rainfall • Volume and quantity of runoff • Buffers
Other Relevant Factors	• Waste handling and storage • Land application timing, methods, rates and areas

Following the on-site inspection, the NPDES permitting authority will prepare a brief report that: (1) identifies findings and any follow-up actions; (2) determines whether or not the facility should be designated as a CAFO; and (3) documents the reasons for that determination. Regardless of the outcome, a letter would be prepared and sent to the facility. The letter should inform the facility that it has been either: (1) designated a CAFO and required to apply for an NPDES permit; or (2) has not been designated as a CAFO at this time. In those cases where a facility has not been designated as a CAFO but the NPDES authority has identified areas of concern, these would be noted in the letter.

II.D. Geographic Distribution and Economic Trends

As described in the executive summary of the *Preliminary Data Summary: Feedlots Point Source Category Study* (December 1998), livestock production operations in the U.S. vary widely in both the mode and scale of production, with individual farms spanning small scale production facilities with few animals to large, intensive production facilities. The following are summaries of the principal producing States in 1992 by animal commodity for beef cattle, swine, dairy cattle, and poultry.

- Ranked by the number of cattle and calves sold, the top ten producing states controlled 65 percent of U.S. beef production in 1992. Texas was the largest beef producing state accounting for 16 percent of 1992 sales. Other major states included Kansas, Nebraska, Oklahoma, Colorado, Iowa, California, South Dakota, Missouri, Wisconsin, and Montana.

- The hog farming sector is concentrated among the top five producing states that together supply about 60 percent of U.S. pork production. Iowa accounted for 24 percent of 1992 hog sales. Other major hog producing states included North Carolina, Illinois, Minnesota, Indiana, and Nebraska.

- The top five dairy cattle states controlled more than 50 percent of all U.S. milk production in 1992. Wisconsin was the largest dairy producing state with 16 percent of volume milk sales. Other major milk producing states included California, New York, Pennsylvania, and Minnesota.

- Broiler and chicken meat production is controlled by 10 producing states, which supply about 80 percent of all broilers sold. Arkansas was the largest broiler producer in 1992, with 16 percent of sales. Other major states included Georgia, Alabama, North Carolina, Mississippi, Texas, Maryland, California, Delaware, and Virginia.

- The top ten producing states accounted for about 80 percent of turkey production. North Carolina was the largest turkey producing state in 1992, with about 20 percent of sales. Other top producing states included Minnesota, California, Arkansas, Virginia, Missouri, Indiana, Texas, Iowa, and Pennsylvania.

- Egg production is dominated by 10 producing states that supply almost two-thirds of the eggs sold. California was the largest egg producing state in 1992 with about 12 percent of all eggs sales. Other major producers included Indiana, Pennsylvania, Georgia, Ohio, Arkansas, Texas, North Carolina, and Alabama.

Recent trends in the U.S. livestock sector are marked by a decline in the number of farms attributable to ongoing consolidation in the livestock industry. Farms are closing – especially small farming operations – due to competitive pressures from highly specialized – often lower cost – large scale producers. This trend toward fewer and larger livestock operations represents a significant shift in the industry. Both 1992 and 1997 Agriculture Census data highlight the ongoing shift from many small, diversified farms toward fewer large-scale, year-round, intensive breeding and feeding operations.

Another industry trend has been a steady increase in animal production and sales in the U.S. This trend has occurred at the same time there has been a decrease in the number of animals on site. This trend signals continued gains in production efficiency on U.S. farms in the form of higher per-animal yields and quicker turnover of animals prior to marketing.

A detailed industry economic profile is presented in the *Feedlots Point Source Category Study* and covers major commodity sectors, industry trends in the U.S. livestock and poultry farm sectors, recent market trends, farm revenue, farm-gate prices, financial operating conditions, industry marketing chain, and industry employment generated.

Additional geographic and economic information can be found by accessing the 1997 Agriculture Census at http://www.nass.usda.gov/census/ and the National Agriculture Statistics Service at http://www.usda.gov/nass/.

THIS PAGE LEFT INTENTIONALLY BLANK

III. SUMMARY OF OPERATIONS, IMPACTS, AND POLLUTION PREVENTION OPPORTUNITIES FOR THE AGRICULTURAL LIVESTOCK PRODUCTION INDUSTRY

This section provides an overview of commonly employed operations and maintenance activities in the agricultural livestock production industry. This discussion is not exhaustive; the operations and maintenance activities discussed are intended to represent the material inputs, major pollution outputs, and associated environmental impacts from agricultural livestock production practices. General pollution prevention and waste minimization opportunities are also discussed in the context of each of the operations and maintenance activities.

The choice of practices or operations influences the material used and the resulting pollution outputs and environmental impacts. Keep in mind that environmental impacts are relative, as some kinds of pollution outputs have far greater impacts than others.

Impact of Agriculture on the Environment

According to the *EPA/USDA Unified National Strategy for Animal Feeding Operations* (March 9, 1999), despite progress in improving water quality, 40 percent of the Nation's waterways assessed by States do not meet goals for fishing, swimming, or both. While pollution from factories and sewage treatment plants has been dramatically reduced, the runoff from city streets, agricultural activities, including AFOs, and other sources continues to degrade the environment and puts environmental resources (i.e., surface water, drinking water) at risk. According to EPA's 1996 305(b) water quality report, the top two pollutants from agriculture were identified as sediment and nutrients, respectively. Additional agricultural pollutants, such as animal wastes, salts, and pesticides, were identified by EPA[1]. The following presents a brief discussion of the environmental impacts or effects of agricultural pollutants.

> The Clean Water Act Plan of 1998 called for the development of the EPA/USDA *Unified National Strategy for Animal Feeding Operations* (AFOs) to minimize the water quality and public health impacts of AFOs.

(1) ***Nutrients***. Excess nutrients in water (i.e., phosphorus and nitrogen) can result in or contribute to low levels of dissolved oxygen (anoxia),

[1] *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, U.S. Environmental Protection Agency, January 1993.

R0074475

eutrophication, and toxic algal blooms. These conditions may be harmful to human health; may adversely affect the suitability of the water for other uses; and, in combination with other circumstances, have been associated with outbreaks of microbes such as *Pfiesteria piscicida*.

- Phosphorus. Phosphorus determines the amount of algae growth and aging that occurs in freshwater bodies. Runoff and erosion can carry some of the applied phosphorus to nearby water bodies.

- Nitrogen. In addition to eutrophication, excessive nitrogen causes other water quality problems. Dissolved ammonia at concentrations above 0.2 mg/L may be toxic to fish. Biologically important inorganic forms of nitrogen are ammonium, nitrate, and nitrite. Ammonium becomes adsorbed to the soil and is lost primarily with eroding sediment. Even if nitrogen is not in a readily available form as it leaves the field, it can be converted to an available form either during transport or after delivery to waterbodies. Nitrogen in the form of nitrate, can contaminate drinking water supplies drawn from groundwater. Nitrates above 10 ppm in drinking water are potentially dangerous, especially to newborn infants.

(2) ***Sediment.*** Sediment affects the use of water in many ways. Suspended solids reduce the amount of sunlight available to aquatic plants, cover fish spawning areas and food supplies, clog the filtering capacity of filter feeders, and clog and harm the gills of fish. Turbidity interferes with the feeding habits of fish. These effects combine to reduce fish and plant populations and decrease the overall productivity of waters. In addition, recreation is limited because of the decreased fish population and the water's unappealing, turbid appearance. Turbidity also reduces visibility, making swimming less safe.

(3) ***Animal Wastes***. Animal waste includes the fecal and urinary wastes of livestock and poultry; process water (such as from a milking parlor); and the feed, bedding, litter, and soil with which fecal and urinary matter and process water become intermixed. Manure and wastewater from AFOs have the potential to contribute pollutants such as nutrients (e.g., nitrogen and phosphorus), organic matter, sediments, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment. Decomposing organic matter (i.e., animal waste) can reduce oxygen levels and cause fish kills. Solids deposited in waterbodies can

accelerate eutrophication through the release of nutrients over extended periods of time.

Contamination of groundwater can be a problem if runoff results from the misapplication or over application of manure to land or if storage structures are not built to minimize seepage. Because animal feed sometimes contains heavy metals (e.g., arsenic, copper, zinc), the possibility for harmful accumulations of metals on land where manure is improperly or over applied is possible.

Pathogens in manure. Pathogens in manure can cause diseases in humans if people come in contact with the manure. Pathogens in manure also create a food safety concern if manure is applied directly to crops at inappropriate times or if manure contaminates a product (e.g., food, milk). In addition, pathogens are responsible for some shellfish bed closures. Runoff from fields receiving manure may contain extremely high numbers of bacteria (though all of these bacteria may not be harmful) if the manure has not been properly incorporated. Pathogens, such as *Cryptosporidium*, have been linked to impairments in drinking water supplies and threats to human health.

Air pollution is also a concern in relation to animal wastes. Farms on which animals are raised often concentrate odors associated with the microbial degradation of manure and other by-products of the production of meat, milk and eggs. Odors can be a nuisance to neighbors of animal operations, and there is increasing concern about the potential health effects from emissions of odorous compounds.

(4) ***Salts***. Salts are a product of the natural weathering process of soil and geologic material. In soils that have poor subsurface drainage, high salt concentrations are created within the root zone where most water extraction occurs. The accumulation of soluble and exchangeable salts leads to soil dispersion, structure breakdown, decreased infiltration, and possible toxicity; thus, salts often become a serious problem on irrigated land, both for continued agricultural production and for water quality considerations. High salt concentrations in streams can harm freshwater aquatic plants just as excess soil salinity damages agricultural crops.

(5) ***Pesticides.*** The primary pollutants from pesticides are the active and inert ingredients, diluents, and any persistent degradation products. Pesticides and their degradation products may enter groundwater and surface water in solution, in emulsion, or bound to soils. Pesticides may, in some instances, cause impairments to the uses of surface

waters and groundwater. Both the degradation and sorption characteristics of pesticides are highly variable. Some types of pesticides are resistant to degradation and may persist and/or accumulate in aquatic ecosystems. Pesticides may harm the environment by eliminating or reducing populations of desirable organisms, including endangered species.

Within a livestock production establishment, pesticides may be applied directly to livestock or to structures (e.g., barns, housing units) to control pests, including parasites, vectors, and predators.

Pesticides are both suspected and known for causing immediate and delayed-onset health hazards for humans. If exposed to pesticides, humans may experience adverse effects, such as nausea, respiratory distress, or more severe symptoms up to and including death. Animals and birds impacted by pesticides can experience similar illnesses or develop other types of physical distress.

Pollution Prevention/Waste Minimization Opportunities in the Agricultural Livestock Production Industry

The best way to reduce pollution is to prevent it in the first place. Industries have creatively implemented pollution prevention techniques that improve operations and increase profits while minimizing environmental impacts. This can be done in many ways such as reducing material inputs, reusing byproducts, improving management practices, and employing substitute toxic chemicals.

To encourage these approaches, this section provides general descriptions of some pollution prevention advances that have been implemented within the agricultural livestock production industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for establishments interested in beginning their own pollution prevention projects. This section provides information from real activities that may be or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land, and water pollutant releases.

The use of pollution prevention technologies and environmental controls can substantially reduce the volume and concentration of the contaminants released/discharged into the surrounding environment. In some cases, these pollution prevention approaches may be economically beneficial to the agricultural production industries because they decrease the amount of chemicals needed, and therefore the cost of maintaining operations.

Waste minimization generally encompasses any source reduction or recycling that results in either the reduction of total volume or the toxicity of hazardous waste. Source reduction is a reduction of waste generation at the source, usually within a process. Source reduction can include process modifications, feedstock (raw material) substitution, housekeeping and management processes, and increases in efficiency of machinery and equipment. Source reduction includes any activity that reduces the amount of waste that exits a process. Recycling refers to the use or reuse of a waste as an effective substitute for a commercial product or as an ingredient or feedstock in an industrial process.

It should be noted that as individual practices, these pollution prevention and waste minimization practices can significantly reduce the environmental impacts of agricultural operations. However, to get the full effect of the practices and maximize pollution prevention potential, an agricultural operation must consider its individual practices in the context of a system. The practices combine to form an integrated system in which each practice interacts with the others and is affected by the others. That is, outputs from one practice may be inputs into one of the other practices, in effect creating a closed-loop system that both maximizes profits and minimizes environmental impacts. By considering their establishments as systems, operators will be better able to evaluate and implement pollution prevention or waste minimization opportunities.

Operations of Livestock Production

Livestock production generally includes the following activities:

- Feed storage, loading, and unloading
- Housing
- Feeding and watering
- Managing animal waste
- Applying pesticides and pest control
- Maintaining and repairing agricultural machinery and vehicles
- Fuel use and fueling activities

The additional activities of planning and management are required for all of the above processes to occur. Exhibit 17 presents the material inputs and pollution outputs from each of these processes.

Exhibit 17. Livestock Production Activities and Potential Pollution Outputs

Activity		Potential Pollution Outputs
Feed storage, loading, and unloading	➜	– Dust emissions – Unusable or spilled feed – Leachate from silage – Nutrient-contaminated runoff
Housing	➜	– Animal waste – Waste bedding – Air emissions (e.g., odors, methane, ammonia) – Washwater from flushing and washdown of housing areas
Feeding	➜	– Animal waste – Air emissions (e.g., dust, methane) – Moldy feed discard – Spilled feed – Nutrient-contaminated runoff
Watering	➜	– Animal waste – Water contaminated with animal waste – Destruction of stream bank, riparian zone (from animals in streams)

Typically, most of the above activities include the generation of *animal waste*. Animal waste must be managed appropriately because of its potential environmental impacts.

Managing animal waste, includes collecting and transporting; storing and treating; and utilizing animal waste	➜	– Discharges and leaching of wastewater – Manure and urine – Bedding – Air emissions (e.g., ammonia, methane, other gases, odor, dust) – Hair and/or feathers – Carcasses – Pathogens – Heavy metals – Wasted products (e.g., milk, eggs)

R0074480

Exhibit 17. Livestock Production Activities and Potential Pollution Outputs

Activity		Potential Pollution Outputs
Additional activities that occur at agricultural establishments and their potential pollution outputs include:		
Pest control	→	– Discharges and leaching of pesticides – Chemical air emissions
Maintaining and repairing agricultural machinery and vehicles	→	– Used oil – Spent fluids and organic solvents – Used tires – Spent batteries – Metal machining wastes – Scrap metal
Fuel use and fueling activities	→	– Fuel spills or leaks

III.A. Feed Storage, Loading, and Unloading

Feed storage, loading, unloading, and transport are major activities in livestock production. Livestock feed may include hay, grain (sometimes supplemented with protein, vitamins, mineral supplements and antibiotics), and silage -- with grain and hay being the most common feeds. Livestock operations may produce all, a portion, or none of the animal feed. Purchased feed is transported to the livestock operation by truck or, at very large animal operations, by rail. Stored feed must be loaded, transported to the animals' normal feed location, and unloaded.

– Hay that has been cut and partially dried is collected from fields and compacted into small rectangular bales or rolled into large round bales. Hay may be stored in covered and enclosed buildings, in fields, and in outside storage areas where it may or may not be covered. Small rectangular hay bales may be placed in a barn by conveyor.

  Feed hay is often transported on tractor-drawn wagons to feed bunkers, feed rings, and mangers. Small rectangular hay bales may be mechanically or manually placed in bunkers and mangers. Front-end loaders are used to unload round bales and place them in the feed rings.

- Harvested grain is sometimes milled (ground) on site or more commonly sent offsite to a milling facility for grinding prior to being returned to the facility for use. Depending on the livestock species, protein, vitamins, mineral supplements, and antibiotics are often added at the time of milling or mixing. Grain is typically stored in aerated grain bins and handled with augers. High moisture corn is stored in silos. Grain, which is typically placed in feed bunkers, troughs, or feeder units, can be transported using a front-end loader, tractor front bucket, grain wagon, or manually for smaller volumes.

- Silage is usually produced onsite and may consist of chopped green corn or hay. Silage is allowed to ferment in vertical or horizontal silos or storage bunkers prior to use as feed. Silage is removed from silos and then distributed along the feed bunks.

Potential Pollution Outputs and Environmental Impacts

The primary pollution outputs include unusable feed; dust emissions from loading, unloading, and grinding activities; air emissions from transportation to and from sites; and leachate from silage. A minor pollution output is contamination of storm water from spilled feed. Dust emissions pollute the air that agricultural workers and animals breathe and can cause respiratory problems in instances of prolonged exposure. Research indicates that silage materials stored at 65 percent moisture content or higher can produce leachate.

Pollution Prevention/Waste Minimization Opportunities

One potential pollution prevention practice focuses on minimizing unusable feed and consequently maximizing the amount of feed that is consumed by the animal. One way to maximize animal consumption is by grinding the feed in either a grinder-mixer or a tub grinder. Grinding increases the ability of the animal to digest the feed. Where possible, grinders should be used with a dust collector to reduce dust emissions. Silage leachate can be reduced by allowing the material to wilt in the field for 24 hours, varying cutting and harvesting times, cutting or crimping the material, or adding moisture-absorbent material to the silage as it is stored[2].

---

[2] *Farm-A-Syst, Fact Sheet #9, Reducing the Risk of Groundwater Contamination by Improving Silage Storage*, University of Wisconsin, Extension/Cooperative Extension, College of Agricultural and Live Sciences.

III.B. Housing

Livestock housing may consist of feed lots, barns, stables or stalls, corrals, covered loafing areas, pens, poultry houses, and other similar structures that confine the animals in an area and manner best suited to the overall livestock production process. There are three general ways to house livestock:

(1) Enclosed housing (i.e., a roofed and walled structure)
(2) Partially enclosed (i.e., usually roofed with walls on some structure sides)
(3) Open or no structures

The type of housing used for a particular animal type/livestock production is related to animal size, feeding, animal health and biosecurity, climate, and the goal of achieving the optimum weight gain or commodity produced at the lowest cost.

- Dairy cattle. Most dairy operations provide separate housing for different animal groups based on age or milking status (lactating versus dry). Calves may be housed in barns, individual pens within a barn, open fields, and hutches. Heifers may be housed in freestall barns and bedded pack housing. Bedded pack housing is often used with an open feeding area. Dry cows (<3 months to calving) are usually housed on pasture or in freestall barns. Lactating cows are housed in freestall and other types of barns such as stanchion, corrals, structures, and open lots that provide shade[3].

- Beef cattle. Beef cattle are mainly housed in pastures and open feedlots. Calving facilities may consist of an open pasture, a shed with stalls, or an open, wind-protected pen. Bulls are either penned separately or in groups of up to 10. They may be contained in a barn or in an open pen with shade. Cattle feedlots are usually open areas that may have windbreaks and shade. Very few beef cattle are housed in freestall barns with slotted floors for manure collection.

- Sheep. Sheep are maintained primarily on open grazing land, but some are kept in open lots with shelters, facilities with slotted floors for manure collection, and in bedded pens.

[3] *Preliminary Data Summary: Feedlots Point Source Category Study*, U.S. Environmental Protection Agency, Office of Water, Washington, DC, December 1998.

- Horses. Most horses maintained in concentrated numbers are housed in stalls within an enclosed barn. Approximately 70 percent of the horse operations that use stalls have one animal per stall. Horses may also be housed in partially enclosed housing or on pasture.

- Poultry. Poultry including turkeys and ducks are maintained in an enclosed house. Chicken broilers, roasters, and pullets, which may be caged, are usually maintained in houses on a solid floor with bedding. Breeders are usually maintained in houses with a slatted floor generally covering one-third of each side of the house along the length of the side-wall of the house. Most layers are maintained in houses inside of cages with mesh floors, and a few in houses with a litter or slat/litter floor. Turkey poults are reared in enclosed brooder houses, then generally are moved to grower houses and sometimes to range. Turkeys are normally raised on a dirt or clay floor with a bedding cover. Duck housing is normally an enclosed house that has a wire-mesh floor, a solid floor, or a combination of the two.

- Goats. Goats are housed in loose housing common areas that may contain bedded and exercise areas, individual stalls, pens, and corrals. Pregnant does are usually housed in bedded pens.

- Swine. While some swine are raised outdoors with a shelter (e.g., hoop housing), most are housed in an enclosed barn or house. Breed sows may be kept in small group pens and then during farrowing, a sow is usually placed in an individual pen. Young pigs are placed together in larger nursery pens. Finishing operations keep several pigs in the same pen.

The floors of some livestock housing for cattle, swine, and sheep, may be of slotted construction. The floors for some poultry housing may be of wire-mesh or slat construction. The slotted, wire-mesh, and slatted housing floor systems allow the manure to drop into a long-term or temporary storage/collection/transfer area.

Bedding is mostly used in the housing of dairy cattle, poultry, and horses but may be used for the housing of any of the livestock types presented above. Manure and bedding needs to be removed at regular intervals. Methods of removal vary depending on the type of housing. Manure is primarily removed from housing by scraping, scooping, and flushing (see Section III.D. Managing Animal Wastes).

Potential Pollution Outputs and Environmental Impacts
The primary pollution outputs include animal wastes, bedding, wastewater from flushing and washdown of housing areas, and air emissions (e.g., methane, ammonia, and odors). The main impacts of these outputs are soil and water contamination stemming from waste spills, improper storage, and runoff.

From an environmental standpoint, each type of livestock housing (enclosed, partially enclosed or open) has advantages and disadvantages. The move from outdoor housing to confinement housing has removed the weather factor and runoff, which is a substantial problem for outdoor housing, and provided producers the opportunity to manage manure as a resource and not a waste. However, concentrated amounts of manure can be viewed as a disadvantage. While concentrating the animals (and therefore the animal manure) may lead to easier manure management, concentrated amounts of manure have a greater potential to significantly impact the environment in the event of a spill, release, or improper management.

Wastes, including manure and fouled bedding, that are not properly transported from housing could spill and potentially contaminate storm water runoff. Open housing such as feedlots, corrals, and pens, if not scraped as necessary, may also contaminate storm water runoff. Wastes carried in storm water runoff may be discharged to surface waters causing pollution, or may be deposited in low areas and potentially leach to the groundwater.

Animals contained in pasture areas (technically not housing but used for livestock containment) can wear away soil from feeding sites, destroy streambanks at natural watering sites, and, if allowed access, defecate and urinate in surface waters. This results in increased runoff, soil erosion as well as sediments, manure, and urine in the water.

With enclosed or partially enclosed housing areas, odors and other gases (e.g., methane, ammonia, and hydrogen sulfide gases) from animal waste can be concentrated, potentially harming the health of the animals and workers. When the gases are released outside, the odor can affect the surrounding areas and create nuisance problems for neighbors.

Pollution Prevention/Waste Minimization Opportunities
While the majority of the wastes discussed above for housing cannot be prevented, both the wastes and their impacts can be reduced by implementing best management practices.

- *Minimize water use during cleaning.* By cleaning livestock (except poultry) housing on a regular and frequent basis and using minimal amounts of water during cleaning, operations may reduce the volume of wastes to be handled and used. Keeping the waste dry also facilitates its management, reduces runoff potential, and minimizes odors from decomposition.

- *Minimize runoff by cleaning open areas.* Cleaning open areas reduces the potential for the runoff of wastes to surface waters.

- *Reduce odor by preventing ammonia generation.* Ammonia is created by the rapid conversion of urinary nitrogen (urea) to ammonia by microorganisms. By applying various chemicals (e.g., urease inhibitors) on a weekly basis, the conversion of nitrogen to ammonia can be reduced, thus minimizing ammonia emissions and odors, and conserving valuable fertilizer[4].

- *Use tools to minimize odor impacts on the surrounding community.* When considering the installation of a new livestock operation or the expansion of an existing operation, facilities should consider maximizing the distance to neighboring dwellings, the existence of "reverse" setback rules, the potential for new neighbors, and the potential impact neighbors may have on limiting the expansion of the animal housing. Additional methods for reducing odors in other aspects of livestock operations are discussed below.

III.C. Animal Nutrition and Health

There are many activities and considerations when managing animal nutrition and health, including feeding, watering, and biosecurity issues. Animal nutrition is an important consideration for livestock operators for various reasons, including the health of the animals, as well as the nutrient

[4] *Use of Urease Inhibitors to Control Nitrogen Loss From Livestock Waste,* U.S. Department of Agriculture, 1997.

composition of the manure. The nutrient composition of manure (nitrogen and phosphorus) is directly related to the composition of the animal feed, feed supplements, and ability of the animal to digest the feed.

Feeding

Corn, soybean, grasses, hay, silage, and other grains are some of the common food sources for livestock. Most livestock operations adjust the composition of the animals' feed to meet the animals' current protein needs. As an example, dry cows are typically fed a lower protein diet when compared to cattle being milked or nursing calves. Likewise, swine operations often use phase feeding and separation of sexes to best meet the animals' protein needs, lower feed costs, and reduce nutrient levels of the manure. Generally, swine operations feed varying protein diets in relationship to the growth phase and/or need of the animal. As an example, operations provide higher protein feed to farrowing sows, less protein to gilts, and even less to barrows (made possible through separate confinement of sexes). Some livestock operations place swine in confinements recently used for cattle. The swine will receive a portion of its nutrient requirement by feeding on the cattle manure. This provides an overall reduction in the nutrients excreted at the livestock operation.

Feed supplements may include amino acids and enzymes. The supplement of synthetic lysine in swine feed assists in lowering the nitrogen level in the manure. The addition of this amino acid allows feeding of a lower protein diet. Normally, the phosphate in the phytic acid passes through the digestive tract of swine and poultry and is excreted. The addition of phytase, an enzyme, to swine and poultry feed, will allow the animal to digest phytic acid from cereal grains and soybean meal and convert it to phosphate for use by the animal. This reduces the need for supplemental phosphorus in the diet of swine and poultry. Currently, the use of phytase is not feasible due to economic and production concerns.

The ability of the animal to digest the feed can be increased by fine grinding and pelletizing feed. Fine grinding increases the surface area of the feed and thereby increases the portion digested.

Feeding can take place in the housing facility, at a separate feeding facility or feeder unit(s), and from pastureland. Other than grazing, where the animal (e.g., sheep, horses, cattle) goes to the feed, the feed is brought to the animals and placed in a feeding device. The feeding process begins with the feed being transported, by various means, from the storage areas to feeding area or unit. The method of feeding is usually related to the type of animal and the housing structure.

- Most dairy operations feed the animals between milking events and may feed the animals from feed bunks that may be covered or uncovered. Small dairy cattle operations may feed the animals during milking and place them on pasture for grazing between milkings.

- Beef (feeder) cattle operations generally feed the animals from feed bunks that may be covered or uncovered. These operations may also use feed rings for large bales of hay.

- Horses, if maintained inside, are fed from a manger and/or other feed device.

- Housed poultry and swine are generally fed continuously from feeding devices. The two major types of feeding devices for poultry and swine are self feeders, which provide the animal with a constant supply of food, and mechanical feeders, which distribute the feed to the animals at predetermined intervals.

Watering
Watering involves the operation and maintenance of animal drinking systems or access to naturally-occurring surface waters or man-made watering structures (e.g., ponds, reservoirs). It is essential that a constant or on-demand supply of water be provided for livestock.

For those housed or in other types of confined areas, there are many different types of man-made watering devices, each of which can be modified depending on the animal using the system. Some of the most commonly used systems include the following:

- *Animal-operated pumps or drinkers*. Large livestock kept in enclosed and partially enclosed housing can use animal-operated pumps or valves (nose pumps/valves). Livestock-operated on-demand watering devices allow the animal to use its nose to actuate a valve or push a pendulum unit that dispenses water. Small livestock kept in enclosed housing generally have on-demand drinkers that are actuated by the mouth or beak of the livestock.

- *Trough systems*. Large livestock kept in enclosed and partially enclosed housing can also use trough systems. In trough systems, animals drink directly from troughs or tanks. The discharge of water to the trough/tank may be float-controlled or continuous.

Many partially enclosed, open, and pasture/grazing livestock operations perform water hauling or provide access to watering sources to meet livestock watering needs.

- *Water hauling*. Water may also be provided to animals in open pastures and grazing operations through water hauling. By using a truck with a main storage tank and an easily-moved stock tank, the watering point can be relocated as necessary throughout the operation.

- *Access to privately-owned ponds or reservoirs using restricted access ramps*. For grazed cattle and pastured dairies, natural streams and other surface waters provide a source of drinking water. Many partially enclosed, open, and pasture/grazing livestock operations allow animals access to watering sources, such as privately-owned ponds or reservoirs, via restricted access ramps. Access ramps allow the animals to use the water source while minimizing erosion of the banks. While some reservoirs are supplied by natural precipitation, many use water pumping systems. Powered by gas, solar energy, and wind, these systems transport water from the water source to the reservoir or pond.

Biosecurity
Biosecurity consists of the procedures used to prevent the spread of animal diseases from one facility to another. Animal diseases can enter a facility with new animals, on equipment, and on people. Animals, equipment, and people that have recently been at another facility may pose the greatest biosecurity risk. Biosecurity procedures include such general categories as use of protective clothing, waiting periods for new animals and visitors, and cleaning.

Biosecurity is important to livestock owners because some diseases can weaken or kill large numbers of animals at an infected facility. In some cases, the only remedy available to an operation is to sacrifice an entire group of animals in order to prevent the spread of the disease to other parts of the facility or to other facilities. In other words, a failure to conduct biosecurity procedures can cause serious financial and productivity losses for a livestock operation.

The types of biosecurity procedures necessary will depend on the type of animal at a facility, the way the diseases of concern spread to and infect animals, and vulnerability of the animals to each specific disease. For example, if a group of swine has little immunity to a serious virus, and that virus can enter the facility on the skin or clothing of visitors, a facility may need to require visitors to observe a waiting period, take a shower, and change into clean clothing provided by the facility before entering. A different group of swine may have better immunity to the virus, and such biosecurity measures would be unnecessary.

Some of the general types of biosecurity procedures include:

- Controls on the introduction of new animals to a group or facility (such as quarantine periods).
- Controls on equipment entering the farm (such as washing and disinfecting crates).
- Controls on personnel entering the farm (such as requiring service personnel to stay out of animal buildings, or providing protective clothing and footwear).
- Controls on wild or domestic animal access (such as closing holes in buildings to keep undesirable animals out).
- Sanitation in animal housing areas (such as cleaning pens).
- Identification and segregation of sick animals (including adequate removal and disposal of dead animals).

The key to developing adequate biosecurity procedures is to find accurate information about animal diseases and how to prevent them. Potential sources for specific biosecurity information and recommendations include extension services and other agricultural education organizations; veterinarians and veterinary organizations; producer and industry groups; and published information in books, magazines, and World Wide Web sources.

Potential Pollution Outputs and Environmental Impacts

Feeding. When feeding, the potential pollution outputs are soil erosion due to overgrazing, animal wastes (which are partially composed of unabsorbed feed components), spilled feed during feed unloading to feed equipment and by livestock as they feed, mechanical failures with feed equipment (e.g., inoperative cutoff switch), and dust emissions during feed transport. The pollution outputs and potential environmental impacts vary based on the type and location of feed equipment and number of animals.

- *Overgrazing* can contribute to soil losses due to severe erosion, and impoverishment can change the vegetation composition and associated organisms in rangelands.

- *Surface water and groundwater contamination from concentrated wastes*. Totally enclosed feed locations (e.g., barns, poultry houses), when compared to the same livestock types in a partially sheltered or open area, may generate a larger quantity of animal waste per acre of land due to a higher concentration of livestock in a smaller area. Totally enclosed structures are protected from rainfall and should not experience the runoff of livestock wastes and wasted feed that may occur in partially sheltered and open feed locations.

- *Surface water and groundwater contamination from runoff.* Partially sheltered feed locations (e.g., dairy operation free-stall barns and covered loafing areas) and open feed locations (e.g., feeder cattle maintained in an area that has no roofed or walled structures) have a greater pollution potential due to runoff. Areas with no vegetation may experience runoff of livestock waste and spilled feed during rainfall events.

- *Air emissions (e.g., dust).* Areas with no vegetation that are dry may produce dust pollution during the transportation of feed.

Watering. The primary pollution output from watering is excess water, which most likely becomes wastewater that is contaminated with livestock wastes (e.g., manure, urine) and feed. Surface waters and groundwater can become contaminated from wastewater runoff, and surface waters can be directly contaminated with wastes (e.g., manure, urine) from livestock that are allowed access to the water (e.g., during watering).

Properly operated man-made watering systems significantly reduce the environmental impact of livestock. However, continuous watering systems that overflow and cause runoff often cause significant environmental damage. Additionally, livestock with access to creeks, rivers and other natural water sources cause environmental damage by contaminating the water with animal waste, destroying riparian habitat, and eroding the stream banks.

Pollution Prevention/Waste Minimization Techniques
There are many pollution prevention opportunities to reduce or minimize the pollution outputs and impacts from livestock feeding and watering activities. Generation of these wastes can be prevented through management practices, preventive maintenance, appropriate feedlot location, and use of waste minimization technologies.

Feeding. Wastes generated during feeding (e.g., feed spills, unused feed) can be prevented by using troughs or mechanical feeding systems that reduce feed loss and prevent contact with watering areas, weather, and the ground.

- *Use portable and/or covered feeders*. Feeders can be constructed to be portable, eliminating the problem of manure buildup that occurs around stationary feeders. For outdoor or partially enclosed feeding operations, use of covered or protected feeders prevents the feed from being exposed to rain or wind. Examples of such feeders include mineral feeding boxes, and weathervane mineral feeders.

  - A mineral feeding box is simply a trough that is raised off the ground, enclosed on three sides, and covered by a roof.

  - A weathervane mineral feeder consists of a 55-gallon drum with a cut out opening of sufficient size for the animal to reach the feed. The drum pivots on a concrete base that is heavy enough to prevent overturning by cattle or wind. A weathervane is attached to the top of the drum so the feed opening is pushed away from the wind direction, and rain is prevented from reaching the opening.

- *Use specially designed feeders*. For hay feeding operations, using feeders that are specifically designed to accept bales minimizes hay loss and prevents potential nutrient runoff.

- *Use feeders that prevent spills and contact with the ground*. Feeding racks store hay between steel bars, thus minimizing the amount of hay that an animal can pull from the rack and spill on the ground. Totally enclosed racks where the hay is located inside a rectangular or circular enclosure may have diagonally shaped bars containing the hay inside. These bars require the animal to turn its head in order to reach through and remove its head from the hay, thus significantly reducing the amount of hay the animal can pull from the feeder and spill.

Watering. Pollution prevention techniques to prevent environmental impacts from watering include the following:

- *Prevent access to surface waters.* Livestock operations can use physical barriers (e.g., fencing) to prevent animals access to surface waters (e.g., creeks, streams, rivers). This will minimize contamination of these waters caused by animal defecating directly in the water, and runoff carrying waste reaching the water.

- *Reduce excess water use and spills of water.* Preventing overflows of watering devices and excess water use during watering can prevent water becoming mixed with wastes and potential runoff.

- *Use self-watering devices.* The on-demand, self-watering systems that are used in many types of animal operations are an effective method of reducing waste as long as they are well maintained and checked frequently.

III.D. Managing Animal Wastes

Animal wastes are produced at all stages of the livestock production process, including housing, feeding, and watering. *For the purposes of this document, the term animal waste refers to animal manure, urine, and other materials that come in contact with and/or are managed with manure and urine in a typical livestock operation.* These materials may include, but are not limited to, bedding, wastewater from flushing and washdown of housing areas, lot runoff, disinfectants and cleaners, and spilled feed.

Animal manure has been recognized for centuries as an excellent source of plant nutrients and as a soil "builder" in terms of its positive benefits to soil quality. Animal manure is an excellent source of nutrients for plants because it contains most of the elements required for plant growth. Livestock operators today are managing and using manure as an important and valuable resource. If managed and used properly, manure can provide benefits for the livestock operation, such as reduced commercial fertilizer use and increased soil quality.

Overall, the amount of animal wastes to be managed can be extensive. The challenges of animal waste management have been compounded in recent years due to the growth of animal feeding operations. These types of operations have resulted in the concentration of manure production on an ever smaller land area. The consistency and volume of animal waste to be managed at a livestock operation depends on the types of animals at the facility. Generally, dairy cattle, beef cattle, swine, and sheep produce a comparatively wet waste and broiler poultry litter is dry (22-29 percent water). Laying and breeding operations are often considered to have wet manure because of how the waste is handled. Exhibit 18 provides a comparison of the manure production for various animals.

Exhibit 18. Manure Production by Animal Type

Animal Type	Weight of Manure (lbs/day/1000 lbs of animal live weight)	Percent Water Weight
Dairy Cow, Lactating	80.0	75-90
Beef Cow	63.0	20-80
Swine, Grower (40 - 220 lb)	63.4	70-85
Poultry, Broiler	80.0	22-29
Sheep	40.0	70
Horse	50.0	70

Source: *Preliminary Data Summary: Feedlots Point Source Category Study*, Table 11.2, U.S. Environmental Protection Agency, Office of Water, Washington, DC, December 1998.
Composting Manure and Other Organic Residues, Table III, Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, March 1997.

Types of Animal Waste Management Systems. Animal waste management systems involve the collection, transport, storage, treatment, and utilization (rather than disposal) of waste, preferably in a manner that is economically and environmentally sound. The type of system that each operation uses

> Additional management activities at livestock operations include controlling or collecting runoff from outdoor lots and waste storage; directing clean water away from lots and storage areas; and disposing of livestock mortalities.

R0074494

depends on the type of animal(s), manure moisture content, size of the operation, acreage and site, available manure utilization methods, and operator's personal preference. Additional information on animal waste management systems, including collection, storage, treatment, transfer, and utilization, can be found in Chapter 9: Agricultural Waste Management Systems of the *Agricultural Waste Management Field Handbook* (USDA, 1992) which can be accessed at http://www.ftw.nrcs.usda.gov/awmfh.html.

Using Best Management Practices. Livestock operators can implement structural and nonstructural best management practices (BMPs) to reduce the volume of animal wastes that must be managed.

- *Structural BMPs* for an animal waste management system may include roof gutters on buildings to collect and divert clean water; vegetated filter strips and riparian buffers to trap sediment; and surface water diversions to move clean water around the areas containing waste.

- *Non-structural (management) BMPs* for an animal waste management system may include reduced frequency and volume of washdown; implementation of a comprehensive nutrient management plan; relocation of manure stacks; and other site-specific land uses that do not involve construction or land movement.

III.D.1. Collecting & Transporting Animal Wastes

The most significant quantities of animal waste are generated at feeding, watering, and housing locations. Waste collection methods vary based on the type of housing and feeding operations, as well as manpower, available equipment, operator training, pen size, and manure moisture content. Some types of manure collection systems used in livestock productions are:

- *Slotted floor systems*. The slotted floor system allows the manure to drop through the slots to a storage tank or area located beneath the floor.

- *Scraping*. Scraping is the primary method of manure collection for open housing and a common method for partially enclosed housing and enclosed housing. Common scraping equipment includes small tractor operated scrapers, tractor-pulled pan scrapers, and automated alley scraper blades on a cable. The manure may be scraped into storage facilities, to treatment, or to utilization equipment.

R0074495

- *Flushing*. Flushing is often used in enclosed and partially enclosed housing. Manual or automated hydraulic flush equipment uses water to flush the manure to collection/storage pits or lagoons.

The following describes the animal waste collection and transport systems used for different types of animals.

- Dairy cattle. Dairy cattle manure is usually collected and transported from sheds and freestall barn alleys by a manual or automated hydraulic flush in warmer climates and alley scrapers in colder climates. Manure dropped in milking parlors is commonly collected by a manual hydraulic flush. Freestall barns and alleys may also have the manure collected by scraping. Manure in open areas such as corrals is primarily collected by scraping; manure in grazed areas is not collected.

- Beef cattle. Manure is usually collected from beef cattle feedlots by scraping. The feedlot area may be unpaved, partially paved around feed and watering areas, or totally paved. Though rare, if beef cattle are kept in enclosed and partially enclosed housing, manure collection is accomplished by a slotted floor system. The manure drops through the slots to a below-floor tank that provides either short-term or long-term storage. In grazed areas, the manure is not collected.

- Sheep. Sheep are primarily maintained on pasture and the manure is not collected. Manure, from sheep kept in enclosed housing, is usually collected by a slotted floor system.

- Horses. Manure from horses housed in enclosed barn stalls, is most often collected by shoveling. The manure and bedding from stalls is often removed daily and placed in stacks.

- Poultry. Poultry manure collection is generally related to the type of operation. Poultry manure is generally dry (22-29 percent water). Broiler, roaster, pullet, turkey, and some duck houses usually raise the birds on the house floor or in cages on beds of shavings, sawdust, rice hulls, or peanut hulls. The manure is allowed to accumulate on the floor where it is mixed with the bedding.

  Many of the poultry broiler houses are only cleaned out completely once a year. Often, they only remove the top two inches or so between flocks (approximately 5-6 flocks per year in broilers houses). The litter is removed with a cruster machine or a small tractor with a front bucket. In layer and duck operations, the operator commonly collects the manure by allowing it to drop through the wire-mesh cage, house floor or slotted floor to a collection area where it is usually removed by a hydraulic flush or belt scraper to a lagoon. Manure is sometimes composted, but can also be stored in stacking sheds, roofed storage areas, outside and covered or uncovered, or occasionally in ponds until it is ready for transport to a disposal or land application area.

- Goats. Goat manure is collected by manual shoveling from small pens or stalls or scraped from larger containment enclosed, partially enclosed, and open areas.

- Swine. Manure from swine in enclosed housing is often collected by allowing it to drop through a slotted floor to a storage area, or it may be collected by a manual or automated flush system. Manure from swine maintained in partially enclosed or open housing is usually collected by scraping.

In housing where animals are confined, frequent manure collection and transport are critical to livestock health. Frequent removal of wastes reduces the naturally occurring volatilization of nitrogen as ammonia and the anaerobic digestion and the subsequent release of gases in the production buildings. This reduction of pit gases, which can be fatal, and odor improves the in-house environment and employee working conditions.

Collection and transport of wastes by flushing is facilitated by slightly sloped, paved floors, alleys, or gutters. Waste collected through slotted floors and wire-mesh cages is usually transported from the below-floor/below-cage collection area by a hydraulic (water) flush or may be scraped. The flushed manure and/or litter may be transported to a storage area or treatment lagoon. Two advantages of the flush system for collecting and transporting manure are that it is non-labor intensive and it provides a safe means to remove manure from confined spaces. The flush, which can be initiated manually or cycled by timer, dosing system, tip tank, or other means, transports the manure from the collection area. Pumping is used to transport liquid and slurry wastes from collection pits to storage or treatment lagoons. High solid wastes are often collected and transported from the housing or feeding areas using tractors with scraper blades and/or bucket loaders. Manure collected in gutters is often transported by automatic scrapers. Some disadvantages of the flush system include a huge increase in the amount of manure, manure cannot be transported very far because of the high cost versus low value, large use of water, problems with overloading when land-applied, and lagoons increasing the volatilization of nitrogen.

Potential Pollution Outputs and Environmental Impacts
For manure collection and transport, the pollution outputs can include manure, urine, litter, bedding, and water. Additional outputs include ammonia emissions from the waste, odors, hair and/or feathers, pathogens, and heavy metals.

Wastewater that may leak from storage areas or transport processes could result in surface water and groundwater contamination. While waste flushing systems aid in removing manure from underground storage basins, flush systems also generate additional manure wastewater that must be managed. Adding water also increases the risk of a manure spill or runoff reaching groundwater or surface water. Frequent collection and transport of manure and collection of surface runoff assists in reducing the nutrient losses and thereby provides greater nutrient availability during utilization. Between 40 to 60 percent of manure's nitrogen content may be lost through volatilization of ammonia NH_3 while the solid manure remains on an open lot[5]. Other nonvolatile nutrients (e.g., organic nitrogen, phosphorus) may be lost through leaching and surface runoff.

Pollution Prevention/Waste Minimization Opportunities
There are many techniques available to reduce pollution caused by animal waste collection and transport activities.

- *Reduce water used in flushing systems*. Alternative technologies, such as low-flow waste flushing systems or no-flow waste scraping systems, use less water than traditional systems, and decrease the amount of liquid that is sent to be treated in the lagoon.

- *Recycle water for flushing*. To minimize the amount of wastewater generated, some means of recycling clarified wastewater for flushing may be desirable. Separation of solids from flush water can be used to reduce the solids in the recycled flush water.

[5] *Generally Accepted Agricultural and Management Practices for Manure Management and Utilization*, Table 5, Nitrogen Losses During Handling and Storage. Adopted by Michigan Agriculture Commission, Lansing, Michigan, June 1997.

III.D.2. Storing & Treating Animal Wastes

Waste Storage

Storage is the temporary containment of manure and wastes. Following collection, animal waste not immediately used may be stored in dry or wet form by various means and structures. Broiler and beef wastes are stored in dry forms while dairy and swine wastes are stored in wet forms.

- Manure stacks, bunkers, and stacking sheds are commonly used for dry wastes.

- Pits, tanks, ponds, and lagoons for liquid or slurry wastes.

Dry manure or litter is often placed in a covered or roofed area so that it does not come into contact with storm water. Storage may be short-term, usually a few days to a few weeks, or long-term, which is usually less than one year. The purpose of short-term storage is typically the retention of manure at the point of collection until transport to long-term storage or treatment. The purpose of long-term storage is retention of the waste until utilization is possible and/or appropriate as determined by the field condition, crop, weather, and other factors. Storage containment must be designed to hold the total volume of manure generated during the maximum length of time between applications. Additionally, federally regulated CAFO liquid storage units that accept storm water runoff must be sized to contain normal precipitation and runoff (less evaporation) for the storage period plus a 25-year, 24-hour storm event flow and still provide adequate freeboard. Waste storage is not treatment and any treatment that occurs is incidental.

Waste Treatment

Following collection and/or storage, livestock production facilities may treat animal wastes. Treatment may include (1) solids separation by gravity, mechanical, or vegetative methods, and (2) stabilization of the waste by anaerobic lagoons, aerobic lagoons, or composting.

- *Solids Separation.* Solids separation is a physical treatment process whereby a portion of the larger solids and fibers are removed from the manure and can be reused. Solids separation is often used preceding a storage or a treatment lagoon to slow the rate of solids accumulation in the basin. Solids separation may be accomplished by settling basins, mechanical separation, and vegetative filter strips.

- Settling basin. Solids separation, in a settling basin, is achieved by discharging the wastestream to a basin where the rate of flow is low enough to cause gravity settling of the solids.

- Mechanical solids separator. A mechanical solids separator unit may be a static screen, vibrating screen, mechanical flat belt (press), or roller press. In solids separation by static or vibrating screen, the flow is generally passed across the screen where the solids are captured and the liquid drops through. The liquid portion from the settling basin and/or mechanical separator is normally sent to storage or treatment or used to irrigate cropland. The collected solids may be used for bedding, feed, soil amendment, or compost.

- *Lagoons (Anaerobic or Aerobic)*. Lagoons can be anaerobic or aerobic (non-mechanical and mechanical), although aerobic lagoons are used less frequently. In contrast to solids separation, lagoons are biological treatment processes used to satisfy the oxygen demand (e.g., BOD, COD) and volatilize nitrogen. Lagoons can convert ammonia nitrogen to nitrate, though this is extremely rare in animal treatment systems.

  Lagoons vary in shape and size, but when properly constructed should have sufficient volume to hold the waste during the treatment period and contain normal precipitation and runoff (less evaporation) for the storage period plus a 25-year, 24-hour storm event flow and still have adequate freeboard. Lagoons should be lined either with clay, naturally occurring high clay content soils, concrete, or a synthetic liner.

  - *Anaerobic lagoons* are commonly used to treat animal waste -- particularly swine, but also cattle and layers. Because anaerobic lagoons do not require free oxygen for treatment, they are usually six to ten feet deep. Anaerobic systems are sometimes operated with two lagoons in series allowing the first lagoon to overflow via pipe or spillway to the second lagoon.

  - *Non-mechanical aerobic lagoons* are shallow, usually two to five feet deep and have a large surface area. This allows more sunlight to reach the algae, which in turn produce oxygen needed for treatment to occur. Non-mechanical aerobic lagoons are rarely used in livestock applications because they require large amounts of land.

- *Mechanical aerobic lagoons* have higher construction costs due to the aeration equipment. The aeration process is expensive to operate; however, digestion occurs at a faster rate and fewer odors are produced. Due to the additional construction and operating costs, mechanical aerobic lagoons are uncommon. Mechanically aerated lagoons are sometimes used to control odors in odor-sensitive areas. Aerobic lagoons will produce more sludge than anaerobic lagoons and thus require additional solids handling.

- *Composting.* Composting is an aerobic biological process that converts organic waste into a stable organic product that can be used onsite or transported offsite for use. Composting reduces the volume of waste and kills pathogens while preserving more of the nutrients for use by crops. The composted material improves soil fertility, tilth (tilled earth), and water holding capacity. Composting is optimized by proper ratios of carbon to nitrogen and carbon to phosphorus; moisture content; temperature; pH; and time.

  In the composting process, a bulking agent (e.g., wood chips, peanut husks, animal bedding, or other materials) is mixed with the manure to provide the proper carbon ratios. Because of its high nutrient to volume ratio, composted animal waste, or compost, is a beneficial agricultural product. Compost can be spread on paddocks, cropland, and nursery stock, or used for landscaping and home gardens. Note: Many poultry and some swine operations also use composting for carcasses.

  There are four general composting methods -- static pile, aerated static, windrow, and in-vessel.

  - Static pile method is the simplest composting operation and requires the least labor, but takes the longest time to complete the process. The static pile operation is not mixed or aerated.

  - Aerated static pile method is not mixed but usually has piping to allow air to reach the interior of the pile.

  - Windrow method involves a long narrow pile that is regularly mixed and aerated.

- In-vessel method is an enclosed operation that allows accurate control of moisture and other parameters, while containing the odors.

Potential Pollution Outputs and Environmental Impacts
During waste storage, livestock production operations may produce stack seepage and storm water runoff which should be directed to the liquid storage ponds and lagoons.

During waste treatment, the pollution outputs and impacts include releases of ammonia and other gases to the air, contaminated runoff to surface waters, leaching resulting in groundwater contamination, and odors. For lagoons, the major pollution output is wastewater that is leached to groundwater through improperly lined lagoons; discharges to surface waters due to overfilling and breakthroughs; or improper transfer of wastes between facilities resulting in surface water contamination.

Pollution Prevention/Waste Minimization Opportunities
There are pollution prevention techniques that can be used during animal waste storage and treatment activities. These include:

- *Proper location*. The location of manure storage systems should consider proximity to water bodies, floodplains, and other environmentally sensitive areas.

- *Cover wastes*. During storage, place dry manure or litter in a covered or roofed area so that it does not come into contact with storm water. When composting, impacts can be significantly reduced by maintaining the compost operation under a roof or in an enclosed area.

- *Prevent spills by regular inspections and maintenance*. Spills and overflows can be prevented by regular inspections and preventive maintenance of lagoons; never filling lagoons beyond treatment capacity; and removing sludge as needed.

- *Use vegetative filters*. Vegetative filters are often used to prevent runoff from lagoon or settling basin liquid overflow from reaching a waterbody. As the water flows across the vegetative strip, the solids drop out of the water, thus reducing

R0074502

the amount of solids that can impact the environment. Vegetative filters are effective when located near the lagoon.

- *Build a reserve lagoon.* While the installation of a reserve lagoon may not be economically viable in all situations, the potential release of lagoon contents to the environment can be reduced by maintaining a spillway to a reserve lagoon. Spillways provide for limited release of overflow, which reduces the tendency for stress-related structural failure. A reserve lagoon is an integral component of a spillway system that prevents contamination of surface water and groundwater.

- *Prevent overtopping.* In preparation of rain events or to prevent exceeding lagoon capacity, livestock operations may hire a contractor to remove liquids from lagoons that are in danger of overtopping.

III.D.3. Utilizing Animal Wastes

Animal wastes (e.g., manure and urine) can be used as sources of plant nutrients. Land application is the most common, and usually most desirable, method of utilizing manure and wastewater because of the value of the nutrients and organic matter. Land application should be planned to ensure that the proper amount of nutrients are applied in a manner that does not adversely impact the environment or endanger public health.

Benefits of Land Application of Animal Wastes. The benefits of proper application include improvement of the physical, chemical, and biological properties of the soil, as well as significant economic returns from the use of manure as a plant nutrient.

Considerations for appropriate land application should include:

R0074503

Nutrient Management Plans[6]. The primary purpose of nutrient management is to achieve the level of nutrients (e.g., nitrogen and phosphorus) required to grow the planned crop by balancing the nutrients that are already in the soil with those from other sources (e.g., manure, biosolids, commercial fertilizers) that will be applied. At a minimum, nutrient management can help prevent the application of nutrients at rates that will exceed the capacity of the soil and the planned crops to assimilate nutrients and prevent pollution.

- Comprehensive Nutrient Management Plans (CNMPs). As discussed in the *USDA-EPA Unified National Strategy for Animal Feeding Operations*, all animal feeding operations should develop and implement technically sound, economically feasible, and site-specific CNMPs to minimize impacts to water quality and public health. In general, a CNMP identifies actions or priorities that will be followed to meet clearly defined nutrient management goals at an agricultural operation. CNMPs should address, as necessary, manure and wastewater handling and storage, land application of manure and other nutrient sources, site management, record keeping, and feed management. CNMPs should also address other utilization options for manure where the potential for environmentally sound land application of manure is limited at the point where it is generated.

- *Timing and Methods of Application:* The timing and methods of application should minimize the loss of nutrients to groundwater or surface water and the loss of nitrogen to the atmosphere. Manure and wastewater application equipment should be calibrated to ensure that the quantity of material being applied is what is planned. Care must be taken when land-applying manure and wastewater to prevent it from

[6] On May 24, 1999, USDA-NRCS released the Policy for Nutrient Management and the revision to the conservation practice standard for Nutrient Management (Code 590). NRCS' directive and supporting technical guide establishes policy for nutrient management, sets forth guidance to NRCS personnel who provide nutrient management technical assistance, and for the revision of the NRCS nutrient management conservation practice standard. These two documents will provide the framework for all nutrient management plans developed by NRCS for the agricultural community, which will be tailored by State Conservationists within a two-year period. Of particular importance is the new policy as it relates to producers that may not have sufficient land available to spread manure at rates that utilize nitrogen and phosphorus and will, as a result, need to pursue off-farm utilization options.

entering streams, other water bodies, or environmentally sensitive areas.

Manure can be land applied as solids, slurries, and liquids. The type of application equipment used depends on the manure moisture content. Box spreaders are typically used for dry manure, flail spreaders and injection for slurries, and irrigation and injection for liquids. Manure application may be by the livestock operation personnel or a custom applicator.

- *Surface application*. Box and flail spreaders apply the manure to the soil surface as the spreader is pulled or driven across the field. If surface applied, the manure may then be incorporated into the soil. Incorporation within 24 hours greatly reduces ammonia volatilization thus retaining nitrogen.

- *Injection*. Injected manure is incorporated into the soil as the equipment is driven or pulled across the field.

- *Irrigation*. Many livestock operations with storage ponds or treatment lagoons use irrigation systems, portable irrigation equipment, or hire custom irrigators. Those establishments with field crops or silviculture often use portable irrigation systems such as traveling guns or center pivots. Operations with several different fields or large acreage on which to apply the waste typically use travelers. Small acreage establishments often use small-nozzle, moderate-pressure, permanent irrigation systems, because they provide low labor costs and more uniform distribution of lagoon liquids.

Potential Pollution Outputs and Environmental Impacts
While properly applied animal wastes provide nutrients and have little negative environmental consequence, improper management and use of animal wastes, such as overapplication, excessive spraying, or application during rain events or on frozen ground, may result in serious impacts to the environment.

The potential pollution outputs of land application include nutrient runoff and leaching, which may cause surface water and groundwater contamination, respectively. Pollutants of concern include (1) nitrates and nitrites that originate from oxidation of nitrogen contributed by the manure, and (2) phosphorus. Groundwater contamination is caused by the nitrates leaching from the crop root zone into the groundwater aquifer. The amount of contaminated runoff depends on factors such as what type of manure is used, how it is handled, type of crop being grown, stage of growth, weather conditions, method of application, and the amount of existing nutrients in the soil.

Overapplication or improper application of animal waste can also lead to aesthetic problems, including odors and vectors. It can also result in polluted runoff resulting in contamination of surface waters. The presence of ammonia, phosphates and organic matter in surface waters can result in increased biochemical oxygen demand and low levels of oxygen. This can cause the death of fish and other aquatic life forms. (Ohio State University, *Ohio Livestock Manure and Wastewater Guide*)

> Vectors are defined as organisms that carry pathogens from one host to another, such as insects or rats/mice.

Pollution Prevention/Waste Minimization Opportunities
In addition to land application, other manure use practices include:

- ✓ Processing and recycling through ruminant feeding programs.
- ✓ Biogas production as an energy source using anaerobic digester technologies.
- ✓ Pyrolysis processes to produce electricity, chars (materials scorched, burned, or reduced to charcoal), and industrial petrochemicals.
- ✓ Microbial and algae production as an animal feed source.
- ✓ Aerobic degradation to produce composted products.

III.E. Other Management Issues

Odor Control

Odors are typically generated throughout the livestock production process. The odor from manure can vary depending on the type and consistency of the manure, how it is stored, and how and where it is applied.

Potential Pollution Outputs and Environmental Impacts
With enclosed or partially enclosed housing areas, odors and other gases (e.g., methane, ammonia, and hydrogen sulfide gases) from animal waste can be concentrated, potentially harming the health of the

R0074506

animals and workers. When the gases are released outside, the odor can affect the surrounding areas and create nuisance problems for neighbors.

Pollution Prevention/Waste Minimization Techniques
There are several ways livestock facilities can reduce odors resulting from their operations and waste management practices. These include:

✓ *Reduce methane emissions*. One method of reducing methane emissions from livestock is to supplement the animal's diet. Scientists have found that supplementing a cow's diet with substances such as urea increases the animal's ability to digest food. With improved digestion, less fermentation takes place during digestion, and methane emissions per unit of forage have been reduced 25-75 percent. In addition, as digestion improves, productivity also improves, as dairy cows produce more milk and beef cattle fatten faster (*Information Unit on Climate Change, 1993*).

✓ *Follow BMPs for land application*. Odors from land application of manure can be minimized by following BMPs that are designed to maximize the nutrients available to the soil and crops. Many of these BMPs may be required by state or local ordinance. These practices include the following:

- Spreading manure within agronomic rates.
- When possible incorporating surface-applied manure within 24 hours.
- Spreading early in the day as the air is warming and rising; this allows the applied waste to dry which reduces odor.
- Avoiding spreading manure on windy days (i.e., blowing towards the neighbor).
- Avoiding spreading manure during holidays and weekends.
- Avoiding spreading waste near heavily traveled roads.

Managing Animal Carcasses

Dead animals should be disposed of in a way that does not adversely affect ground or surface water or create public health concerns. Composting, rendering, and other practices are common methods used to dispose of dead animals.

As with rendering plants, dead animals may be processed for use as pet food, composted, buried, or incinerated. USDA and FDA regulations prohibit the use of mortalities as feed for animals that are to be consumed by humans. *Note: State law or self-imposed industry standards may limit some of these options.* Because rendering must generally occur within 24 hours of an animal's death, it is helpful for the livestock production facility to establish rendering contacts in advance. Where this may not be possible, freezer storage could be used until such time as the rendering facility can collect the animals for processing. Some centrally located rendering facilities may provide pickup services to local livestock operations.

Animal carcass composting is another common method of handling poultry and small animal mortalities. Carcass composting typically takes more time than manure or yard waste composting, but has been shown to be an effective waste management approach. Many poultry and some swine operations use composting for carcasses. Livestock operations may use poultry compost sheds to dispose of their dead birds by mixing the dead birds with bedding and other materials.

As with manure composting, the compost process requires a carbon source to provide the proper carbon/nitrogen ratio for the necessary bacterial processes. Sawdust and straw are typically used as a carbon source due to their small particle size, ease of handling, absorbency, and high carbon content. Sawdust in excess of that required for the ideal carbon/nitrogen ratio is used in the initial stages of composting to provide adequate coverage of the carcasses. Sawdust also helps reduce odors from the composting process.

Potential Pollution Outputs and Environmental Impacts
Animal carcasses must be properly and quickly managed because they are a source of disease and can attract many vectors. Environmental impacts of carcasses depend on the management method used.

- Burial and/or pit disposal of carcasses in coarse textured soils and in areas of a high water table may contribute nutrients to groundwater.

R0074508

- Animal carcasses that are disposed of above ground or insufficiently covered can cause aesthetic and potential human health impacts including odor generation and vector attraction, such as flies and mice.

- Specifically, poultry compost houses can be a potential source of pollution if not managed properly (e.g., kept at the right temperature, moisture content, etc.) because a leachate can form and leak from the compost house.

- The rendering process generates wastewater that must be managed according to the rendering facility's NPDES permit or pretreatment permit.

Pollution Prevention/Waste Utilization Techniques

There are several techniques that can be used to minimize wastes resulting from animal mortalities. As described above, rendering or composting are considered disposal methods that prevent pollution. If these are not available, burying carcasses can be another option. The impact of burying carcasses can be minimized by burying them deep below the surface of the ground, well away and downgrade from any source of drinking water, and covered with a generous supply of quicklime to reduce soil pH before fill dirt is added. If the carcasses must be disposed of onsite, it is preferable to have:

- A burial area at least 100 meters away from houses and watercourses
- The pit base at least 38 inches above the level of the watertable
- Heavy soil of low permeability and good stability
- Good access to the site for earthmoving machinery and stock transport unless the stock are to be walked in for slaughter

> The burial of dead animals is being phased out. In fact, some states prohibit the practice, except under the most extreme circumstances.

It is important to avoid sites sloping toward watercourses and areas that are likely to drain to surface water. Many states may have more strict statutes regulating the burial of dead animals. For example, Oregon requires that the animal carcasses be buried to such a depth that no part of them are nearer than four feet to the natural surface of the ground and they are covered with quicklime and at least four feet of soil.

III.F. Pest Control

Within a livestock production establishment, pesticides may be used for a variety of purposes. They may be applied directly to livestock or to structures, such as barns and housing units, to control pests (e.g., parasites, vectors). Pesticides can also be used to control predators. Vectors are defined as organisms that carry pathogens from one host to another, such as insects or rats/mice.

Livestock. Commonly, pesticides are applied directly to livestock using high-pressure and low-pressure sprayers, mist application equipment (i.e., fumigation and foggers), and dipping vats. In addition, pesticides may be added to ear tags and to gates through which animals commonly pass (i.e., gate wipes/brushes). Spraying or fogging animals, especially high-pressure spraying, allows penetration into fur and wool to control lice, mange, wool maggots, and other parasites and vectors. Portable dipping vats are used for treating external parasites, especially of sheep and swine.

Structures. Pesticides may also be applied directly to or used in and around structures, such as barns or other types of housing units. Sprayers and foggers are the most commonly used methods to apply insecticides, rodenticides, and disinfectants, although other methods may be used, such as injected termite treatments, rat/mouse traps, or other types of insect traps. Such applications are used to control flies, beetles, and manure larvicides, among others.

Predators. Some livestock operations, especially sheep and goat operations, experience problems with predators. Historically, these problems have been addressed by operators through various methods to scare away potential predators. Such methods included scarecrows or bells. Recently, another method, livestock protection collars, have been developed to help combat predators. Livestock protection collars are placed around the necks of the livestock and contain a rubber bladder filled with a pesticide. When predators, primarily coyotes, attack livestock they go for the throat, puncture the bladder on the collar, and ingest the pesticide. The livestock are unhurt, but the coyotes ultimately die from the ingested pesticide.

Potential Pollution Outputs and Environmental Impacts
The potential environmental impacts from pesticide application are runoff or leaching to surface water or groundwater, spills to surface waters, potential human and animal exposure, overtolerance levels on animals and products, and soil contamination that could leave land unproductive. These environmental impacts may all occur if pesticides

R0074510

are not applied in accordance with the label directions. The degree of environmental impact depends on the application method.

- The application of pesticides using spray or fogger systems is more likely to involve releases to air, which may result in human and excessive animal exposure.

- If not disposed of properly, liquids from dipping vats may contaminate both surface water and groundwater.

- If not protected with backflow prevention devices, pesticides applied through spray systems that are connected to water supplies can siphon back to the water source and potentially contaminate drinking water systems.

- In addition to runoff and leaching, spills of pesticides may also negatively impact the environment. The impacts are the same as for runoff and leaching, but may be more significant since the spilled materials will be concentrated in one specific area. Also, improperly cleaned and disposed pesticide containers may cause releases to the soil and/or surface waters.

Pesticides are both suspected and known for causing immediate and delayed-onset health hazards for humans. If exposed to pesticides, humans may experience adverse effects, such as nausea, respiratory distress, or more severe symptoms up to and including death. To help reduce this potential exposure, tolerance levels have been established for residues on agricultural products. Animals and birds impacted by pesticides can experience similar illnesses or develop other types of physical distress. Following label directions for application, protective gear, and disposal will help ensure such environmental impacts do not occur.

Pollution Prevention/Waste Minimization Opportunities
Environmental impacts from pesticides can be minimized by following the label directions and preventing or minimizing their use wherever possible. Pesticide use accounts for a substantial portion of farm production costs. By reducing their use, agricultural establishments can not only reduce production costs, but also reduce environmental impacts of their operations. Pesticide use and impact can be minimized by using general good housekeeping practices, integrated pest management, and good management practices. Examples of these are presented below.

✓ **Integrated Pest Management**. Integrated pest management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. Examples of IPM in the livestock production industry could include maintaining structures (e.g., plug holes, place stripping around doors and windows), good housekeeping in barns and other structures, rodent and insect traps, and use of predators (e.g., certain insects, snakes). IPM can involve the use of pesticides. In such cases, the IPM plan should indicate when a pesticide is needed, and its selection is based on persistence, toxicity, and leaching and runoff potential such that the most environmentally friendly pesticide is used.

✓ **Good Management Practices**. In addition to use consistent with the label, there are other general management practices associated with pesticides that can help reduce their environmental impact. Such practices include:

- Buy only the amount needed for a year or a growing season.
- Minimize the amount of product kept in storage.
- Calculate how much diluted pesticide will be needed for a job and mix only that amount.
- Apply pesticides with properly-calibrated equipment.
- Purchase pesticide products packaged in such a way as to minimize disposal problems.
- Work with the state to locate a pesticide handler who can use the excess pesticide.
- Return unused product to the dealer, formulator, or manufacturer.

- Implement setbacks from wellheads for application and storage.

- If possible, choose nonleachable pesticides labeled for the pest.

III.G. Maintaining and Repairing Agricultural Machinery and Vehicles

Day-to-day maintenance and repair activities keep agricultural machinery and vehicles safe and reliable. Maintenance activities include oil and filter changes, battery replacement, and repairs, including metal machining.

Potential Pollution Outputs and Environmental Impacts
The wastes from maintenance and repair activities can include used oil, spent fluids, spent batteries, metal machining wastes, spent organic solvents, and tires. These wastes have the potential to be released to the environment if not handled properly, stored in secure areas with secondary containment, protected from exposure to weather, and properly disposed of. If released to the environment, the impact of these releases can be contamination of surface waters, groundwater, and soils, as well as toxic releases to the atmosphere. Groundwater pollution can also result from discharges of wastes to Class V wells.

Pollution Prevention/Waste Minimization Opportunities
Preventive maintenance programs can minimize waste generation, increase equipment life, and minimize the probability of significant impacts and accidents. Where the wastes cannot be eliminated, safe handling and recycling can minimize environmental impacts. The following presents pollution prevention/waste minimization opportunities for each type of waste.

Used Oil. The impact of oil changes can be minimized by preventing releases of used oil to the environment, and recycling or reusing used oil whenever possible. Spills can be prevented by using containment around used oil containers, keeping floor drains closed when oil is being drained, and by training employees on spill prevention techniques. Oil that is contained rather than released can be recycled, thus saving money, and protecting the environment.

Recycling used oil requires equipment like a drip table with a used oil collection bucket to collect oil dripping from parts. Drip pans can be placed under machinery and vehicles awaiting repairs to capture any leaking fluids. By using catch pans or buckets, rather than absorbent materials to contain leaks or spills of used oil, the used oil can be more easily recycled. To encourage recycling, the publication "How To Set Up A Local Program To Recycle Used Oil" is available at no cost from the RCRA/Superfund Hotline at 1-800-424-9346 or 1-703-412-9810.

Proper Disposal of Oil-Based Fluids. Spent petroleum-based fluids and solids should be sent to a recycling center whenever possible. Solvents that are hazardous waste must not be mixed with used oil or, under RCRA regulations, the entire mixture may be considered hazardous waste. Non-listed hazardous wastes can be mixed with waste oil, and as long as the resulting mixture is not hazardous, can be handled as waste oil. All used drip pans and containers should be properly labeled.

Spent Fluids. Farm machinery and vehicles require regular changing of fluids, including oil, coolant, and others. To minimize releases to the environment, these fluids should be drained and replaced in areas where there are no connections to storm drains or municipal sewers. Minor spills should be cleaned up prior to reaching drains. Used fluid should be collected and stored in separate containers. Fluids can often be recycled. For example, brake fluid, transmission fluid, and gear oil are recyclable. Some liquids are able to be legally mixed with used motor oil which, in turn, can be reclaimed.

During the process of engine maintenance, spills of fluids are likely to occur. The "dry shop" principle encourages spills to be cleaned immediately so that spilled fluid will not evaporate to air, be transported to soil, or be discharged to waterways or sewers. The following techniques help prevent and minimize the impact of spills:

✓ Collect leaking or dripping fluids in designated drip pans or containers. Keep all fluids separated so they may be properly recycled.

✓ Keep a designated drip pan under the vehicle while unclipping hoses, unscrewing filters, or removing other parts. The drip pan prevents splattering of fluids and keeps chemicals from penetrating the shop floor or outside area where the maintenance is occurring.

✓ Immediately transfer used fluids to proper containers. Never leave drip pans or other open containers unattended.

Radiator fluids are often acceptable to antifreeze recyclers. This includes fluids used to flush out radiators during cleaning. Reusing the flushing fluid minimizes waste discharges. If a licensed recycler does not accept the spent flushing fluids, consider changing to another brand of fluid that can be recycled.

Batteries. Farm operators have three options for managing used batteries: recycling through a supplier, recycling directly though a battery reclamation facility, or direct disposal. Most suppliers now accept spent batteries at the time of new battery purchase. While some waste batteries must be handled as hazardous waste, lead acid batteries are not considered hazardous waste as long as they are recycled. In general, recycling batteries may reduce the amount of hazardous waste stored at a farm, and thus reduce the farm's responsibilities under RCRA.

The following best management practices are recommended to prevent used batteries from impacting the environment prior to disposal:

- ✓ Place on pallets and label by battery type (e.g., lead-acid, nickel, and cadmium).
- ✓ Protect them from the weather with a tarp, roof, or other means.
- ✓ Store them on an open rack or in a watertight secondary containment unit to prevent leaks.
- ✓ Inspect them for cracks and leaks as they come to the farm. If a battery is dropped, treat it as if it is cracked. Acid residue from cracked or leaking batteries is likely to be hazardous waste under RCRA because it is likely to demonstrate the characteristic of corrosivity, and may contain lead and other metals.
- ✓ Neutralize acid spills and dispose of the resulting waste as hazardous if it still exhibits a characteristic of a hazardous waste.
- ✓ Avoid skin contact with leaking or damaged batteries.

Machine Shop Wastes. The major hazardous wastes from metal machining are waste cutting oils, spent machine coolant, and degreasing solvents. Scrap metal can also be a component of hazardous waste produced at a machine shop. Material substitution and recycling are the two best means to reduce the volume of these wastes.

The preferred method of reducing the amount of waste cutting oils and degreasing solvents is to substitute with water-soluble cutting oils. If non-water-soluble oils must be used, recycling waste cutting oil reduces the potential environmental impact. Machine coolant can be recycled, either by an outside recycler, or through a number of in-house systems. Coolant recycling is most easily implemented when a standardized type of coolant is used throughout the shop. Reuse and recycling of solvents also is easily achieved, although it is generally done by a permitted recycler. Most shops collect scrap metals from machining operations and sell these to metal recyclers. Metal chips which have been removed from the coolant by filtration can be included in the scrap metal collection. Wastes should be carefully segregated to facilitate reuse and recycling.

III.H. Fuel Use and Fueling Activities

Fuel is used to operate agricultural machinery, equipment, and vehicles that are used throughout the livestock operation. Agricultural machinery and vehicles are typically fueled using an above ground fueling dispenser that is connected to an above ground or underground fuel tank.

Potential Pollution Outputs and Environmental Impacts
Agricultural machinery and vehicles that use fuel most likely emit pollutants to the atmosphere. The activity of fueling itself can emit air pollutants, and spills of fuel can cause water, soil and groundwater contamination. Underground fueling systems that are not monitored or maintained properly can leak into the surrounding soils and eventually contaminate groundwater.

Pollution Prevention/Waste Minimization Opportunities
Properly maintaining fuel tanks, lines, and fueling systems can substantially reduce the probability of accidental fuel spills or leaks. All leaking pipe joints, nozzle connections, and any damage to the fueling hose (e.g., kinks, crushing, breaks in the carcass, bulges, blistering, soft spots at the coupling, deep cracks or cuts, spots wet with fuel, or excessive wear) should be fixed immediately to reduce the amount of pollution to the environment. Spill and overflow protection devices can be installed to prevent fuel spills and secondary

containment can be used to contain spills or leaks. Additional pollution prevention techniques for fueling include the following:

- ✓ Inspect fueling equipment daily to ensure that all components are in satisfactory condition. While refueling, check for leaks.
- ✓ If refueling occurs at night, make sure it is carried out in a well-lighted area.
- ✓ Never refuel during maintenance as it might provide a source of ignition to fuel vapors.
- ✓ Do not leave a fuel nozzle unattended during fueling or wedge or tie the nozzle trigger in the open position.
- ✓ Discourage topping off of fuel tanks.

THIS PAGE LEFT INTENTIONALLY BLANK

IV. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulatory requirements.

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute. For specific agricultural information, contact The National Agricultural Compliance Assistance Center at (888) 663-2155 or visit the website at http://www.epa.gov/agriculture.

IV.A. General Description of Major Statutes

Clean Water Act

The primary objective of the Federal Water Pollution Control Act Amendments of 1972, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either "toxic" pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and "indirect" dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and 1 territory to administer the NPDES program), contain industry-specific, technology-based water quality limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR §122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products;

SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program
Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA § 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands
Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in Section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. EPA's authority under Section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the Section 404 program to the states.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed *through the Ground Water and Drinking Water resource center, at (202) 260-7786.*

Oil Pollution Prevention Regulation
Section 311(b) of the CWA prohibits the discharge of oil, in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of Section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990 Congress passed the Oil Pollution Act which amended Section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. 40 CFR § 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with DPCC plans, required by the state, provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to 1 million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past 5 years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. FRPs that meet EPA's requirements can be combined with U.S. Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added Section 6217 (16 U.S.C. § 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The Section 6217 program is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Agency (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under Section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds at http://www.epa.gov/owow or from the Watershed Information Network at http://www.epa.gov/win. The NOAA website at http://www.nos.noaa.gov/ocrm/czm/ also contains additional information on coastal zone management.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is often state/tribe-enforced, since EPA has authorized many states/tribes to administer the program. Currently, EPA shares the UIC permit program responsibility in seven states and completely runs the program in 10 states and on all tribal lands.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1) delineating the source water protection area, (2) conducting a contaminant source inventory, (3) determining the susceptibility of the public water supply to contamination from the inventories sources, and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR 262.34) without a permit or interim status.

Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit. Subtitle C permits for treatment, storage, or disposal facilities contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating certain emergency

response activities and for appointing Local Emergency Planning Committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA § 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA § 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA § 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR 302) or an EPCRA extremely hazardous substance.

- **EPCRA § 311 and § 312** requires a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA § 313** requires certain covered facilities, including SIC codes 20 through 39 and others, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at http://www.epa.gov/epaoswer/hotline. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under §110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and will become effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. The NSPSs are based on the pollution control technology available to that category of industrial source (*see* 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of sources that emit any of

188 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996. Methyl bromide, a common pesticide, has been identified as a significant stratospheric ozone depleting chemical. The production and importation of methyl bromide, therefore, is currently being phased out in the United States and internationally. As specified in the Federal Register of June 1, 1999 (Volume 64, Number 104) and in 40 CFR Part 82, methyl bromide production and importation will be reduced from 1991 levels by 25 percent in 1999, by 50 percent in 2001, by 70 percent in 2003, and completely phased out by 2005. Some uses of methyl bromide such as the production, importation, and consumption of methyl bromide to fumigate commodities entering or leaving the United States or any state (or political subdivision thereof) for purposes of compliance with Animal and Plant Health Inspection Service requirements or with any international, federal, state, or local sanitation or food protection standard, will be exempt from this rule. After 2005, exceptions may also be made for critical agricultural uses. The United

States EPA and the United Nations Environment Programme have identified alternatives to using methyl bromide in agriculture. Information on the methyl bromide phase-out, including alternatives, can be found at the EPA Methyl Bromide Phase-Out Website:
(http://www.epa.gov/docs/ozone/mbr/mbrqa.html).

EPA's Clean Air Technology Center, at (919) 541-0800 and at the Center's homepage at http://www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996 and at http://www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Hotline, at (800) 535-0202 and at http://www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA §112(r); and information on air toxics can be accessed through the Unified Air Toxics website at http://www.epa.gov/ttn/uatw. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration
Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enforcement authority for facilities/persons that are not in compliance with FIFRA.

Product Registration
Under §3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the United States must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site, i.e., where the product may be used, and the amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process

often requires either the citation or submission of extensive environmental, health or safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under §408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA § 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be requested to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA § 3(c)(2)(B) and § 4.

Use Restrictions
As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration
Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (§ 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions
A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR.163.10 through 163.12). Under the Federal Food,

Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension
EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order that makes the suspension immediately effective.

Imports and Exports
Under FIFRA §17(a), pesticides not registered in the United States and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified at 40 CFR 168.65, 168.75, and 168.85.

Under FIFRA §17(c), imported pesticides and devices must comply with United States pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA §17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. United States Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to United States Customs when the shipment arrives in the United States. NOA forms can be obtained from contacts in the EPA Regional Offices or www.epa.gov/oppfead1/international/noalist.htm.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs homepage at www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture Division at http://es.epa.gov/oeca/main/offices/division/ag.html or The National Agriculture Compliance Assistance Center toll-free at 888-663-2155 or http://www.epa.gov/agriculture. Other sources include the National Pesticide Telecommunications Network toll-free at 800-858-7378 and the National Antimicrobial Information Network toll-free at 800-447-6349.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical substance is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA § 6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under § 6 authority are asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs).

Under TSCA § 8(e), EPA requires the producers and importers (and others) of chemicals to report information on a chemicals' production, use, exposure, and risks. Companies producing and importing chemicals can be required to report unpublished health and safety studies on listed chemicals and to collect and record any allegations of adverse reactions or any information indicating that a substance may pose a substantial risk to humans or the environment.

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

IV.B. Industry-Specific Requirements for Agricultural Livestock Production Industry

The agricultural livestock production industry discussed in this notebook is regulated by several different federal, state, and local agencies. EPA has traditionally relied on delegation to states to meet environmental standards, in many cases without regard to the methods used to achieve certain performance standards. This has resulted in states with more stringent air, water, and hazardous waste requirements than the federal minimum requirements. This document does not attempt to discuss state standards, but rather highlights relevant federal laws and proposals that affect the agricultural livestock production industry.

Clean Water Act

Under the CWA, there are five program areas that potentially affect agricultural establishments and businesses. These include: point source discharges, storm water discharges, nonpoint source pollution, wetland regulation, and sludge management. Key provisions addressing each of these areas are summarized below:

- **Point Source Discharges**: The CWA establishes a permitting program known as the NPDES program for "point sources" of pollution. The term "point source" includes facilities from which pollutants are or may be discharged to waters of the United States and is further defined at 40 CFR Part 122. If granted, the permit will place limits and conditions on the proposed discharges based on the performance of available control technologies and on any applicable (more stringent) water quality considerations. Usually the permit also will require specific compliance measures, establish schedules, and specify monitoring and reporting requirements.
  - **Concentrated Animal Feeding Operations (CAFOs):** The CWA defines CAFOs as point sources. Therefore, CAFOs are subject to the NPDES permitting program. See 40 CFR Part 122.23 and 40 CFR 122 Appendix B. A CAFO is prohibited

R0074537

from discharging pollutants to waters of the U.S. unless it has obtained an NPDES permit for the discharge.

- Definition of an AFO – An AFO is defined in EPA regulations as a lot or facility where (1) animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and (2) crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

- Definition of a CAFO – CAFOs are a subset of all AFOs. Whether an AFO is a CAFO under the regulations depends on the number of animals confined at the facility. A CAFO is defined as follows:

  (1) More than 1,000 AUs are confined at the facility [40 CFR 122, Appendix B (a)]; **OR**

  (2) ***From 301 to 1,000 AUs*** are confined at the facility and:

  - Pollutants are discharged into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device; or

  - Pollutants are discharged directly into waters of the U.S. that originate outside of and pass over, across, or through the facility or come into direct contact with the confined animals. [40 CFR 122, Appendix B (b)] OR

  (3) The facility has been **designated as a CAFO** by the permitting authority on a ***case-by-case basis*** [40 CFR 122.23(c)], based on the permitting authority's determination that the operation is a "significant contributor of pollution." In making this determination, the permitting authority considers the following factors:

  - Size of the operation;
  - Amount of waste reaching waters of the United States;
  - Location of the operation relative to waters of the U.S.;

- The means of conveyance of animal wastes and process wastewater into waters of the United States;
- The slope, vegetation, rainfall, and other factors affecting the likelihood or frequency of discharge of animal wastes and process wastewater into waters of the U.S.; and
- Other relevant factors (e.g.,waste handling and storage, land application timing, methods, rates and areas, etc.).

A permit application shall not be required from a concentrated animal feeding designated under the case-by-case authority until after the Director has conducted an on-site inspection and determined that the operation should and could be regulated under the NPDES permit program.

No animal feeding operation with less than the number of animals set forth in 40 CFR 122, Appendix B shall be designated as a concentrated animal feeding operation unless either (1) pollutants are discharged into waters of the U.S. through a manmade ditch, flushing system, or other similar means, or (2) pollutants are discharged directly into waters of the U.S. which originate outside of the facility and pass over, across, or through the facility, or otherwise come into direct contact with the animals confined in the operation.

The NPDES permit regulations [40 CFR 122, Appendix B] contain an exemption for any AFO from being defined as a CAFO if it discharges only in the event of a 25 year, 24-hour, or larger, storm event. To be eligible for an exemption, the facility must demonstrate to the permitting authority that it has not had a discharge. It must also demonstrate that the entire facility is designed, constructed, and operated to contain a storm event of this magnitude in addition to process wastewater. An operation that qualifies for this exemption from being defined as a CAFO may still be designated as a CAFO by the permitting authority on a case-by-case basis.

A 25-year, 24-hour rainfall event means the maximum precipitation event with a probable occurrence of once in 25 years, as defined by the National Weather Service in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments, or equivalent regional or state rainfall probability information developed therefrom [40 CFR Part 412.11(e)].

- **Storm Water Discharges:** Under 40 CFR §122.2, the definition of "point source" excludes agricultural storm water runoff. Thus, such runoff is not subject to the storm water permit application regulations at 40 CFR §122.26. Non-agricultural storm water discharges, however, are regulated if the discharge results from construction over 5 acres or certain other types of industrial activity such as landfills, automobile junk yards, vehicle maintenance facilities, etc.

  - **Concentrated Aquatic Animal Production Facilities**. Under 40 CFR Part 122.24, a *concentrated aquatic animal production facility* is defined and designated as a point source subject to the NPDES permit program.

    - Definition of concentrated aquatic animal production facility (40 CFR Part 122 Appendix C) -- A *concentrated aquatic animal production facility* is a hatchery, fish farm, or other facility that meets one of the following criteria:

      (1) A facility that contains, grows, or holds cold water fish species or other cold water aquatic animals in ponds, raceways, or similar structures which discharge at least 30 days per year. The term does not include (a) facilities which produce less than 9,090 harvest weight kilograms (approximately 20,000 pounds) of aquatic animals per year, and (b) facilities which feed less than 2,272 kilograms (approximately 5,000 pounds) of food during the calendar month of maximum feeding. Cold water aquatic animals include, but are not limited to, the *salmonidae* family (e.g., trout and salmon).

      (2) A facility that contains, grows, or holds warm water fish species or other warm water aquatic animals in

R0074540

ponds, raceways, or similar structures which discharge at least 30 days per year. The term does not include (a) facilities which produce less than 45,454 harvest weight kilograms (approximately 100,000 pounds) of aquatic animals per year or (b) closed ponds which discharge only during periods of excess runoff. Warm water aquatic animals include, but are not limited to, the *Ameiuridae*, *Centrarchidae*, and *Cyprinidae* families of fish (e.g., respectively catfish, sunfish, and minnows).

Designated facility -- A facility that does not otherwise meet the criteria in 40 CFR Part 122 Appendix C (described above) may be *designated* as a concentrated aquatic animal production facility if EPA or an authorized state determines the production facility is a significant contributor of pollution to waters of the U.S. No permit is required for such a designated facility until the EPA or state officials have conducted an onsite inspection and determined that the facility should be regulated under the NPDES permit program.

- **Aquaculture Projects**. Under 40 CFR Part 122.25(b), *aquaculture* means a defined, managed water area that uses discharges of pollutants to maintain or produce harvestable freshwater, estuarine, or marine plants or animals. Discharges into approved aquaculture projects are not required to meet effluent limitations that might otherwise apply. The entire aquaculture project (discharges into and out of the project) is addressed in an NPDES permit.

Wastewater Effluent Guidelines for Dairy Product Processing Establishments. Under 40 CFR Part 405, discharges from twelve categories of dairy products processing are subject to the NPDES permit program. Effluent limitations are established for BOD, TSS, and pH. The effluent guidelines establish technology-based pretreatment standards and effluent limitations for each category.

- **Wastewater Effluent Guidelines for Feedlots (CAFOs)**. Under 40 CFR Part 412, feedlot (beef cattle, dairy cattle, swine, sheep, etc.) point sources are subject to the NPDES permit program. The effluent guidelines establish technology-based pretreatment standards and effluent limitations for this category. In general, the current guidelines for feedlots prohibit any discharge of process wastewater to navigable waters, except in the case of a 25-year, 24-hour rainfall event. CAFOs over 1,000 animal units with NPDES permits may discharge pollutants when chronic or catastrophic rainfall events cause an overflow from a facility designed, constructed, and operated to contain all process wastewater plus the runoff from a 25-year, 24-hour storm for the location of the point source.

- **Nonpoint Source Pollution**. Under the CWA §319 Nonpoint Source (NPS) Management Program and 40 CFR §130.6, states (tribes, and territories) establish programs to manage NPS pollution, including runoff and leaching of fertilizers and pesticides, and irrigation return flows. These NPS management programs must identify: (a) best management practices (BMPs) to be used in reducing NPS pollution loadings; (b) programs to be used to assure implementation of BMPs; (c) a schedule for program implementation with specific milestones; and (d) sources of federal or other funding that will be used each year for the support of the state's NPS pollution management program. Congress provides grant funds to the states annually for the administration of these management programs.

- **Discharges to Publicly Owned Treatment Works (POTWs)**. Under 40 CFR Part 403, facilities, including agricultural establishments, may discharge certain substances to a POTW if the facility has received prior written permission from the POTW and has completed any required pretreatment. Facilities must check with their POTWs for information about permitted discharges and for conditions and limitations.

- **Discharges of Designated Hazardous Substances**. Under 40 CFR Parts 116-117, facilities, including agricultural establishments, must immediately notify the National Response Center (1-800-424-8802) and their state agency of any unauthorized discharge of a designated hazardous substance into (1) navigable waters, (2) the shorelines of navigable waters, or (3) contiguous zones, if the quantity discharged in any 24-hour period equals or exceeds the reportable quantity. A *designated hazardous substance* is any chemical listed in Section 311 of the Clean Water Act. The *reportable quantity* is the amount of the hazardous substance that EPA has determined might cause harm. The list of hazardous substances along with each chemical's reportable quantity is found in 40 CFR Parts 116 and 117. Ammonia and several pesticides are on the list.

- **Discharges of Oil**. Under 40 CFR Part 110, facilities must immediately notify EPA's National Response Center (1-800-424-8802) of any unauthorized discharge of a *harmful quantity of oil* (including petroleum, fuel oil, sludge, oil refuse, or oil mixed with other wastes) into (1) navigable waters, (2) the shorelines of navigable waters, or (3) contiguous zones and beyond. A discharge of oil is considered harmful if it violates applicable water quality standards, causes a sludge or emulsion to be deposited under the surface of the water or on adjoining shorelines, or causes a film or sheen on, or discoloration of, the water or adjoining shorelines. In practice, any quantity of oil or a petroleum product is a harmful quantity, since even small amounts will cause a film or sheen on surface water.

  – **Oil Spill Prevention Control and Countermeasure (SPCC) Program**. Under 40 CFR Part 112, facilities, including agricultural establishments, must comply with EPA's SPCC program when they store oil at their facility. SPCC requirements apply to non-transportation related onshore and offshore facilities of specified size engaged in storing, processing, refining, transferring or consuming oil products, which due to their location, could potentially discharge oil into waters of the U.S. or adjoining shorelines.

    Facilities must comply with the SPCC program: (1) if they have a single aboveground container with an oil storage capacity of more than 660 gallons, multiple aboveground containers with a combined oil storage capacity of more than 1,320 gallons, or a total underground oil storage capacity of more than 42,000 gallons *and* (2) if there is a reasonable expectation that a discharge (spill, leak, or overfill) from the tank will release harmful quantities of oil into navigable waters or adjoining shorelines. The requirements are triggered by tank capacity, regardless of whether tanks are completely filled.

    Facilities subject to the SPCC requirements must prepare an SPCC plan. This plan must include: (1) *prevention* measures that keep oil releases from occurring, (2) *control* measures installed to prevent oil releases from reaching navigable waters, and (3) *countermeasures* to contain, clean up, and mitigate the effects of any oil release that reaches navigable waters. Each plan must be unique to the facility and must be signed by a registered professional engineer.

R0074543

- **Wetlands on Agricultural Lands**. Swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes are common names for wetlands. Wetlands provide a habitat for threatened and endangered species as well as a diversity of other plant, wildlife, and fish species. In addition to providing habitat, wetlands serve other functions, including stabilizing shorelines; storing flood waters; filtering sediments, nutrients, and toxic chemicals from water; and providing an area for the recharge and discharge of groundwater. It is important to note that not all wetlands will be obvious to the untrained observer. For example, an area can appear dry during much of the year and still be classified as a wetland. Your local Natural Resources Conservation Service (NRCS) office can help to identify and delineate wetlands on your property.

  NRCS, formerly the Soil Conservation Service, is the lead agency for identifying wetlands on *agricultural lands*. According to NRCS, agricultural lands means those lands intensively used and managed for the production of food or fiber to the extent that the natural vegetation has been removed and therefore does not provide reliable indicators of wetland vegetation. Areas that meet this definition may include intensively used and managed cropland, hayland, pastureland, orchards, vineyards, and areas that support wetland crops (e.g., cranberries, taro, watercress, rice). Lands not included in the definition of *agricultural lands* include rangelands, forest lands, woodlots, and tree farms.

  - ***Exemption to Section 404 Permit Requirements***. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. The 404 permit program requires a permit for point source discharges of dredged and fill material into waters of the United States. However, many normal established farming activities (e.g., plowing, cultivating, minor drainage, and harvesting), silviculture, and ranching activities that involve discharges of dredged or fill materials into U.S. waters are **exempt from Section 404 permits** and do **NOT** require a permit (33 CFR §323.4). In order to be exempt, the activity must be part of an ongoing operation and cannot be associated with bringing a wetland into agricultural production or converting an agricultural wetland to a non-wetland area.

If not covered by the above exemption, a permit is required before discharging dredged or fill material into U.S. waters, including most wetlands (33 CFR Part 323). The Army Corps of Engineers (Corps) reviews Section 404 permit applications to determine if a project is the least environmentally damaging and practicable alternative.

- **POTW Sludge Management - Land Application of Biosolids**. Land application is the application of biosolids to land to either condition the soil or fertilize crops or other vegetation grown in the soil. Biosolids are a primarily organic solid product produced by wastewater treatment processes that can be beneficially recycled.

  EPA regulates the land application of biosolids under 40 CFR Part 503. As described in *A Plain English Guide to the EPA Part 503 Biosolids Rule* (EPA/832/R-93-003, September 1994), the Part 503 rule includes general provisions, and requirements for land application, surface disposal, pathogen and vector attraction reduction, and incineration. For each regulated use or disposal practice, a Part 503 standard includes general requirements, pollutant limits, management practices, operational standards, and requirements for the frequency of monitoring, recordkeeping, and reporting. For the most part, the requirements of the Part 503 rule are ***self-implementing*** and must be followed even without the issuance of a permit covering biosolids use or disposal requirements.

- **Total Maximum Daily Load (TMDL) Program**. There are still waters in the nation that do not meet the CWA national goal of "fishable, swimmable" despite the fact that nationally required levels of pollution control technology have been implemented by many pollution sources. The TMDL program, established under Section 303(d) of the Clean Water Act, focuses on identifying and allocating pollutant loads to these waterbodies. The goal of a TMDL is the attainment of water quality standards.

  A TMDL identifies the amount a pollutant needs to be reduced to meet water quality standards, allocates pollutant load reductions among pollutant sources in a watershed, and provides the basis for taking actions needed to restore a waterbody. It can identify the need for point source and nonpoint source controls.

  Under this provision, States are required to (1) identify and list waterbodies where State water quality standards are not being met following the application of technology-based point source pollution controls; and (2) establish TMDLs for these waters. EPA must review and approve (or disapprove) State lists and TMDLs. If State actions are not adequate, EPA must prepare lists and TMDLs. TMDLs are to be implemented using existing federal, state, and local authorities and voluntary programs.

TMDLs should address all significant pollutants which cause or threaten to cause waterbody use impairment, including:

- Point sources (e.g., sewage treatment plant discharges)
- Nonpoint sources (e.g., runoff from fields, streets, range, or forest land)
- Naturally occurring sources (e.g., runoff from undisturbed lands)

A TMDL is the sum of the individual wasteload allocations for point sources, load allocations for nonpoint sources and natural background pollutants, and an appropriate margin of safety. TMDLs may address individual pollutants or groups of pollutants, as long as they clearly identify the links between: (1) the waterbody use impairment or threat of concern, (2) the causes of the impairment or threat, and (3) the load reductions or actions needed to remedy or prevent the impairment.

TMDLs may be based on readily available information and studies. In some cases, complex studies or models are needed to understand how pollutants are causing waterbody impairment. In many cases, simple analytical efforts provide an adequate basis for pollutant assessment and implementation planning.

Where inadequate information is available to draw precise links between these factors, TMDLs may be developed through a phased approach. The phased approach enables states to use available information to establish interim targets, begin to implement needed controls and restoration actions, monitor waterbody response to these actions, and plan for TMDL review and revision in the future. Phased approach TMDLs are particularly appropriate to address nonpoint source issues.

Numerous TMDLs are under development in many states and TMDLs are likely to impact agricultural activities by prompting states and stakeholders to mitigate water pollution caused by agricultural sources (assuming agriculture-related industries are identified as significant contributors to water quality impairment).

Coastal Zone Act Reauthorization Amendments of 1990

The Coastal Nonpoint Pollution Control Program, which is implemented under the authority of Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Administration (NOAA). The Section 6217 program requires the 29 states and territories with NOAA-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. These submitted programs must include: (1) management measures that are in conformity with applicable federal guidance and (2) state-developed management measures as necessary to achieve and maintain applicable water quality standards.

On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters.* The federal guidance specifies management measures for the following agricultural sources: (1) erosion from cropland, (2) confined animal facilities, (3) the application of nutrients to croplands, (4) the application of pesticides to cropland, (5) grazing management, and (6) irrigation of cropland.

Once approved, the programs are implemented through state nonpoint source programs (under CWA §319) and state coastal zone management programs (authorized under §306 of the Coastal Zone Management Act). Agricultural establishments located in coastal states should determine whether their land is included in the state's coastal management area. If so, they must comply with their state's applicable coastal nonpoint programs. Currently, all state coastal nonpoint management programs have been conditionally approved and have begun to be implemented.

Coastal Zone Management Act

The 1996 amendments to the Coastal Zone Management Act that may affect agriculture-related industries include those that relate to aquaculture in the coastal zone. Eligible states may now receive grants for developing a coordinated process among state agencies to regulate and issue permits for aquaculture facilities in the coastal zone. States may also receive grants for adopting procedures and policies to evaluate facilities in the coastal zone that will enable the states to formulate, administer, and implement strategic plans for marine aquaculture. Each state that receives such grants will make its own determination as part of its coastal management plan on how to specifically use the funds. Therefore, persons engaged in aquaculture productivity in the

R0074547

coastal zone may be eligible for technical or financial assistance under their state's plan.

Safe Drinking Water Act

The SDWA, which has been amended twice since 1974, protects the water supply through water quality regulations and source protection, such as underground injection control (UIC) regulations. SDWA requirements apply to all public water systems (PWSs). Currently, 54 of 56 states and territories have been delegated primacy to run the drinking water program.

- **Public Water Systems**. Under 40 CFR Parts 141-143, facilities that operate a PWS or receive water from a PWS and provide treatment to it are subject to SDWA regulations. Prior to 1996, SDWA defined a PWS as "a system for the provision to the public of piped water *for human consumption* if such system has at least 15 service connections or regularly serves at least 25 individuals." The 1996 Amendments expanded the means of delivering water to include not only pipes, but also other constructed conveyances such as ditches and waterways.

  While there are three categories of PWSs, an agricultural establishment will most likely operate a non-transient, non-community system. This type of system serves at least 25 people for over 6 months of the year, but the people generally do not live at the facility. All PWSs must comply with the national primary drinking water regulations (40 CFR 141). Under 40 CFR Part 141 Subpart G, EPA has established drinking water standards for numerous pesticides.

  Establishments that operate a non-transient, non-community system, in general, will need to: (1) monitor for the contaminants the state has established for that type of system, (2) keep records of the monitoring results, (3) report results from all tests and analyses to the state/tribe on a set schedule, (4) take immediate action to correct any violations in the allowable contaminant levels, (5) make a public announcement of any violations to warn people about potential adverse effects and to describe the steps taken to remedy the problem, and (6) keep records of actions taken to correct violations.

- **Comprehensive State Ground Water Protection Program**. Under the SDWA §1429, states/tribes are allowed to establish a Comprehensive State Ground Water Protection Program to protect underground sources of drinking water. Under this program, a state/ tribe can require facilities, including agricultural establishments, to use designated best management practices (BMPs) to help prevent contamination of groundwater by nitrates, phosphates, pesticides, microorganisms, or petroleum products. These requirements generally apply only to facilities that are subject to the public water system supervision program. Persons applying pesticides or fertilizers must know the location of all the public water supply source areas in the vicinity that are protected by state/tribal (and sometimes local) requirements.

- **Source Water and Protection Program**. Under the SDWA, states are required to develop comprehensive Source Water Assessment Programs (SWAP). The statutorily defined goals for SWAPs are to provide for the protection and benefit of public water systems and for the support of monitoring flexibility. These programs plan to identify the areas that supply public tap water, inventory contaminants and assess water system susceptibility to contamination, and inform the public of the result.

- **Wellhead Protection Program**. Under the SDWA §1428, if a facility, has an onsite water source (e.g., well) that qualifies as a PWS, it must take the steps required by the state/tribe to protect the wellhead from contaminants. A wellhead protection area is the surface and subsurface area surrounding a water well or wellfield supplying a PWS through which contaminants are reasonably likely to move toward and reach such water well or wellfield.

  Since drinking water standards (40 CFR Part 141 Subpart G) exist for numerous pesticides, which may be used in various agriculture-related activities, some state/tribe and local wellhead and source water protection programs restrict the use of agricultural chemicals in designated wellhead protection areas. In addition, persons applying pesticides or fertilizers must know the location of all the public water supply source areas in the vicinity that are protected by state/tribal (and sometimes local) requirements, and the requirements for mixing, loading, and applying agricultural chemicals within any designated wellhead or source water protection areas.

- **Sole Source Aquifer Protection Program**. Under the SDWA §1424 and 40 CFR Part 149 Subpart B, EPA can establish requirements for protecting sole source aquifers. EPA designates an aquifer as a ***sole source aquifer*** if it supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer and no alternative drinking water sources are feasible. The Sole Source Aquifer program prohibits federal financial assistance (any grant, contract, loan guarantee, or otherwise) for any project, including agricultural projects, that may result in contamination to the aquifer and create a hazard to public heath. Currently, only a few aquifers have been designated as protected sole source aquifers.

- **Underground Injection Control (UIC) Program**. The UIC program (40 CFR Parts 144 and 146-148) is a permit program that protects underground sources of drinking water by regulating five classes of injection wells (I - V). *Underground injection* means depositing fluids beneath the surface of the ground by injecting them into a hole (any hole that is deeper than it is wide). *Fluids* means any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.

  If a facility disposes of (or formerly disposed of) waste fluids onsite in an injection well, it triggers the UIC requirements. In general, a facility may not inject contaminants into any well if the contaminant could cause a violation of any primary drinking water regulation or endanger an underground source of water if the activity would adversely affect the public health. Most deep well underground injections are prohibited without a UIC permit. No Class I, II, or III injection well may be constructed or opened before a permit has been issued. UIC permits include design, operating, inspection, and monitoring requirements. In many states/tribes, EPA has authorized the state/tribal agency to administer the program.

  Class V Wells. Owners/operators of Class V wells (shallow wells that inject fluids above an underground source of water) must not construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation (40 CFR Part 142) or may otherwise adversely affect the health of persons. Examples of Class V wells potentially applicable to agricultural establishments include, but are not limited to:

  (1) Drainage wells, such as agricultural drainage wells, primarily used for storm runoff.

  (2) Cesspools with open bottoms (and sometimes perforated sides) and septic system wells used to inject waste or effluent from <u>multiple</u> dwellings or businesses (the UIC requirements do not apply to single family residential septic system or cesspool wells or to non-residential septic system or cesspool wells that

are used solely for the disposal of sanitary wastes and have the capacity to serve fewer than 20 persons per day).

(3) Dry wells used for waste injection.

(4) Recharge wells used to replenish aquifers.

(5) Injection wells associated with the recovery of geothermal energy for heating, aquaculture, and production of electric power.

(6) Floor drains in maintenance shops/work areas.

Agricultural drainage wells typically drain water from low-lying farm land, but some serve to recharge aquifers from which irrigation water is withdrawn. These wells are usually constructed in areas with poor soil drainage, but where underlying geologic formations allow rapid infiltration of water. Sometimes abandoned water supply wells are adapted for use in agricultural drainage. Agricultural drainage wells typically receive field drainage from saturated topsoil and subsoil, and from precipitation, snowmelt, floodwaters, irrigation return flow, and animal feedlots. The types of pollutants injected into these wells include (1) pesticide runoff, (2) nitrate, nitrite, and salts, such as those of calcium, magnesium, sodium, potassium, chloride, sulfate, and carbonate from fertilizer runoff, (3) salts and metals (i.e., iron, lead, cadmium, and mercury) from biosolid sludges and compost, (4) microbes (i.e., bacteria and viruses) from animal waste runoff, and (5) petroleum contaminants, such as fuel and oil, from runoff from roads or equipment maintenance areas.

If a facility has a Class V well, it must furnish inventory information about the well to the appropriate state/tribal agency. If at any time EPA or the state/tribal agency learns that a Class V well may cause a violation of primary drinking water regulations (40 CFR Part 142) or may be otherwise adversely affecting the health of persons, it may require the injector to obtain an individual UIC permit, or order the injector to take such actions (including, where required, closure of the injection well) as may be necessary to prevent the violation.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) was enacted to address problems related to hazardous and solid waste management. RCRA gives EPA the authority to establish a list of solid and hazardous wastes and to establish standards and regulations for the treatment, storage, and disposal of these wastes. Regulations in Subtitle C of RCRA address the identification, generation. transportation, treatment, storage, and disposal of hazardous wastes. These regulations are found in 40 CFR Part 124 and 40 CFR Parts 260-279. Under RCRA, persons who generate waste must determine whether the waste is defined as solid waste or hazardous waste. Solid wastes are considered hazardous wastes if they are listed by EPA as hazardous or if they exhibit characteristics of a hazardous waste: toxicity, ignitability, corrosivity, or reactivity.

Most agriculture-related activities do not generate significant amounts of hazardous waste. Generally, the activities potentially subject to RCRA involve the use of pesticides and fertilizers, and the use and maintenance of different types of machinery.

Hazardous Waste Generator Categories. Facilities that generate hazardous waste can be classified into one of three hazardous waste generator categories as defined in 40 CFR Part 262:

- ***Conditionally exempt small quantity generator (CESQG)***. A facility is classified as a CESQG if it generates no more than 220 lbs (100 kg) of hazardous waste in a calendar month. There is no time limit for accumulating ≤2,200 lbs of hazardous waste onsite. However, CESQGs cannot store more than 2,200 lbs (1,000 kg) of hazardous waste onsite at any time. In addition, CESQGs cannot accumulate onsite more than 2.2 lbs (1 kg) of acutely hazardous waste or more than 220 lbs spill residue from acutely hazardous waste for any period of time.

- ***Small quantity generator (SQG)***. A facility is classified as a SQG if it generates >220 lbs (100 kg) and <2,200 lbs (1,000 kg) of hazardous waste in a calendar month. SQGs can accumulate onsite no more than 13,200 lbs (6,000 kg) of hazardous waste. SQGs can store hazardous waste onsite for up to 180 days (or up to 270 days if the waste treatment/disposal facility is more than 200 miles away).

- ***Large quantity generator (LQG)***. A facility is classified as a LQG if it generates > 2,200 lbs (1,000 kg) of hazardous waste in a calendar month. While there is no limit on the amount of hazardous waste that LQGs can accumulate onsite, they can only store it onsite for up to 90 days.

If a facility is a CESQG and generates ≤2.2 lbs (1 kg) of acutely hazardous waste; or ≤220 lbs (100 kg) of acutely hazardous waste spill residues in a calendar month, and never stores more than that amount for any period of time, it may manage the acutely hazardous waste according to CESQG requirements. If it generates more than 2.2 lbs (1 kg) of acutely hazardous waste or >220 lbs (100 kg) of acutely hazardous waste spill residues in a calendar month, the facility must manage it according to LQG requirements. The hazardous wastes that must be measured are those: (1) accumulated at the facility for any period of time before disposal or recycling, (2) packaged and transported away from the facility, (3) placed directly into a treatment or disposal unit at the facility, or (4) generated as still bottoms or sludges *and* removed from product storage tanks.

Requirements for CESQGs. Based on the quantity of hazardous waste generated per month, most agricultural establishments will qualify as CESQGs. As CESQGs, facilities must comply with three basic waste management requirements:

(1) Identify all hazardous waste generated.

(2) Do not generate per month more than 220 lbs (100 kg) of hazardous waste; more than 2.2 lbs (1 kg) of acutely hazardous waste; or more than 220 lbs (100 kg) of acutely hazardous waste spill residues; and never store onsite more than 2,200 lbs (1,000 kg) of hazardous waste; 2.2 lbs of acutely hazardous waste; or more than 220 lbs of acutely hazardous waste spill residues for any period of time.

(3) Ensure proper treatment and disposal of the waste. This means ensuring that the disposal facility is one of the following:
   - A state or federally regulated hazardous waste management treatment, storage, or disposal facility.
   - A facility permitted, licensed, or registered by a state to manage municipal or industrial solid waste.
   - A facility that uses, reuses, or legitimately recycles the waste (or treats the waste before use, reuse, or recycling).
   - A universal waste handler or destination facility subject to the requirements for universal wastes.

CESQGs are allowed to transport their own wastes to the treatment or storage facility, unlike SQGs and LQGs who are required to use a licensed, certified transporter. While there are no specific RCRA requirements for CESQGs who transport their own wastes, the U.S. Department of Transportation (DOT) requires all transporters of hazardous waste to comply with all applicable DOT regulations. Specifically, DOT regulations require all transporters, including CESQGs, transporting hazardous waste that qualifies as a DOT hazardous material to comply with EPA hazardous waste transporter requirements found in 40 CFR Part 263. CESQGs are not required by federal hazardous waste laws to train their employees on waste handling or emergency preparedness.

Requirements for SQGs and LQGs. Facilities determined to be SQGs or LQGs must meet many requirements under the RCRA regulations. These requirements, found in 40 CFR 260-279, include identifying hazardous waste; obtaining EPA identification numbers; meeting requirements for waste accumulation and storage limits; container management; conducting personnel training; preparing a manifest; ensuring proper hazardous waste packaging, labeling, and placarding; reporting and recordkeeping; and contingency planning, emergency procedures, and accident prevention.

Notes: Facilities that fall into different generator categories during different months may choose to simplify compliance by satisfying the more stringent requirements all the time.

Specific Provisions. RCRA regulations include several specific provisions addressing agriculture-related materials and activities. Key provisions are briefly summarized below:

- ***Exemption for Certain Solid Wastes Used as Fertilizers***. Under 40 CFR §261.4(b), solid wastes generated by (1) growing and harvesting of agricultural crops, or (2) raising animals (including animal manure), and that are returned to the soils as fertilizers are excluded from regulation as hazardous waste.

- ***Exemption for Certain Hazardous Waste Pesticides***. Under 40 CFR §262.70, farmers who generate any amount of hazardous waste pesticides from their own use are excluded from the generator, treatment/storage/disposal facility, land disposal, and permit requirements under RCRA Subtitle C, provided that the farmer: (1) disposes of the waste pesticide in a manner consistent with the label on the pesticide container; (2) triple rinses each empty container in accordance with requirements at 40 CFR §261.7(b)(3); and (3) disposes of the rinsate on his own farm in accordance with the instructions on the label. If the label does not include disposal instruction, or no instructions are available from the pesticide manufacturer, the waste pesticide and rinsate must be disposed of in accordance with Subtitle C hazardous waste requirements. (Also see 40 CFR Part 165 - FIFRA)

- ***Exemption for Commercial Fertilizers***. Under 40 CFR §266.20, commercial fertilizers produced for general public (including agricultural) use that contain recyclable materials are not presently subject to regulation provided they meet the applicable land disposal restriction (LDR) standards for each recyclable material they contain. For example, zinc-containing fertilizers containing K061 (emission control dust from the primary production of steel in electric furnaces) are not subject to regulation.

- ***Fertilizers Made from Hazardous Wastes***. Under 40 CFR Parts 266 and 268, EPA regulates fertilizers containing hazardous wastes as ingredients. Hazardous wastes may be used as ingredients in fertilizers under certain conditions, since such wastes can be a beneficial component of legitimate fertilizers. EPA has established standards that specify limits on the levels of heavy metals and other contents used as fertilizer ingredients. These standards are based on treatment, by the best technology currently available, to reduce the toxicity and mobility of all the contents of the hazardous waste components. These standards are based on waste management considerations and do not include consideration of the potential agronomic or dietary risk.

- ***Food Chain Crops Grown on Hazardous Waste Land Treatment Units***. Under 40 CFR Part 264.276, food chain crops (including feed for animals consumed by humans) may be grown in or on hazardous waste land treatment units under certain conditions and only with a permit. The permit for a facility will list the specific food-chain crops that may be grown. To obtain a permit, the owner/operator of the facility wishing to grow the food-chain crops must demonstrate -- prior to the planting of such crops -- that there is no substantial risk to human health caused by the growth of such crops in or on the treatment zone.

- ***Solid Waste Disposal Criteria***. Under RCRA Subtitle D, 40 CFR 257.3 establishes solid waste disposal criteria addressing floodplains, endangered species, groundwater protection, application to land used for food chain crops, disease vectors, air pollution, and safety. These criteria are largely guidelines used by states in developing solid waste regulations, which control the disposal of waste on a farmer's property.

- ***Land Application of Fertilizers Derived from Drinking Water Sludge***. Under 40 CFR Part 257, EPA regulates the land application of solid wastes, including drinking water sludge applied as fertilizer. These requirements include: (1) cadmium limits on land used for the production of food-chain crops (tobacco, human food, and animal feed) or alternative less stringent cadmium limits on land used solely for production of animal feed; (2) polychlorinated biphenyls (PCBs) limits on land used for producing animal feed, including pasture crops for animals raised for milk; and (3) minimization of disease vectors, such as rodents, flies, and mosquitoes, at the site of application through incorporation of the fertilizer into soil so as to impede the vectors' access to the sludge.

- ***Pesticides That Are Universal Wastes***. Under 40 CFR Part 273, EPA has established a separate set of requirements for three types of wastes called *universal wastes*. Universal wastes include certain batteries, certain pesticides, and mercury thermostats. Pesticides designated as universal wastes include (1) recalled pesticides that are stocks of a suspended or canceled pesticide and part of a voluntary or mandatory recall under FIFRA §19(b); (2) recalled pesticides that are stocks of a suspended or canceled pesticide, or a pesticide that is not in compliance with FIFRA, that are part of a voluntary recall [see FIFRA §19(b)(2)] by the registrant; and (3) stocks of other unused pesticide products that are collected and managed as part of a waste pesticide collection program.

  The Universal Waste rule is *optional* for states/tribe to adopt. In those states/tribes that have not adopted the Universal Waste rule, these wastes must be disposed of in accordance with the hazardous (or acutely hazardous) waste requirements (see 40 CFR Part 262).

- ***Exemption for Small Quantities of Used Oil***. Under 40 CFR §279.20, agricultural establishments that generate an average of 25 gallons or less of used oil per month per calendar year from vehicles or machinery used on the establishment are not subject to the requirements of 40 CFR Part 279.

- ***Exemption for "Farm Tanks" and Tanks of 110 Gallons or Less***. Under the underground storage tank (UST) regulations (RCRA Subtitle I, 40 CFR §280.12), "farm tanks" of 1,100 gallons or less capacity used for storing motor fuel for non-commercial purposes are not regulated as underground storage tanks. *"Farm tanks"* include tanks located on a tract of land devoted to the production of crops or raising animals (including fish) and associated residences and improvements. Also under 40 CFR §280.10, the UST program does not apply to UST systems of 110 gallons or less capacity, or that contain a *de minimis* concentration of a regulated substance.

  Even with the above exemptions, keep in mind that many agricultural establishments may be subject to the UST program (40 CFR Part 280). The UST regulations apply to facilities that store either petroleum products or hazardous substances (except hazardous wastes) identified under CERCLA. UST regulations address design standards, leak detection, operating practices, response to releases, financial responsibility for releases, and closure standards.

Comprehensive Environmental Response, Compensation, and Liability Act

Under CERCLA, there are a limited number of statutory and regulatory requirements that potentially affect agricultural businesses. The key provisions are summarized below:

- **Emergency Release Notification Requirements**. Under CERCLA §103(a), facilities are required to notify the National Response Center about any release of a CERCLA hazardous substance in quantities equal to or greater than its reportable quantity (RQ). Releases include discharges into the air, soil, surface water, or groundwater. Any release at or above the RQ must be reported regardless of whether there is a potential for offsite exposure.

  – ***Hazardous Substances***. The term "hazardous substance" is defined in CERCLA §101(14) and these substances (more than 700) are listed at 40 CFR Part 302, Table 302.4. Several agricultural chemicals are on the CERCLA hazardous substance list, including many pesticides, anhydrous ammonia, and ethylene glycol.

  – ***Reportable Quantities***. For each hazardous substance, EPA has designated a RQ of 1, 10, 100, 1,000, or 5,000 pounds. RQs are listed in 40 CFR Part 355, Appendices A and B and 40 CFR Part 302, Table 302.4.

  – ***When No Notification is Required***. There are several types of releases that are excluded from the requirements of CERCLA release notification. Two of these releases, excluded under CERCLA §§101(22) and 103(e), include the normal application of fertilizer and the application of pesticide products registered under FIFRA. *Keep in mind that spills, leaks, or other accidental or unintended releases of fertilizers and pesticides are subject to the reporting requirements.*

- **Facility Notification and Recordkeeping Requirements - Exemption for Agricultural Producers**. Under CERCLA §§103(c) and (d), certain facilities must notify EPA of their existence and the owners/operators must keep records. However, CERCLA §103(e) exempts agricultural producers who store and handle FIFRA-registered pesticides from the facility notification and recordkeeping requirements. CERCLA does not define the term *agricultural producer*.

- **Liability for Damages**. Under CERCLA §107(a), an owner/operator of a facility that has CERCLA hazardous substances onsite may be liable for cleanup costs, response costs, and natural resource damages associated with a release or threatened release of hazardous substances. Agricultural establishments are potentially liable under this section, and that liability extends to past practices.

Emergency Planning and Community Right-to-Know Act

A summary of the potential applicability of specific sections of EPCRA on the agricultural sector follows below.

- **Emergency Planning and Notification**. Under EPCRA §302, owners or operators of any facility, including agricultural establishments, that have *extremely hazardous substances* (40 CFR Part 355 Appendices A and B) present in excess of the *threshold planning quantity* must notify in writing their state emergency response commission (SERC) and their local emergency planning committee (LEPC) that they are subject to EPCRA planning requirements. Under EPCRA §303, they must also notify the LEPC of the name of a person at their facility whom the LEPC may contact in regard to planning issues related to these extremely hazardous substances. They must also inform the LEPC promptly of any relevant changes, and when requested, must provide information to the LEPC necessary for emergency planning.

  Ammonia, several agricultural pesticides, and certain fuels are included on the list of extremely hazardous substances found in 40 CFR Part 355 Appendices A and B. If a listed substance is a solid, two different planning quantities are listed (e.g., 500 lbs/10,000 lbs). The smaller amount (e.g., 500 lbs.) applies if the substance is in powder form, such as a soluble or wettable powder, or if it is in solution or molten form. The larger quantity (10,000 lbs.) applies for most other forms of the substance. If the extremely hazardous substance is part of a mixture or solution, then the amount is calculated by multiplying its percent by weight times the total weight of the mixture or solution. If the percent by weight is less than one percent, the calculation is not required (40 CFR Part 355.30).

  ✓ Ammonia -- The quantity of anhydrous ammonia that triggers the planning requirement is 500 pounds.

✓ Pesticides -- Examples of pesticides on the list with the quantity in pounds that triggers the planning requirement include: ethion (1,000), nicotine (100), dichlorvos (1,000), parathion (100), chlordane (1,000), methyl bromide (1,000), ethylene oxide (1,000), fenitrothion (500), phorate (10), zinc phosphide (500), aluminum phosphide (500), terbufos (100), phosphamidon (100), demeton (500), ethoprop (1,000), and disulfoton (500).

✓ Solid Pesticides -- Examples of pesticides with dual quantities that trigger the planning requirements include: coumaphos (100/10,000), strychnine (100/10,000), dimethoate (500/10,000), warfarin (500/10,000), azinphos-methyl (10/10,000), methyl parathion (100/10,000), phosmet (10/10,000), methidathion (500/10,000), carbofuran (10/10,000), paraquat (10/10,000), methiocarb (500/10,000), methamidophos (100/10,000), methomyl (500/10,000), fenamiphos (10/10,000), and oxamyl (100/10,000).

- **§304 Emergency Release Notification**. Under 40 CFR 355, facilities must *immediately* notify the SERC and LEPC of releases of EPCRA extremely hazardous substances and CERCLA hazardous substances when the release equals or exceeds the reportable quantity within a 24-hour period and has the *potential* for offsite exposure. There are two notifications required: the initial notification and the written followup notification.

  Exemption for Substances Used in Agricultural Operations. Only facilities that produce, use or store *hazardous chemicals* are subject to EPCRA release reporting. EPCRA §311(e) excludes from the definition of *hazardous chemicals* those substances used in routine agricultural operations. The exemption covers fertilizers and pesticides used in routine agricultural operations and fuels for operating farm equipment (including to transport crops to market). If all the hazardous chemicals present at the facility do not fall within this exemption, the facility must report all releases of any EPCRA extremely hazardous substance or CERCLA hazardous substance. Additionally, spills, leaks, or other accidental or unintended releases of fertilizers and pesticides are subject to the EPCRA release reporting requirements.

- **§311 and §312 Hazardous Chemical Inventory and Reporting**. Under EPCRA §311 and §312, facilities must inventory the hazardous chemicals present onsite in amounts equal to or in excess of the threshold planning quantities, and meet two reporting requirements:

- A one-time notification of the presence of hazardous chemicals onsite in excess of threshold levels (EPCRA §311) to the SERC, LEPC, and the local fire department; and

- An annual notification (Tier I or Tier II report) to the SERC, LEPC, and the local fire department detailing the locations and hazards associated with the hazardous chemicals found on facility grounds (EPCRA §312).

Exemption for Substances Used in Agricultural Operations. As mentioned above, the term "hazardous chemical," as defined in EPCRA §311(e), *excludes* substances used in routine agricultural operations.

Clean Air Act

Agriculture-related industries generally do not include those industry sectors considered to be major sources of air pollution. Nevertheless, some agriculture-related activities are potentially subject to regulation under the CAA. The provisions identified below summarize the CAA requirements applicable to certain agriculture-related activities:

- **Risk Management Program**. Under §112(r) of the Clean Air Act, EPA has promulgated the Risk Management Program Rule. The rule's main goals are to prevent accidental releases of regulated substances and to reduce the severity of those releases that do occur by requiring facilities to develop risk management programs. A facility's risk management program must incorporate three elements: a hazard assessment, a prevention program, and an emergency response program. These programs are to be summarized in a risk management plan (RMP) that will be made available to state and local government agencies and the public.

  Under 40 CFR Part 68, facilities that have more than the threshold quantity of any of the listed regulated substances in a single process are required to comply with the regulation. *Process* means any regulated activity involving a regulated substance, including manufacturing, storing, distributing, or handling a regulated substance or using it in any other way. Any group of interconnected vessels (including piping), or separate vessels located close enough together to be

R0074560

involved in a single accident, are considered a single process. Transportation is not included.

Listed regulated substances are acutely toxic substances, flammable gases, volatile liquids, and highly explosive substances listed by EPA in the Risk Management Program rule. The *threshold quantity* is the amount of a regulated substance that triggers the development of a RMP. The list of regulated substances and their corresponding threshold quantities are found at 40 CFR Part 68. Examples of threshold quantities of listed regulated substances include: formaldehyde -- 15,000 pounds; ethylene oxide -- 10,000 pounds; methyl isocyanate -- 10,000 pounds; anydrous ammonia -- 10,000 pounds; and mixtures containing ammonia in a concentration of 20 percent or greater -- 20,000 pounds.

Exception: Ammonia that farmers are holding for use as fertilizer is not a regulated substance under the risk management program. Farmers are not responsible for preparing a risk management plan if ammonia held for use as a fertilizer is the only listed regulated substance that they have in more than threshold quantities. However, ammonia that is on a farm for any other use, such as for distribution or as a coolant/refrigerant, is not exempt.

Three program levels. The risk management planning regulation (40 CFR Part 68) defines the activities facilities must undertake to address the risks posed by regulated substances in covered processes. To ensure that individual processes are subject to appropriate requirements that match their size and the risks they may pose, EPA has classified them into 3 categories ("programs"):

- **Program 1** requirements apply to processes for which a worst-case release, as evaluated in the hazard assessment, would not affect the public. These are processes that have **not** had an accidental release that caused serious offsite consequences.

- **Program 2** requirements apply to less complex operations that do **not** involve chemical processing.

- **Program 3** requirements apply to higher risk, complex chemical processing operations and to processes already subject to the **OSHA Process Safety Management Standard (29 CFR 1910.119)**.

Risk Management Planning. Facilities with more than a threshold quantity of any of the 140 regulated substances in a single process are required to develop a risk management program and to summarize their program in a risk management plan (RMP). A facility subject to the requirements was required to have submitted a registration and RMP by June 21, 1999, or whenever it first exceeds the threshold for a listed regulated substance after that date.

All facilities with processes in Program 1 must carry out the following elements of risk management planning:

- An offsite consequence analysis that evaluates specific potential release scenarios, including worst-case and alternative scenarios.
- A five-year history of certain accidental releases of regulated substances from covered processes.
- A risk management plan, revised at least once every five years, that describes and documents these activities for all covered processes.

Facilities with processes in Programs 2 and 3 must also address each of the following elements:

- An integrated prevention program to manage risk. The prevention program will include identification of hazards, written operating procedures, training, maintenance, and accident investigation.
- An emergency response program.
- An overall management system to put these program elements into effect.

- **National Ambient Air Quality Standards (NAAQS)/SIPS**. Under the CAA §10, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. If the applicable SIP imposes requirements on an agricultural establishment, that facility must comply with the SIP. The most likely pollutant of concern with respect to agriculture-related businesses is particulate matter.

Federal Insecticide, Fungicide, and Rodenticide Act

For agricultural producers, FIFRA is the environmental statute that most significantly impacts day-to-day operations of pesticide use. It also imposes administrative requirements on pesticide users, including agricultural producers. A summary of major provisions applicable to agricultural producers is provided below.

- **Use Restrictions**. The pesticide product label is information printed on or attached to the pesticide container. Users are legally required to follow the label. Labeling is the pesticide product label and other accompanying materials which contain directions that pesticide users are legally required to follow. Under FIFRA §12, each pesticide must be used only in a way that is consistent with its labeling.

  - As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

  - It is against the law (Endangered Species Act) to harm an endangered species. Harm includes not only acts that directly injure or kill the protected species, but also significant habitat modification or degradation that disrupts breeding, feeding, or sheltering. Pesticide users must comply with any pesticide labeling restrictions or requirements that concern the protection of endangered species or their habitats.

- **Tolerances and Exemptions**. A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR.163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

  To avoid being responsible for products being over tolerance, users must be particularly careful to comply with the label instructions concerning application rate and minimum days between pesticide application and harvest (i.e., preharvest interval), slaughter, freshening, or grazing.

- **Worker Protection Standard (WPS) Requirements for Users**. The WPS for Agricultural Pesticides (40 CFR Parts 156 and 170) covers pesticides that are used in the commercial production of agricultural plants on farms, forests, nurseries, and greenhouses. The WPS requires pesticide users to take steps to reduce the risk of pesticide-related illness and injury if they or their employees may be exposed to pesticides used in the commercial production of agricultural plants.

- **Cancellation and Suspension**. EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

  In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

  When EPA believes and emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order that makes the suspension immediately effective.

Toxic Substances Control Act

TSCA has a limited impact on the agricultural sector. TSCA §3, Definitions, specifies that the term chemical substance means any organic or inorganic substance of a particular molecular identity. The definition also states, as declared at subsection (2)(B)(ii), that such term does not include any pesticide (as defined in FIFRA) when manufactured, processed, or distributed in commerce for use as a pesticide. Since the majority of potentially hazardous substances used by agricultural producers are pesticides, they are regulated under FIFRA. Regulation of hazardous substances under other authorities is part of TSCA's overall scheme which allows EPA to decline to regulate a chemical under TSCA if other federal regulatory authorities (e.g., FIFRA) are sufficiently addressing the risks posed from those substances.

- **Asbestos and Asbestos-Containing Material**. Under TSCA §6 and 40 CFR Part 61, Subpart M, EPA regulates the renovation/demolition activities, notification, work practices and removal, and disposal of asbestos-containing material (ACM). ACM should be carefully monitored; however, the mere presence of asbestos in a building is not considered hazardous. ACM that becomes damaged, however, may pose a health risk since it may release asbestos fibers over time. If a material is suspected of containing asbestos and it is more than slightly damaged, or if changes need to be made to a building that might disturb it, repair or removal of the ACM by a professional is needed.

- **Asbestos Brake Pads**. Facilities that repair their own brakes should be aware of asbestos requirements. Asbestos brake pads must be removed using appropriate control measures so that no visible emissions of asbestos will be discharged to the outside air. These measures can include one of the following: (1) wetting that is generally done through the use of a brake washing solvent bath, such as those provided by a service; (2) vacuuming that is usually performed with a commercial brake vacuum specifically designed for use during brake pad changing or pad re-lining operations; or (3) combination of wetting and vacuuming.

  Asbestos brake pads and wastes must be managed by: (1) labeling equipment, (2) properly disposing of spent solvent, (3) properly disposing of used vacuum filters, and (4) sealing used brake pads. The containers or wrapped packages must be labeled using warning labels as specified by OSHA [29 CFR 1910.001 (j) (2) or 1926.58 (k)(2)(iii)].

  Asbestos waste must be disposed of as soon as practical at an EPA-approved disposal site. The asbestos containers must be labeled with the name and location of the waste generator. Vehicles used to transport the asbestos must be clearly labeled during loading and unloading. The waste shipment records must be maintained (40 CFR 61.150) so that the asbestos shipment can be tracked and substantiated.

- **Polychlorinated Biphenyls (PCBs)**. PCBs were widely used in electrical equipment manufactured from 1932 to 1978. Types of equipment potentially containing PCBs include transformers and their bushings, capacitors, reclosers, regulators, electric light ballasts, and oil switches. Any equipment containing PCBs in their dielectric fluid at concentrations of greater than 50 ppm are subject to the PCB requirements.

Under TSCA §6 and 40 CFR Part 761, facilities must ensure through activities related to the management of PCBs (e.g., inspections for leaks, proper storage) that human food or animal feed are not exposed to PCBs. While the regulations do not establish a specific distance limit, any item containing PCBs is considered to pose an unacceptable exposure risk to food or feed if PCBs released in any form have the potential to reach/contaminate food or feed.

- **Lead**. Approximately 1.7 million children have blood-lead levels high enough to raise health concerns. Studies suggest that lead exposure from deteriorated residential lead-based paint, contaminated soil, and lead in dust are among the major existing sources of lead exposure among children in the U.S.

  Section 1018 of the Residential Lead-Based Paint Hazard Reduction Act of 1992 directs EPA and the Department of Housing and Urban Development (HUD) to jointly issue regulations requiring disclosure of known lead-based paint and/or lead-based paint hazards by persons selling or leasing housing constructed before the phaseout of residential lead-based paint use in 1978. Under that authority, EPA and HUD jointly issued on March 6, 1996, regulations titled *Lead; Requirements for Disclosure of Known Lead-Based Paint and/or Lead-Based Paint Hazards in Housing* (40 CFR Part 35 and 40 CFR Part 745). In these regulations, EPA and HUD established requirements for sellers/lessors of residential housing built before 1978.

  Pre-Renovation Lead Information Rule. If conducted improperly, renovations in housing with lead-based paint can create serious health hazards to workers and occupants by releasing large amounts of lead dust and debris. Under TSCA §406 and through a rule published on June 1, 1998 entitled *Lead; Requirements for Hazard Education Before Renovation of Target Housing* (40 CFR Part 745), EPA required the distribution of lead hazard information (i.e., EPA-developed pamphlet) prior to professional renovations on residential housing built before 1978.

IV.C. Proposed and Pending Regulations

Clean Water Act

Feedlots Effluent Limitation Guidelines. EPA is in the process of reviewing and revising the effluent limitation guidelines for feedlots. EPA is

R0074566

under a court-ordered schedule to revise the guidelines for poultry and swine by December 2001 and for beef and dairy cattle by December 2002.

NPDES Implementing Regulations. EPA intends to revise the existing NPDES permitting regulations to clarify expectations and requirements for CAFOs as well as to reflect the changes in the industry. NRCS and other USDA agencies will participate on the regulatory workgroup to advise EPA on the technical and implementation aspects related to any proposed revisions. Revision of the permitting regulations is expected to be closely coordinated with the revision of the Feedlots Effluent Limitation Guidelines (40 CFR Part 412) because of the commonality of issues and the administrative efficiencies for EPA, States and all interested groups. Permits in effect on the date of new regulations will remain in effect until subsequently changed to incorporate the new requirements.

Coastal Zone Act Reauthorization Amendments of 1990

Implementation of Management Measures. Under Section 6217, states/tribes must fully implement the management measures in their Coastal Nonpoint Pollution Control Programs by January 2004. States/tribes are required to perform effectiveness monitoring between 2004 and 2006 and implement other measures between 2006 and 2009.

Safe Drinking Water Act

Management of Class V Wells. EPA plans to propose additional requirements addressing the environmental risks posed by the highest risk Class V wells. This rulemaking potentially affects agricultural operations that use industrial and commercial disposal wells and large capacity cesspools.

Federal Insecticide, Fungicide, and Rodenticide Act

Pesticide Management and Disposal: Proposed Rule - issued on May 5, 1993 (FR26857). The regulations for this rule will be found in the Code of Federal Regulations (CFR) at 40 CFR Part 165 - Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticides Containers. This final rule will:

- Describe procedures for voluntary and mandatory recall actions.
- Establish criteria for acceptable storage and disposal plans which registrants may submit to EPA to become eligible for reimbursement of storage costs.
- Establish procedures for the indemnification of owners of suspended and canceled pesticides.

- Amend the Agency's responsibility for accepting for disposal suspended and canceled pesticides.

V. COMPLIANCE AND ENFORCEMENT HISTORY

V.A. Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match air, water, waste, toxics/pesticides, EPCRA, Toxics Release Inventory (TRI), and enforcement docket records for a given facility and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, EPA is developing sector-specific measures of success for compliance assistance efforts.

V.B. Compliance and Enforcement Profile Description

This section uses inspection, violation, and enforcement data from the IDEA system to provide information about the historical compliance and enforcement activity of this sector. While other sector notebooks have used Standard Industrial Classification (SIC) data from the Toxics Release Inventory System (TRIS) to define their data sampling universes, none of the SIC codes associated with the livestock production sector identifies facilities that report to the TRI program. As such, sector-defining data have been provided from EPA data systems

> **Note:** Many of the previously published sector notebooks contained a chapter titled *"Chemical Release and Transfer Profile."* The information and data for that chapter were taken primarily from EPA's Toxic Release Inventory (TRI). Because the industries discussed in this notebook do not, in general, directly report to TRI, that chapter has not been included in this sector notebook.

linked to EPA's Facility Indexing System (FINDS), which tracks facilities in all media databases. This section does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census. With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Before presenting the data, the next section defines general terms and the column heads used in the data tables. The data represent a retrospective summary of inspections and enforcement actions and solely reflect EPA, state, and local compliance assurance activities that have been entered into EPA databases. To identify trends, EPA ran two data queries, one for five calendar years (March 7, 1992 to March 6, 1997) and the other for a twelve-month period (March 7, 1996 to March 6, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and state's efforts within each media program. The presented data illustrate the variations across EPA regions for certain sectors[1]. This variation may be attributable to state/local data entry variation, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

[1]EPA Regions are as follows: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) - assigns a common facility number to EPA single-media permit records, establishing a linkage capability to the permit data. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) - is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are AFS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS. IDEA also contains information from outside sources, such as Dun and Bradstreet (DUN) and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in this section were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search - based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, or industries in which only a very small fraction of facilities report to TRI, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected - indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections - measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections - provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities With One or More Enforcement Actions - expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal state actions. A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions - describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (i.e., a facility with 3 enforcement actions counts as 3).

State Lead Actions - shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions - shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from state agencies. Many of these actions result from coordinated or joint federal/state efforts.

Enforcement to Inspection Rate - is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. The ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified - expresses the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections - four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

V.C. Livestock Production Industry Compliance History

Exhibit 19 provides an overview of the reported compliance and enforcement data for the livestock sector over a 5-year period (March 1992 to March 1997). These data are also broken out by EPA regions thereby permitting geographical comparisons. A few points evident from the data are listed below.

> **Note:** It should be noted that the data presented in this section represent federal enforcement activity only. Enforcement activity conducted at the state level is not included in this analysis.

- Of the 1,001 facilities identified through IDEA with livestock SIC codes, approximately 20 percent (205) were inspected in the last 5 years.

- Region 4 had more inspections (163) than other regions and the most enforcement actions (9), accounting for 29 percent of the total enforcement actions.

- Region 10 had only 3 percent of the total inspections, but had 16 percent of the total enforcement actions yielding the highest enforcement/inspection ratio of 0.29.

- The total inspections (600) conducted nationwide have resulted in 31 enforcement actions, which results in an enforcement-to-inspection rate of 0.05. This means that for every 100 inspections conducted, there are approximately 5 resulting enforcement actions.

- Enforcement actions were primarily state-led (84%). Regions 7 and 9 had no enforcement actions.

- Several regions (1, 4, 6, 7, 8, 10) had an average time between inspections of greater than 100 months.

Exhibit 19. Five-Year Enforcement and Compliance Summary for the Livestock Industry

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	16	3	5	192	1	1	100%	0%	0.20
II	20	12	33	36	3	6	100%	0%	0.18
III	49	24	161	18	3	5	100%	0%	0.03
IV	304	67	163	112	7	9	56%	44%	0.06
V	69	18	42	99	2	3	100%	0%	0.07
VI	96	6	14	411	1	1	100%	0%	0.07
VII	217	11	20	651	0	0	--	--	--
VIII	122	23	67	109	1	1	100%	0%	0.01
IX	40	35	78	31	0	0	--	--	--
X	68	6	17	240	1	5	80%	20%	0.29
TOTAL	1,001	205	600	100	19	31	84%	16%	0.05

Comparison of Enforcement Activity Between Selected Industries

Exhibits 20 and 21 allow the compliance history of the livestock production sector to be compared to other industries covered by the sector notebooks. Comparisons between these exhibits permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering a 5-year period (March 1992 to March 1997) to that of a 1-year period (March 1996 to March 1997). Some points evident from the data are listed below.

- The one-year enforcement-to-inspection ratio (0.01) is one-fifth of the five-year ratio (0.05).
- In the 5-year comparison, the average months between inspections (100) was more than any other sector.
- In Exhibit 20, the livestock production industry data approximate the averages of the industries shown for percent state-lead versus federal-led actions.
- In Exhibit 21, when compared to all sectors over the period March 1996 - March 1997, the livestock sector had the third fewest number of inspections conducted (146) and fewest enforcement actions (2).

Exhibits 22 and 23 provide a more in-depth comparison between the livestock production sector and other sectors by breaking out compliance and enforcement data by environmental statute. As in the previous exhibits (Exhibits 20 and 21), the data cover a 5-year period (Exhibit 22) and a 1-year period (Exhibit 23) to facilitate the identification of recent trends. Points evident from the data are listed below.

- As shown in Exhibit 22, over the past 5 years, more than half (57%) of all inspections conducted at livestock facilities and nearly two-thirds (65%) of all enforcement actions have been under the Clean Water Act. It should be noted that 3 percent of all enforcement actions were taken under the FIFRA/TSCA/EPCRA/Other category although no inspections were conducted within that category. This number is possible because in many EPA regions, media inspectors are being trained to examine the facility from a multimedia viewpoint.
- As shown in Exhibits 22 and 23, Clean Water Act inspections account for more than half (57% and 51%, respectively) of all inspections, with the Clean Air Act representing nearly all of the remaining inspections (38% and 48%, respectively). However, from March 1996 - March

1997, every single enforcement action taken was under the Clean Water Act.

Exhibit 20. Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Livestock	**1,001**	**205**	**600**	**100**	**20**	**31**	**84%**	**16%**	**0.05**
Crop Production	6,688	3,046	10,453	38	141	262	73%	27%	0.03
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Aerospace	237	184	1,206	12	67	127	75%	25%	0.10
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Exhibit 21. One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Livestock	**1,001**	**107**	**146**	**22**	**21%**	**2**	**2%**	**2**	**0.01**
Crop Production	6,688	1,012	1459	866	86%	23	2%	29	0.02
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Aerospace	237	119	216	105	88%	8	7%	11	0.05
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*

R0074579

Exhibit 22. Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Livestock	**205**	**600**	**31**	**38%**	**26%**	**57%**	**65%**	**3%**	**6%**	**0%**	**3%**
Crop Production	3,046	10,453	262	72%	35%	11%	23%	13%	25%	3%	17%
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Aerospace	184	1,206	127	34%	38%	10%	11%	54%	42%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

R0074580

Exhibit 23. One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Livestock	**107**	**146**	**2**	**48%**	**0%**	**51%**	**100%**	**1%**	**0%**	**0%**	**0%**
Crop Production	1,012	1,459	29	71%	31%	13%	34%	16%	28%	0%	7%
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Aerospace	119	216	11	37%	36%	7%	0%	54%	55%	1%	9%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

R0074581

THIS PAGE LEFT INTENTIONALLY BLANK

VI. Review of Major Legal Actions and Compliance/Enforcement Strategies

This section provides summary information about major cases that have affected the livestock production industry, as well as regional highlights of CAFO compliance/enforcement strategies.

Usually, this section also contains information on any supplemental environmental projects (SEPs) that were negotiated. SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. However, no information on SEPs in this sector was discovered during the research process. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility. To learn more about SEPs, go to http://www.epa.gov/oeca/sep.

Review of Major Cases

A review of EPA's FY92 and FY93 *Enforcement Accomplishments Report* and the FY94 through FY98 *Enforcement and Compliance Assurance Accomplishments Report* identified several cases involving the livestock production industry. These cases are discussed below.

- In February 1999, EPA cited David Jaindl, president of Jaindl Land Company, for filling in federally protected wetlands at a turkey farm. EPA has alleged that Mr. Jaindl violated the Clean Water Act by filling three acres of wetlands at the farm in September and October 1998 without a required permit from the U.S. Army Corps of Engineers. EPA is seeking a $44,000 penalty for this violation.

- In October 1996, an Administrative Penalty Order (APO) with a $25,000 penalty was administered against *Del Oro Dairy* of New Mexico for failing to provide a Pollution Prevention Plan as required by the NPDES General Permit for Concentrated Animal Feeding Operations. This violation occurred from 1994 thru 1996. In March 1997, another Administrative Penalty Order and $5,500 fine was issued for failure to complete and implement a Pollution Prevention Plan. These enforcement actions are intended to prevent the pollution of the groundwater by requiring the facility to apply good management practices.

- United States v. Harry James Saul and Ronnie Snead: Harry Saul, part owner and operator of Harry Saul Minnow Farm, Inc., Prairie County, Arkansas, and a company employee, Ronnie Snead, were sentenced on June 19, 1996 by Federal Magistrate Henry Jones for a misdemeanor violation of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The defendants had mixed furadan, a restricted use pesticide, with minnows and spread the treated minnows on a levee on the minnow farm to control nuisance birds. Saul was ordered to pay a $5,000 fine and Snead a $1,000 fine for use inconsistent with the label. The defendants are appealing the Court's judgement.

- During fiscal year 1996, *Esplin Dairy* allegedly discharged approximately 900,000 pounds per year of animal waste to a slough discharging to Nehalem Bay, Oregon. In response to an EPA order, the dairy set up a system to keep manure from contaminating clean water and installed a 10,000 gallon tank to collect wastewater before pumping it to larger containment facilities. The wastewater is high in fecal coliform bacteria, BOD, TSS, and nutrients.

- The *Four Brothers Dairy* paid a penalty of $7,350 in fiscal year 1996 for the alleged unpermitted discharge of an estimated 561,000 gallons of wastewater from its Shoshone, Idaho dairy to a canal draining to the Snake River. EPA measured fecal coliform levels as high as 180,000 colonies/100ml in the wastewater in the canal.

- *Gienger Farms, Inc.* allegedly discharged approximately 1.3 million gallons of manure-laden wastewater to drainage ditches flowing into the Tillamook Bay, Oregon, without a permit. In fiscal year 1996, in response to an EPA administrative complaint, the farm paid a $20,000 penalty and modified its operations to separate clean water from contaminated material, thereby extending the holding capacity of its wastewater storage lagoon from two to 57 days. In addition, the facility began monitoring and managing its land application practices, thus preventing the discharge of wastewater containing about 6,435 pounds of BOD and TSS to waters of the U.S.

- In fiscal year 1996, *Misty Meadow Dairy* agreed to pay a $6,000 fine for the alleged unpermitted discharge of about 685,000 pounds of manure per year to navigable waters flowing into Tillamook Bay, Oregon. The dairy is expected to sell half of its herd in order to allow more flexibility in managing waste accumulations.

- In fiscal year 1996, *Veeman Dairy* paid a $1,000 penalty for allegedly discharging 52 to 78 million gallons of wastewater to navigable waters flowing into the Willamette River, Oregon. In response to a separate compliance order, the dairy will repair and maintain its wastewater storage ponds to eliminate future discharges.

- In March 1998, a significant criminal enforcement case was taken by the California Resource Board. The U.S. District Court assessed the operator of the *3H Dairy Farm* in Oakdale, CA a $100,000 fine; $101,000 in farm improvements; 90 days in jail; 90 days of home confinement; and 4 years of probation for repeatedly violating state water pollution laws.

Regional Initiatives

According to the FY 1997 and FY 1998 *Enforcement and Compliance Assurance Accomplishments Reports*, several regions targeted their enforcement efforts on agricultural practices during these fiscal years. It should be noted that while CAFOs were the primary focus within the agriculture sector, there were other agriculture activities as well. Some of the Regional initiatives included the following:

- During FY 96, **Region 6** conducted CAFO inspections in the states of Oklahoma, Texas, and New Mexico. These resulted in the EPA issuing five Orders for non-compliance and two Administrative Penalty Orders. The State of Texas also issued penalty actions to three dairies for violation of the State permit. Region 6's emphasis on CAFOs was on the NPDES general permit and its implementation. Six EPA and 24 state CAFO inspections were conducted in FY97 to determine whether facilities were compliant with the CAFO general permit. The region continues to improve its knowledge of the numbers of facilities by the improvement of the database in all states.

- In FY 1997, **Region 7** states took 26 enforcement actions against feedlots for water quality-related violations. In FY 1998, Iowa settled 13 CAFO cases with penalties of $21,238; Kansas settled 4 CAFO cases with $77,520 in penalties; Missouri settled 12 CAFO cases with $20,256 in penalties; and Nebraska settled 2 CAFO cases with $1,700 in penalties.

- In February 1997, **Region 9** initiated a Regional Agriculture Team to complement the Agriculture Initiative team by developing a Regional Agriculture Strategy and incorporating agriculture pollution prevention principles into core agency programs.

- Through the **Region 10** CAFO Whatcom County Initiative, the Region conducted NPDES inspections at 67 targeted facilities; six were issued penalties, three were designated as significant contributors of pollutants, six were issued certificates of merit, and 52 were issued warning letters.

CAFO Compliance/Enforcement Strategies

EPA concluded a total of 93 enforcement cases against this sector in fiscal years 1997, 1998, and 1999 with a total of $163,000 in penalties. In FY 98, Regions conducted 339 compliance inspections. Each Region is working with its NPDES States to develop and implement individual state specific CAFO strategies. Regional highlights include:

- **Region 3** served as the EPA lead on the recently concluded national Poultry Dialog which included recommendations for actions by the poultry industry. Recently, in a key action growing out of the dialog, Perdue Farms Inc. agreed to help farmers dispose of chicken waste in the Delmarva peninsula region.

- **Region 6** held 5 outreach meetings in 4 states in 1998. The Region conducted 95 inspections resulting in 20 administrative orders and 2 administrative penalties.

- **Region 7** initiated a compliance tracking system to collect accurate and readily available information about state CAFO enforcement actions and penalty amounts. The Region also developed maps of CAFO locations in Iowa and Kansas by using state databases.

- **Region 9's** approach combines compliance assistance and inspections/enforcement. The Region is one of 20+ partners of the California Dairy Initiative which seeks to combine education, outreach, nutrient management plans with third party certification. In addition, the Region has developed an inspection targeting approach based on herd size and proximity to surface water. In 1998, the region conducted 133 inspections in 3 counties. The region issued 3 compliance orders and 2 penalty orders against dairy operators.

- **Region 10** expanded its compliance enforcement focus to include an additional 4 other counties in Western Washington State. The Region conducted 58 inspections resulting in 11 compliance orders/penalties; 3 compliance orders only; and 33 warning letters. Facilities found in compliance were issued courtesy letters. EPA's efforts have succeeded in raising public awareness as indicated by real-estate appraisers asking if EPA has any concerns about the facilities they are appraising.

VII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VII.A. Sector-Related Environmental Programs and Activities

There are several federal programs available to the agricultural community to assist agricultural producers in complying with environmental regulations and reducing pollution. The following examples represent some industry initiatives that promote compliance or assess methods to reduce environmental contamination.

National Agriculture Compliance Assistance Center

The U.S. Environmental Protection Agency (EPA), with the support of the Department of Agriculture (USDA), has developed a national Agriculture Compliance Assistance Center (Ag Center) to provide a base for "first-stop shopping" for the agricultural community -- one place for the development of comprehensive, easy-to-understand information about approaches to compliance that are both environmentally protective and agriculturally sound. The Ag Center, a program offered by EPA's Office of Compliance, seeks to increase compliance by helping the agricultural community identify flexible, common sense ways to comply with the many environmental requirements that affect their business. Initial efforts will focus on providing information about EPA's requirements. The Ag Center will rely heavily on existing sources of agricultural information and established distribution mechanisms. The Ag Center is designed so growers, livestock producers, other agribusinesses, and agricultural information/education providers can access its resources easily -- through telephone, fax, mail, and Internet. The Ag Center website can be accessed at http://www.epa.gov/agriculture.

Unified National Strategy for Animal Feeding Operations

As part of President Clinton's Clean Water Action Plan (CWAP), a USDA-EPA unified national strategy has been developed to minimize the water quality and public health impacts of animal feeding operations (AFOs). AFOs are agricultural enterprises where animals are kept and raised in confined situations and have been shown to contribute to significant problems in surface waters. Such problems have included nutrient loading, fish kills, and odors. AFOs are agricultural livestock facilities that confine feeding activities, concentrating livestock and their manure. There are approximately

450,000 AFOs in the U.S. Of these, 6,600 were concentrated AFOs, or CAFOs. CAFOs pose a greater environmental threat, since they confine larger numbers of animals. Less than a quarter of CAFOs have Clean Water Act permits to control the amount of wastes that run off into waterways.

The Unified National Strategy for Animal Feeding Operations presents USDA and EPA's plan for addressing the water quality and public health impacts associated with AFOs. USDA and EPA issued the final Strategy in March 1999. The USDA-EPA Unified National Strategy for Animal Feeding Operations reflects several guiding principles:

- Minimize water quality and public health impacts from AFOs.
- Focus on AFOs that represent the greatest risks to the environment and public health.
- Ensure that measures to protect the environment and public health complement the long-term sustainability of livestock production in the United States.
- Establish a national goal and environmental performance expectations for all AFOs.
- Promote, support, and provide incentives for the use of sustainable agricultural practices and systems.
- Build on the strengths of USDA, EPA, State and Tribal agencies, and other partners and make appropriate use of incentive-base approaches.
- Foster public confidence that AFOs are meeting their performance expectations and that USDA, EPA, local governments, States, and Tribes are ensuring the protection of water quality and public health.
- Coordinate activities among the USDA, EPA, and related State and Tribal agencies and other organizations that influence the management and operation of AFOs.
- Focus technical and financial assistance to support AFOs in meeting the national goal and performance expectation established in this Strategy.

USDA and EPA's goal is for AFO owners and operators to take actions to minimize water pollution from confinement facilities and land application of manure. To accomplish this goal, this Strategy is based on a national performance expectation that all AFOs should develop and implement technically sound, economically feasible, and site-specific Comprehensive Nutrient Management Plans (CNMPs) to minimize impacts on water quality and public health.

This Strategy describes short- and long- term activities to implement and improve the existing regulatory program using a two-phased approach to permitting CAFOs. During Round I, beginning in about 2000, EPA and States will issue permits to CAFOs under the existing National Pollutant Discharge

Elimination System (NPDES) regulations. During Round II, beginning in about 2005, EPA and States will reissue NPDES permits to CAFOs based on revised effluent guidelines for feedlots, as well as revised regulations for NPDES permitting and any other new information. During Round I and Round II, State NPDES permitting authorities will have flexibility to define specific permitting approaches within their existing programs. For more information, the complete unified national strategy can be accessed at http://www.epa.gov/owm/finafost.htm.

Compliance Assurance Implementation Plan For Concentrated Animal Feeding Operations

The Office of Enforcement and Compliance Assurance (OECA) is making implementation of the existing concentrated animal feeding operation (CAFO) regulations a priority. The purpose of the implementation plan is to protect and enhance water quality by ensuring compliance with the Clean Water Act and its implementing requirements. The Plan's major elements are: 1) strong state and regional compliance/enforcement partnerships; 2) effective state specific compliance/enforcement strategies; 3) productive, coordinated compliance assistance activities; 4) strong compliance monitoring programs; 5) effective enforcement; 6) better data/information on CAFOs for targeting compliance assistance and inspections; and 7) plans for developing a feedback mechanism to EPA, states, and other federal agencies. This plan was finalized in March 1998. For more information, refer to http://es.epa.gov/oeca/strategy.html.

VII.B. EPA Programs and Activities

Section 319 Nonpoint Source Management Program
In 1987, Congress amended the Clean Water Act (CWA) to establish the §319 Nonpoint Source Management Program in recognition of the need for greater federal leadership to help focus state and local nonpoint source efforts. Under §319, states, territories, and Indian tribes receive grant money to support a wide variety of activities, including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects. For more information about the Clean Water Act §319 Program refer to EPA's Office of Water website at http://www.epa.gov/OWOW/NPS/sec319.html.

Clean Lakes Program
EPA's Clean Lakes Program supports a variety of lake management activities including classification, assessment, study, and restoration of lakes. The program, authorized in §314 of the Clean Water Act, was established to provide technical and financial assistance to states/tribes for restoring the

quality of publicly owned lakes. The Clean Lakes Program has funded approximately $145 million for grant activities since 1976 to address lake problems, but there have been no appropriations for the program since 1994. EPA has not requested funds for the Clean Lakes Program in recent years, but has encouraged states to use §319 funds to fund "eligible activities that might have been funded in previous years under Section 314." Information on the Clean Lakes Program is available at the following Internet site: http://www.epa.gov/owow/lakes/cllkspgm.html.

National Estuary Program

EPA's National Estuary Program is a national demonstration program, authorized in §320 of the Clean Water Act, that uses a comprehensive watershed management approach to address water quality and habitat problems in 17 estuaries. Nonpoint source pollution is a major contributor of contaminants in the estuary and coastal waters around the country. In this program, EPA and states/tribes develop conservation and management plans that recommend priority corrective actions to restore estuarine water quality, fish populations, and other designated uses of the waters. Information on the National Estuary Program is available at the following Internet site: http://www.epa.gov/owowwtr1/estuaries/nep.html or by contacting the National Estuary Program Office at (202) 260-1952.

Chesapeake Bay Program and The Great Lakes National Program

EPA's Chesapeake Bay Program and the Great Lakes National Program focus substantial resources on understanding the extent of nonpoint source pollution problems in their respective watersheds and supporting State implementation of non-point source pollution controls. Since 1984, the Chesapeake Bay Program, in particular, has supported the implementation of a substantial amount of animal waste management practices through State cost share programs funded jointly by the Bay States and EPA. Information on the Chesapeake Bay Program is available at http://www.epa.gov/owowwtr1/ecoplaces/part1/site2.html. Information on The Great Lakes National Program is available at http://www.epa.gov/glnpo/.

AgSTAR Program

The AgSTAR program is a voluntary program that promotes the use of profitable manure management systems that reduce pollution. The program, a component of President Clinton's Climate Action Plan, is based on a computer model that shows the economic value of capturing the methane naturally produced by manure.

AgSTAR, a joint program of EPA, USDA, and the Department of Energy, helps agricultural producers determine which methane recovery and use technologies will work best for them, and develops financing sources to help with start-up costs. By investing in these technologies, AgSTAR participants realize substantial returns through reduced electrical, gas, and oil bills, revenues from high quality manure by-products, and savings on manure management operational costs. Partners also reduce pollution associated with water resources, odors, and global warming. Information on AgSTAR is available at the following Internet site: http://yosemite.epa.gov/methane/home.nsf/pages/agstar.

Ruminant Livestock Efficiency Program (RLEP)
Ruminant livestock such as cattle and sheep are the largest source of methane emissions resulting from human activity. Methane, produced as part of the animals' normal digestive process, is a potent greenhouse gas that contributes to global climate change. By improving livestock production efficiency, producers can both increase profits and reduce methane emissions.

The RLEP is a joint EPA-USDA program helping livestock producers improve their operations' efficiency, preserve the nation's natural resources and reduce methane emissions. The program focuses on reducing livestock methane emissions and producing economic benefits by offering technical assistance to producers around the country. For more information, review the Program Overview at http://yosemite.epa.gov/methane/home.nsf/pages/rlep to learn how RLEP is helping improve the environment and livestock producers' profits.

Pesticide Environmental Stewardship Program
EPA's Pesticide Environmental Stewardship Program (PESP) is a voluntary program dedicated to protecting human health and preserving the environment by reducing the risks associated with pesticide use. The partnership is a key element of the program, which is sponsored by EPA, USDA, and FDA. Current partners include agricultural producers as well as non-agricultural interests. Partners in PESP volunteer to develop and implement a well designed pesticide management plan that will produce the safest and most effective way to use pesticides. In turn, EPA provides a liaison to assist the partner in developing comprehensive, achievable goals. Liaisons act as "customer service representatives" for EPA, providing the partner with access to information and personnel. EPA also promises to integrate the partners' stewardship plans into its agricultural policies and programs.

So far, agricultural producers have committed to a number of projects, including conducting more research into IPM techniques, developing computer prediction models for more precise pesticide applications, educating their members and the public regarding pesticide use, and working with

Focus on Pesticides
EPA's Endangered Species Protection Program is designed to protect Federally-listed endangered and threatened species from exposure to pesticides.

R0074591

equipment manufacturers to refine application techniques. Information on PESP is available at the following Internet site: http://www.pesp.org, or contact the PESP hotline at (800) 972-7717.

Endangered Species Protection Program
The Endangered Species Protection Program (ESPP) began in 1988. This program is largely voluntary at the present time and relies on cooperation between the U.S. Fish and Wildlife Service (FWS), EPA Regions, States, and pesticide users. ESPP is intended to provide information concerning and regulation for the use of pesticides that may adversely affect the survival, reproduction and/or food supply of listed species. Due to labeling requirements, potential users will be informed prior to making a purchase that there may be local limitations on product use due to endangered species concerns. Information on the Endangered Species Protection Program is available at the following Internet site: http://www.epa.gov/oppfead1/endanger/index.htm.

Energy Star® Buildings and Green Lights® Partnership
In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy-efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings— a strategy that optimizes whole-building energy-efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star® Buildings upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to $25 billion annually.

The more than 2,900 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. As of March 31, 1999, Energy Star® Buildings and Green Lights® Program participants are saving $775 million in energy bills with an annual savings of 31.75 kilowatt per square foot and annual cost savings of $0.47 per square foot. By joining, participants agree to upgrade 90 percent of their owned facilities with energy-efficient lighting and 50 percent of their owned facilities with whole-building upgrades, where profitable, over a seven-year period. Energy Star® participants first reduce their energy loads with the Green Lights® approach to building tune-ups, then focus on "right sizing" their heating and cooling equipment to match their new energy needs. EPA's Office of Air and Radiation is responsible for operating the Energy Star® Buildings and Green Lights® Program. (Contact: Energy Star Hotline, 1-888-STAR-YES (1-888-782-7937) or Maria Tikoff Vargas, Co-Director at (202) 564-9178 or visit the website at http://www.epa.gov/buildings.

WasteWi$e Program
The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection, and the manufacturing and purchase of recycled products. As of 1998, the program had about 700 business, government, and institutional partners. Partners agree to identify and implement actions to reduce their solid wastes by setting waste reduction goals and providing EPA with yearly progress reports for a three-year period. EPA, in turn, provides partners with technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at (800) 372-9473 or Joanne Oxley, EPA Program Manager, (703) 308-0199.)

Climate Wise Program
In October 1993, President Clinton unveiled the Climate Change Action Plan (CCAP) in honor of the United States' commitment to reducing its greenhouse gas emissions to 1990 levels by the year 2000. Climate Wise, a project jointly sponsored by the U.S. Department of Energy and EPA, is one of the projects initiated under CCAP.

Climate Wise is a partnership between government and industry that offers companies a nonregulatory approach to reducing greenhouse gas emissions. Climate Wise state and local government "allies" work with U.S. industries to develop flexible, comprehensive strategies for achieving energy efficiency and pollution prevention. They help local business identify and implement projects that often require little capital investment, but promise a high rate of return. Companies that become Climate Wise partners receive technical assistance and financing information to help them develop and implement cost-effective changes. (Contact: Climate Wise Clearinghouse at (301) 230-4736 or visit the Climate Wise website at http://www.epa.gov/climatewise/allies.htm or http://www.epa.gov/climatewise/index.htm.)

VII.C. USDA Programs and Activities

Environmental Quality Incentives Program
The Environmental Quality Incentives Program (EQIP) is a USDA funded program (led by Natural Resources Conservation Service) that was established in the 1996 Farm Bill to provide a voluntary conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. EQIP embodies four of USDA's former conservation programs, including the Agricultural Conservation Program, the Water Quality

Incentives Program, the Great Plains Conservation Program, and the Colorado River Basin Salinity Control Program.

EQIP offers 5 to 10 year contracts that provide *incentive payments* and *cost-sharing* for conservation practices called for in a site-specific conservation plan that is required for all EQIP activities. *Cost-sharing* may include up to 75 percent of the costs of certain conservation practices, such as grassed waterways, filter strips, manure management facilities, capping abandoned wells, and other practices. *Incentive payments* may be made to encourage land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management. These payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the program incentive.

EQIP has an authorized budget of $1.3 billion through the year 2002. It was funded for $174 million in 1999. Total cost-share and incentive payments are limited to $10,000 per person per year and $50,000 for the length of the contract. Eligibility is limited to persons who are engaged in livestock or agricultural production. Fifty percent of the funds must be spent on livestock production. The 1996 Farm Bill prohibits owners of large confined livestock operations from being eligible for cost-share assistance for animal waste storage or treatment facilities. However, technical, educational, and financial assistance may be provided for other conservation practices on such operations. Further information relating to EQIP may be found on NRCS's website located at
http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/eqipfact.html.

Conservation Reserve Program

The Conservation Reserve Program (CRP) is a highly successful conservation program administered by USDA. Since 1986, CRP has provided financial incentives to farmers and ranchers to take land out of agricultural production and plant trees, grass and other types of vegetation. The result has been reduced soil erosion, improved air and water quality and establishment of millions of acres of wildlife habitat.

With the New Conservation Reserve Program, launched with the final rule published in the Federal Register on February 19, 1997, the Farm Service Agency (FSA) begins a renewed effort to achieve the full potential of government-farmer conservation partnerships. Only the most environmentally-sensitive land, yielding the greatest environmental benefits, will be accepted into the program.

The 36.4-million-acre congressionally mandated cap on enrollments is carried over from the previous program, meaning that the new CRP has authority to enroll only about 15 percent of the eligible cropland. To make the most of the program's potential, a new Environmental Benefits Index (EBI) was developed. The new EBI will be used to select areas and acreages offering the greatest environmental benefits.

Conservation priority areas (CPAs) are regions targeted for CRP enrollment. The four national CPAs are the Long Island Sound region, the Chesapeake Bay and surrounding areas, an area adjacent to the Great Lakes, and the Prairie Pothole region. FSA State Committees may also designate up to 10 percent of a State's remaining cropland as a State Conservation Priority Area. The NRCS is responsible for determining the relative environmental benefits of each acre offered for participation.

Continuous Sign-Up. For certain high-priority conservation practices yielding highly desirable environmental benefits, producers may sign up at any time, without waiting for an announced sign-up period. Continuous sign-up allows farmers and ranchers management flexibility in implementing certain conservation practices on their cropland. These practices are specially designed to achieve significant environmental benefits, giving participants a chance to help protect and enhance wildlife habitat, improve air quality, and improve the condition of America's waterways. Unlike the general CRP program, sign-up for these special practices is open continuously. Provided certain eligibility requirements are met, acreage is automatically accepted into the program at a per-acre rental rate not to exceed the Commodity Credit Corporation's maximum payment amount, based on site-specific soil productivity and local prevailing cash-equivalent rental rates. For more information on the CRP, see USDA's website at http://www.fsa.usda.gov/dafp/cepd/crpinfo.htm.

Conservation Reserve Enhancement Program

The Conservation Reserve Enhancement Program (CREP), a refinement of the CRP, is a state-federal conservation partnership program targeted to address *specific* state and nationally significant water quality, soil erosion and wildlife habitat issues related to agricultural use. The program uses financial incentives to encourage farmers and ranchers to voluntarily enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production. This community-based conservation program provides a flexible design of conservation practices and financial incentives to address environmental issues. For more information about CREP, refer to USDA's website at http://www.fsa.usda.gov/dafp/cepd/crep/crephome.htm.

Wetlands Reserve Program

Congress authorized the Wetlands Reserve Program (WRP) under the Food Security Act of 1985, as amended by the 1990 and 1996 Farm Bills. USDA's Natural Resources Conservation Service (NRCS) administers the program in consultation with the Farm Service Agency and other Federal agencies. WRP is a voluntary program to restore wetlands. Landowners who choose to participate in WRP may sell a conservation easement or enter into a cost-share restoration agreement with USDA to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership.

WRP offers landowners three options: *permanent easements*, *30-year easements*, and *restoration cost-share agreements* of a minimum 10-year duration. In exchange for establishing a *permanent easement*, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetland. In exchange for the *30-year easement*, the landowner receives a payment of 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The *restoration cost-share agreement* is an agreement (generally for a minimum of 10 years) to re-establish degraded or lost wetland habitat, in which USDA pays the landowner 75 percent of the cost of the restoration activity. Restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the agreement. In all instances, landowners continue to control access to their land. For more information about WRP, see NRCS's website at: http://wl.fb-net.org.

Conservation Farm Option

The Conservation Farm Option (CFO) is a voluntary pilot program for producers of wheat, feed grains, cotton, and rice. The program purposes include conservation of soil, water, and related resources, water quality protection and improvement, wetland restoration, protection and creation, wildlife habitat development and protection, or other similar conservation purposes. Eligibility is limited to owners and producers who have contract acreage enrolled in the Agricultural Market Transition program. Participants are required to develop and implement a conservation farm plan. The plan becomes part of the CFO contract which covers a ten year period. CFO is not restricted as to what measures may be included in the conservation plan, so long as they provide environmental benefits. During the contract period the owner or producer (1) receives annual payments for implementing the CFO contract, and (2) agrees to forgo payments under the Conservation Reserve Program, the Wetlands Reserve Program, and the Environmental Quality Incentives Program in exchange for one consolidated program.

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program (administered by NRCS) for people who want to develop and improve wildlife habitat primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

Under this program, NRCS helps participants prepare a wildlife habitat development plan in consultation with the local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement. This plan may or may not be part of a larger conservation plan that addresses other resource needs such as water quality and soil erosion.

USDA and the participant enter into a cost-share agreement that generally lasts between 5 to 10 years from the date the agreement is signed. Under the agreement: the landowner agrees to install and maintain WHIP practices and allow NRCS or its agent access to monitor the effectiveness of the practices; and USDA agrees to provide technical assistance and pay up to 75 percent of the cost of installing the wildlife habitat practices.

WHIP is currently budgeted for $50 million total through the year 2002. WHIP funds are distributed to States based on State wildlife habitat priorities, which may include wildlife habitat areas, targeted species and their habitats, and specific practices. WHIP may be implemented in cooperation with other Federal, State, or local agencies; conservation districts; or private conservation groups. For more information, see NRCS's website at http://www.nrcs.usda.gov.

Conservation of Private Grazing Land Initiative

The Conservation of Private Grazing Land initiative will ensure that technical, educational, and related assistance is provided to those who own private grazing lands. It is not a cost share program. This technical assistance will offer opportunities for better grazing and land management; protecting soil from erosive wind and water; using more energy-efficient ways to produce food and fiber; conserving water; providing habitat for wildlife; sustaining forage and grazing plants; using plants to sequester greenhouse gases and increase soil organic matter; and using grazing lands as a source of biomass energy and raw materials for industrial products.

The Wetland Conservation Provision (Swampbuster)

This provision, part of the 1985, 1990, and 1996 farm bills, requires all agriculture producers to protect wetlands on the farms they own or operate if they want to be eligible for USDA farm program benefits. The Swampbuster program generally allows the continuation of most ongoing farming practices as long as wetlands are not converted or wetland drainage increased. The program discourages farmers from altering wetlands by withholding Federal farm program benefits from any person who does the following:

- Plants an agricultural commodity on a converted wetland that was converted by drainage, dredging, leveling or any other means after December 23, 1985.
- Converts a wetland for the purpose of or to make agricultural commodity production after November 28, 1990.

In order to ensure farm program benefits under the Swampbuster provisions, the local NRCS office should be contacted before clearing, draining, or manipulating any wet areas on any farmland.

VII.D. Other Voluntary Initiatives

NICE^3

The U.S. Department of Energy sponsors a grant program called National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). The NICE^3 program provides funding to state and industry partnerships (large and small businesses) for projects demonstrating advances in energy efficiency and clean production technologies. The goal of the NICE^3 program is to demonstrate the performance and economics of innovative technologies in the U.S., leading to the commercialization of improved industrial manufacturing processes. These processes should conserve energy, reduce waste, and improve industrial cost-competitiveness. Industry applicants must submit project proposals through a state energy, pollution prevention, or business development office. Awardees receive a one-time, three-year grant of up to $400,000, representing up to 50 percent of a project's total cost. In addition, up to $25,000 is available to support the state applicant's cost share. (Contact: View the website at http//www.oit.doe.gov/Access/nice3; Steve Blazek, DOE, (303) 275-4723; or Eric Hass, DOE, (303) 275-4728.)

ISO 14000

ISO 14000 is a series of internationally-accepted standards for environmental management. The series includes standards for environmental management systems (EMS), guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of over 110 country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO. Information on ISO is available at the following Internet site: http://www.iso.ch/welcome.html.

VII.E. Summary of Trade Associations

There are more than 200 trade associations that deal with agricultural issues. Many of these are at the national level, while others deal specifically with regions of the country or individual states. The following identify some of the major associations addressing agricultural production.

American Dairy Goat Association
Ronald E. Gelvin, Secretary Treasurer
P.O. Box 865
209 W. Main Street
Spindale, NC 28160
Telephone: 704-286-3801
Fax: 704-287-0476

American Dairy Association
10255 W. Higgins
Rosemont, IL 60018
Telephone: 847-803-2000
Fax: 847-803-2077

American Farm Bureau Federation
Washington DC Office
600 Maryland Avenue, SW
Suite 800
Washington, DC 20024
Telephone: 202-484-3600
Fax: 202-484-3604

American Hereford Association
Craig Huffhines,
Executive Vice President
P.O. Box 014059
Kansas City, MO 64101
Telephone: 816-842-3757
Fax: 816-842-6931

American Horse Council
James J. Hickey, Jr., President
1700 K Street, NW, # 300
Washington, DC 20006
Telephone: 202-296-4031
Fax: 202-296-1970

American Equine Association
Carol Winterburger, Executive Director
Box 658
Newfoundland, NJ 07435
Telephone: 973-697-9668
Fax: 973-697-1538

American Farm Bureau Federation
Headquarters Office
225 Touhy Avenue
Park Ridge, IL 60068
Telephone: 847-685-8600
Fax: 847-685-8896

National Broilers Council
George B. Watts
1015 15th Street, NW, Suite 950
Washington, DC 20005
Telephone: 202-408-1339

National Cattlemen's Beef Assoc.
Charles Schroeder, CEO
1301 Pennsylvania Avenue, NW, Suite 300
Washington, DC 20004-1701
Telephone: 202-347-0228
Fax: 202-638-0607

National Farmers Organization
2505 Elwood Drive
Ames, IA 50010-2000
Telephone: 515-292-2000
Fax: 515-292-7106

American National Cattle Women
4278 Highway 196
Lamar, CO 81052
Telephone: 303-829-4475
Fax: 303-694-2390

American Poultry Association
Lorna Rhodes, Secretary Treasurer
133 Millville Street
Mendon, MA 01756
Telephone and Fax: 508-473-8769

American Sheep Industry Association
Peter Orwick, Executive Director
6911 South Yosemite St.
Englewood, CO 80112-1414
Telephone: 303-771-3500
Fax: 303-771-8200

Association of American Pesticide Control Officials
P.O. Box 1249
Hardwick, VT 05843
Telephone: 802-472-6956
Fax: 802-472-6957

National Pork Producers Council
Jerry King, President
P.O. Box 10383
Des Moines, IA 50306
Telephone: 515-223-2600
Fax: 515-223-2646

National Farmers Union
Leland Swenson, President
11900 E. Cornell Avenue
Aurora, CO 80014-3194
Telephone: 303-337-5500
Fax: 303-368-1390

National Fisheries Institute
Dick Gutting,
Executive Vice President
1901 N. Fort Myer Drive, Suite 700
Arlington, VA 22209
Telephone: 703-524-8880
Fax: 703-524-4619

National Live Stock Producers Association
R. Scott Stuart, CEO
660 Southpointe Court, Suite 314
Colorado Springs, CO 80906
Telephone: 719-538-8843
Fax: 719-538-8847

National Turkey Federation
1225 New York Avenue, NW
Washington, DC 20005
Telephone: 202-898-0100
Fax: 202-898-0203

VIII. CONTACTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the agricultural livestock production industry, a list of contacts and publications are provided below:

Contacts[2]

Name	Organization	Telephone	Subject
Ginah Mortensen	EPA, Office of Enforcement and Compliance Assurance (OECA), Agriculture Division, Agriculture Branch	913-551-5211	Notebook Contact
Arty Williams	EPA, Office of Prevention, Pesticides and Toxic Substances (OPPT)	703-305-5239	Ground Water Pesticide Management Plan Rule
Jean Frane	EPA, OPPT	703-305-5944	Food Quality Protection Act
David Stangel	EPA, OECA	202-564-4162	Stored or Suspended Pesticides; Good Laboratory Practice Standards; Pesticide Management and Disposal
Joseph Hogue	EPA, OPPT	703-308-9072	FIFRA Restricted Use Classifications
Robert McNally	EPA, OPPT	703-308-8085	FIFRA Pesticide Tolerances
Joseph Nevola	EPA, OPPT	703-308-8037	FIFRA Pesticide Tolerances
Ellen Kramer	EPA, OPPT	703-305-6475	FIFRA Pesticide Tolerances
Robert A. Forrest	EPA, OPPT	703-308-9376	FIFRA Exemptions
Nancy Fitz	EPA, OPPT	703-305-7385	FIFRA Pesticide Management and Disposal
John MacDonald	EPA, OPPT	703-305-7370	Certification and Training
Kevin Keaney	EPA, OPPT	703-305-5557	FIFRA Worker Protection Standards
Al Havinga	EPA, OECA	202-564-4147	Livestock Issues
Carol Galloway	EPA, OECA	913-551-5008	Livestock Issues

[2] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Sharon Buck	EPA, OWOW	202-260-0306	Nonpoint Source Issues
Greg Beatty	EPA, OWM	202-260-6929	NPDES Permitting Issues
Roberta Parry	EPA, OPEI	202-260-2876	Livestock and Crop Issues
Robin Dunkins	EPA, OAQPS	919-541-5335	Air Issues
Kurt Roos	EPA, OAR	202-564-9041	Atmospheric Programs
Howard Beard	EPA, OGWDW		Drinking Water Issues
Tracy Back	EPA, CCSMD	202-564-7076	Compliance Assistance Centers

General Profile

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Enforcement and Compliance Assurance Accomplishments Report, FY 1994, U.S. EPA, Office of Enforcement (EPA/300-R-95-004), May 1995.

Enforcement and Compliance Assurance Accomplishments Report, FY 1995, U.S. EPA, Office of Enforcement (EPA/300-R-96-006), July 1996.

Enforcement and Compliance Assurance Accomplishments Report, FY 1996, U.S. EPA, Office of Enforcement (EPA-300-R-97-003), May 1997.

Enforcement and Compliance Assurance Accomplishments Report, FY 1997, U.S. EPA, Office of Enforcement (EPA-300-R-98-003), 1998.

Occupational Outlook Handbook Home Page, Bureau of Labor Statistics Home Page. December 1996.

North American Industrial Classification System, Office of Management and Budget.

SIC Code Profile 02, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Draft, September 30, 1994.

Small and Part Time Farms, Newsletter, U.S. Department of Agriculture, Fall 1996.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Agriculture Census, 1992 and 1997.

Operations and Pollution Prevention

Agricultural Waste Management Field Handbook, U.S. Department of Agriculture, April 1992 (www.ftw.nrcs.usda.gov/awmfh.html).

Animal Agriculture: Information on Waste Management and Water Quality Issues, United States General Accounting Office (GAO/RCED-95-200BR), June 1995.

Animal Waste Disposal Issues (Audit Report No. E1XWF7-13-0085-7100142), Office of Inspector General, Report of Audit, U.S. Environmental Protection Agency. March 31, 1997.

CAFO Standards for Pork Production, Survey, Association of State and Interstate Water Pollution Control Administrators (ASIWPCA), Washington, D.C., December 1997.

Composting Manure and Other Organic Residues, University of Nebraska-Lincoln, Cooperative Extension, Institute of Agriculture and Natural Resources (G97-1315-A) NebGuide. Electronic version issued January 1998.

Control of Odor Emissions from Animal Operations: A Report from the Board of Governor of the University of North Carolina, North Carolina State University, College of Agriculture and Life Sciences, September, 1998.

Environmental Considerations for Manure Application System Selection, University of Nebraska-Lincoln, Cooperative Extension, Institute of Agriculture and Natural Resources (G95-1266-A) NebGuide. Electronic version issued June 1996.

Farm Animal Waste Management Systems: Proper Handling, Storage, and Use, Rutgers Cooperative Extension, New Jersey Agricultural Experiment Station.

Farm-A-Syst, Fact Sheet #9, Reducing the Risk of Groundwater Contamination by Improving Silage Storage, University of Wisconsin, Extension/Cooperative Extension, College of Agricultural and Live Sciences.

Generally Accepted Agricultural and Management Practices for Manure Management and Utilization (Table 5, Nitrogen losses During Handling and Storage). Adopted by Michigan Agriculture Commission, Lansing, Michigan, June 1997.

Greater Harmony Between Agriculture and the Environment, U.S. Department of Agriculture, 1997.

Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, U.S. Environmental Protection Agency (http://www.epa.gov/OWOW/MMGI/), January 1993.

Guidelines for Livestock Producers, Heidi Hutchinson, Ohio Environmental Protection Agency, November 20, 1997.

The Quality of Our Nation's Water (http://www.epa.gov/305b).

Ohio Livestock Manure and Wastewater Guide, Ohio State University (http://ohioline.ag.ohio-state.edu/b604/), 1992.

National Unified Strategy for Animal Feeding Operations, U.S. Environmental Protection Agency, March 9, 1999.

NRCS Conservation Practice Standards (http://www.ncg.nrcs.usda.gov/practice_stds.html).

NRCS Technical Tools (http://www.ncg.nrcs.usda.gov/tech_tools.html).

Pesticide Applicator Training Manual, Category 1, Agricultural, Subcategory - Animal, Cornell University, October 1976.

Preliminary Data Summary: Feedlots Point Source Category Study, U.S. Environmental Protection Agency, Office of Water, Washington, DC, December 1998.

Region 7's Efforts to Address Water Pollution From Livestock (Audit Report No. E1HWF6-07-0017-6100312), Office of Inspector General, Report of Audit, U.S. Environmental Protection Agency, September 30, 1996.

Summary: Integrated Animal Waste Management, Council for Agricultural Science and Technology. *The Report of the EPA/State Feedlot Workgroup*, Office of Wastewater Enforcement and Compliance, U.S. Environmental Protection Agency, September 1993.

Use of Urease Inhibitors to Control Nitrogen Loss From Livestock Waste, U.S. Department of Agriculture, 1997.

Water Quality and Waste Management, North Carolina Cooperative Extension, (http://www2.ncsu.edu/bae/programs/extension/publicat/wqwm/index.html).

North Carolina Cooperative Extension Service webpage articles (http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/animops.html):

- Managing a Livestock Operation to Minimize Odors
- Manure Liquid-Solids Separation
- Design Criteria for Swine Waste Flushing Systems

R0074604

- Components of a Complete Manure Management Plan
- Lagoon Design and Management For Livestock Waste Treatment and Storage
- Groundwater: Livestock and Water Quality - Manure Management
- Liquid Animal Waste Sampling
- Current Litter Practices and Future Needs

Miller, W.P., "Environmental Considerations in Land Application of By-Product Gypsum," *Agricultural Utilization of Urban and Industrial By-Products*, American Society of Agronomy, Madison, WI, 1995.

Regulatory Profile

Ag Environmental Programs (http://es.epa.gov/oeca/ag/aglaws/).

Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution, Environmental Law Institute, 1997.

1996 Farm Bill Conservation Provisions (http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/FBillLnk.html).

1996 Farm Bill Summary (http://www.usda.gov/farmbill/title0.htm).

Guidance Manual On NPDES Regulations For Concentrated Animal Feeding Operations, Office of Water, U.S. Environmental Protection Agency, December 1995. EPA 833-B-95-001.

Overview of the Storm Water Program, Office of Water, U.S. Environmental Protection Agency, June 1996. EPA 833-R-96-008.

Preliminary Data Summary, Feedlots Point Source Category Study, U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, December 31, 1998. EPA 821-R-99-002.

Major Existing EPA Laws and Programs That Could Affect Producers of Agricultural Commodities, U.S. Environmental Protection Agency, Agriculture and Ecosystems Division, August 8, 1996.

Landfair, Stanley W. "Toxic Substances Control Act," Chapter 11 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Miller, Marshall E. "Federal Regulation of Pesticides," Chapter 13 in *Environmental Law Handbook*, 12th ed., Government Institutes, Inc., Rockville, MD, 1993.

Other Resources

AgNIC (http://www.agnic.org/).

*Farm*A*Syst* (http://www.wisc.edu/farmasyst/index.html).

Manure Master Decision Support Tool (http://www.ftw.nrcs.usda.gov/ManureMaster/).

State Partners of the Cooperative State Research, Education, and Extension Service (http://www.reeusda.gov/statepartners/usa.htm).

Charge your order,
It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800
Order online at http://bookstore.gpo.gov

Order Processing Code: 3212

Qty	GPO Stock #	Title	Price (each)	Total
		Published in 1995		
	005-000-00512-5	Profile of the Dry Cleaning Industry, 104 pages	$6.50	
	055-000-00513-3	Profile of the Electronics and Computer Industry, 160 pages	$11.00	
	055-000-00518-4	Profile of the Fabricated Metal Products Industry, 164 pages	$11.00	
	055-000-00515-0	Profile of the Inorganic Chemical Industry, 136 pages	$9.00	
	005-000-00516-8	Profile of the Iron and Steel Industry, 128 pages	$8.00	
	055-000-00517-6	Profile of the Lumber and Wood Products Industry, 136 pages	$9.00	
	055-000-00519-2	Profile of the Metal Mining Industry, 148 pages	$10.00	
	055-000-00520-6	Profile of the Motor Vehicle Assembly Industry, 156 pages	$11.00	
	055-000-00521-4	Profile of the Nonferrous Metals Industry, 140 pages	$9.00	
	055-000-00522-2	Profile of the Non-Fuel, Non-Metal Mining Industry, 108 pages	$6.00	
	055-000-00523-1	Profile of the Organic Chemical Industry, 152 pages	$11.00	
	055-000-00524-9	Profile of the Petroleum Refining Industry, 124 pages	$11.00	
	005-000-00525-7	Profile of the Printing Industry, 124 pages	$7.50	
	055-000-00526-5	Profile of the Pulp and Paper Industry, 156 pages	$11.00	
	055-000-00527-3	Profile of the Rubber and Plastic Industry, 152 pages	$11.00	
	055-000-00528-1	Profile of the Stone, Clay, Glass and Concrete Industry, 124 pages	$7.50	
	055-000-00529-0	Profile of the Transportation Equipment Cleaning Industry, 84 pages	$5.50	
	055-000-00514-1	Profile of the Wood Furniture and Fixtures Industry, 132 pages	$8.00	
		Published in 1997		
	055-000-00570-2	Profile of the Air Transportation Industry, 90 pages	$7.50	
	055-000-00576-1	Profile of the Fossil Fuel Electric Power Generation Ind., 160 pages	$14.00	
	055-000-00571-1	Profile of the Ground Transportation Industry, 130 pages	$10.00	
	055-000-00573-7	Profile of the Metal Casting Industry, 150 pages	$13.00	
	055-000-00574-5	Profile of the Pharmaceutical Manufacturing Industry, 147 pages	$13.00	
	055-000-00575-3	Profile of the Plastic Resin & Man-made Fiber Industry, 180 pages	$15.00	
	055-000-00577-0	Profile of the Shipbuilding and Repair Industry, 120 pages	$9.50	
	055-000-00578-8	Profile of the Textile Industry, 130 pages	$10.00	
	055-000-00572-9	Profile of the Water Transportation Industry, 90 pages	$7.50	
		Published in 1998		
	055-000-00579-6	Sector Notebook Data Refresh-1997, 210 pages	$17.00	
	055-000-00619-9	Profile of the Aerospace Industry, 130 pages	$10.00	
		Published in 1999		
	055-000-00620-2	Profile of Local Government Operations, 310 pages	$25.00	
		Published in 2000		
	055-000-00635-1	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry, 200 pp.	$18.00	
	055-000-00636-9	Profile of the Agricultural Crop Production Industry, 178 pages	$16.00	
	055-000-00633-4	Profile of the Agricultural Livestock Production Industry, 159 pages	$15.00	
	055-000-00634-2	Profile of the Oil and Gas Extraction Industry,	$16.00	

The total cost of my order is $__________. Price includes regular shipping and handling and is subject to change. International orders add 25 percent.

____
Company or personal name (please type or print)

____
Additional address/attention line

____
Street Address

____
City, State, Zip Code

____
Daytime phone including area code

Check method of payment:

- ☐ Check payable to Superintendent of Documents
- ☐ GPO Deposit Account _______________
- ☐ VISA ☐ MasterCard ☐ Discover/NOVUS

Credit Card # ____________________
Expiration date ______ *Thank you for your order!*

____
Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954

****Important: Please include completed order form with payment**

R0074607

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States Environmental Protection Agency

Enforcement And Compliance Assurance (2223A)

EPA 310-R-98-001
November 1998

EPA

Profile Of The Aerospace Industry

SECTOR EPA 29 NOTEBOOKS

EPA Office of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

- NOV 18 1997

THE ADMINISTRATOR

Message from the Administrator

Since EPA's founding over 25 years ago, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and those as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper and smarter. As a result, we no longer have rivers catching fire. Our skies are clearer. American environmental technology and expertise are in demand around the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

The Environmental Protection Agency has undertaken its Sector Notebook Project to compile, for major industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with an extensive series covering other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to understand better their regulatory requirements, and learn more about how others in their industry have achieved regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that we together achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-049968-2

EPA/310-R-98-001.

EPA Office of Compliance Sector Notebook Project

Profile of the Aerospace Industry

November 1998

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office. [A listing of available Sector Notebooks and document numbers is included on the following page.]

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, and local governments, and the media from EPA's National Center for Environmental Publications and Information at (800) 490-9198. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available via Internet on the Enviroene World Wide Web at **http://www.epa.gov/oeca/sector/index.html**. Enviro$ense is a free, public, environmental exchange system operated by EPA's Office of Enforcement and Compliance Assurance and Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization. Direct technical questions to the "Feedback" button on the bottom of the web page.

Cover photograph courtesy of The Boeing Company.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

Questions and comments regarding the individual documents should be directed to the specialists listed below. **See the Notebook web page at: www.epa.gov/oeca/sector for the most recent titles and staff contacts.**

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*	Steve Hoover	564-7007
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-005.	Profile of the Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*	Scott Throwe	564-7013
EPA/310-R-95-008.	Profile of the Metal Mining Industry	Maria Malave	564-7027
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry	Debbie Thomas	564-5041
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	564-2628
EPA/310-R-95-012.	Profile of the Organic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Profile of the Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Profile of the Pulp and Paper Industry	Seth Heminway	564-7017
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry	Robert Tolpa	564-2337
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	564-7013
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Profile of the Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Profile of the Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Profile of the Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Profile of the Metal Casting Industry	Steve Hoover	564-7007
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Profile of the Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997	Seth Heminway	564-7017
EPA/310-R-98-001.	Profile of the Aerospace Industry	Anthony Raia	564-6045

Government Series

EPA/310-R-99-001.	Profile of Local Government Operations	John Dombrowski	564-7036

*Spanish translations available.

R0074614

AEROSPACE INDUSTRY
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AIA-	Aerospace Industries Association
AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CARB-	California Air Resources Board
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
DOC-	Department of Commerce
DOD-	Department of Defense
DOE-	Department of Energy
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
GPS-	Global Positioning System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
HVLP-	High Volume/Low Pressure
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NAICS-	North American Industrial Classification System
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEC-	Not Elsewhere Classified
NEIC -	National Enforcement Investigation Center

NESHAP - National Emission Standards for Hazardous Air Pollutants
NO_2 - Nitrogen Dioxide
NOV - Notice of Violation
NO_X - Nitrogen Oxide
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center
NRMRL- National Risk Management Research Laboratory
NSPS - New Source Performance Standards (CAA)
OAQPS- Office of Air Quality Planning and Standards
OAR - Office of Air and Radiation
OECA - Office of Enforcement and Compliance Assurance
OEM- Original Equipment Manufacturer
OMB- Office of Management and Budget
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
SO_X - Sulfur Oxides
TOC - Total Organic Carbon
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TCRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are becoming an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process.

The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2223-A), 401 M St., SW, Washington, DC 20460. Comments can also be sent via the web page or to notebook@epamail.epa.gov.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE AEROSPACE INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the aerospace industry. Facilities described within this document are described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

This industry sector profile provides an overview of the aerospace industry as listed under SIC industry groups 372 and 376. Establishments listed under these codes primarily manufacture and assemble aircraft, space vehicles, guided missiles, and all the associated parts.

Within the industry groups 372, Aircraft and Parts, and 376, Guided Missiles and Space Vehicles and Parts, are the following SIC codes:

- 3721- Aircraft
- 3724- Aircraft Engines and Engine Parts
- 3728- Aircraft Parts and Auxiliary Equipment, Not Elsewhere Classified
- 3761- Guided Missiles and Space Vehicles
- 3764- Guided Missile and Space Vehicle Propulsion Units and Propulsion Unit Parts
- 3769- Guided Missile and Space Vehicle Parts and Auxiliary Equipment, Not Elsewhere Classified

While this notebook covers all of the SIC codes listed above, the large number and variability of the products will not allow a detailed description of each. Instead, commonalities in the industrial processes, pollutant outputs, and pollution prevention opportunities will be identified and described in more general terms. An overview of general manufacturing processes within the industry will be presented, along with descriptions of the actual products and information on the state of the industry. Although certain products covered under these SIC codes may not be specifically mentioned, the economic, pollutant output, and enforcement and compliance data in this notebook covers all establishments producing aerospace products.

SIC codes were established by the Office of Management and Budget (OMB) to track the flow of goods and services within the economy. OMB is in the process of changing the SIC code system to a system based on similar production processes called the North American Industrial Classification System (NAICS). In the NAICS, the SIC codes for the aerospace industry correspond to the following NAICS codes:

R0074622

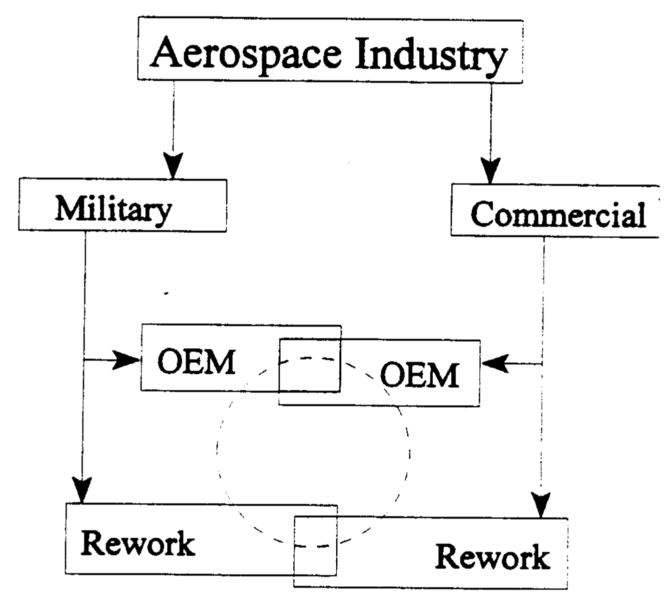
SIC	Industry Sector	NAICS
3721	Aircraft	336411
3724	Aircraft Engines	336412
3728	Aircraft Parts	336413
3761	Guided Missiles and Space Vehicles	336414
3764	Space Vehicle Propulsion Units	336415
3769	Guided Missile and Space Vehicle Parts	336419

II.B. Characterization of the Aerospace Industry

There are many different aerospace products classified under the six aerospace SIC codes. The products produced, geographical distribution, and economic trends of the aerospace industry are discussed below. Figure 1 represents the general structure of the aerospace industry. The aerospace industry operations are often classified as either military or commercial and as either original equipment manufacturers (OEM) or rework. Most aerospace facilities specialize in either military or commercial and either rework or OEM. OEM facilities might do both military and commercial work, and likewise for rework facilities. Some facilities might even work in all areas of the industry, as indicated by the dotted circle in Figure 1.

R0074623

Figure 1: Structure of the Aerospace Industry



Source: NESHAP BID, USEPA/OAQPS, May 1994.

II.B.1. Product Characterization

The aerospace industry consists of manufacturers of aircraft, aircraft engines, aircraft parts, guided missiles and space vehicles, and guided missile and space vehicle propulsion units and parts. Table 1 lists the products included in aircraft, aircraft engines, and space vehicle and missile categories. One source of manufacturer and model information is *The Aerospace Sourcebook*, published by *Aviation Week & Space Technology*.

R0074624

Table 1: Products Included in the Aerospace Industry

Category	Products
Military Fixed-Wing Aircraft	Attack Bombers Cargo/Transport/Refueling Early Warning Electronic Warfare Fighters Observation Patrol ASW Reconnaissance Research/Test Bed Training Utility
Commercial Fixed-Wing Aircraft	Narrow Body Turbofans Wide Body Turbofans Turboprops
Rotary-Wing Aircraft	Naval Scout/Attack Tiltrotor Training Transport Utility
Business & General Aviation Aircraft	Turbofan Turboprop Reciprocating Engine-Powered
Gas Turbine Engines	
Unmanned Aerial Vehicles and Drones	
Space/Launch Vehicles	Manned Systems Unmanned Systems
Missiles	Air-to-Air Air-to-Surface Anti-Armor Anti-Ballistic Anti-Ship Anti-Submarine Surface-to-Air Surface-to-Surface

Source: *Aerospace Source Book, Aviation Week & Space Technology*, 1/12/98.

These manufacturing facilities are classified under SIC codes 372 and 376 as listed above. In order to discuss the production of these parts in a sequential manner, Sections II and III of this profile are divided into four categories: aircraft parts, aircraft assembly, aircraft rework and repair, and space vehicles and guided missiles.

The diverse nature of parts needed to produce these products requires the support of many other major U.S. industries. Many of the parts utilized by aerospace manufacturers are made by other industry sectors such as the plastics and rubber industry, the fabricated metal industry, the metal casting industry, the glass industry, the textile industry, and the electronic components industry. Manufacturing and assembling of complete units in the aerospace industry typically involves prime contractors and several tiers of subcontractors, as follows:

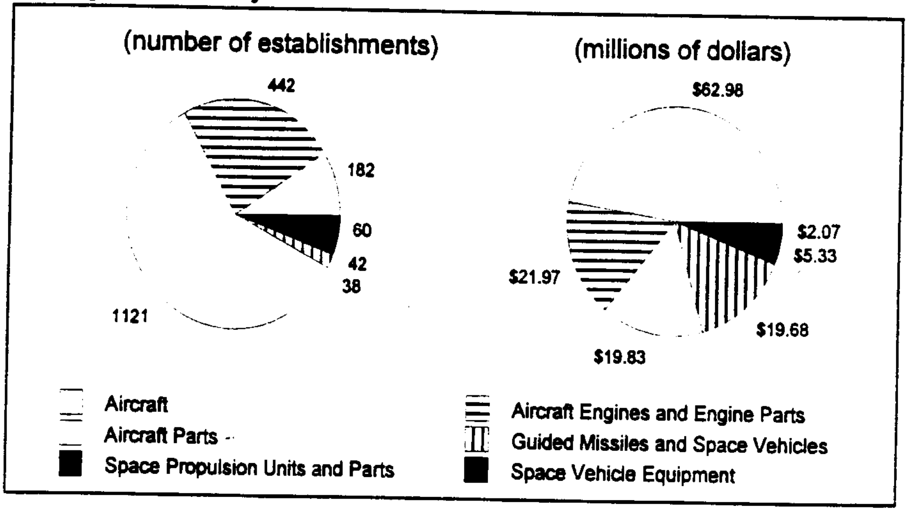
•Prime Contractors-	Design (develop) and assemble or manufacture complete units.
•First Tier Subcontractors-	Do major assembly and/or manufacture of sections of air/space craft without designing or assembling complete units.
•Second Tier Subcontractors-	Make various subassemblies and sections.
•Third Tier Subcontractors-	Produce machined components and sub-assemblies.
•Fourth Tier Subcontractors-	Specialize in the production of particular components and in specific processes.

Typically, those facilities designated as "prime contractors" are included in SIC codes 3721, 3724, 3761 and 3764. Both first and second tier subcontractors correspond to SIC codes 3728 and 3769. Third and fourth tier subcontractors may be included in a variety of industry SIC codes (EPA/OAQPS, 1994).

Figure 2 illustrates the distribution of manufacturing facilities and value of shipments within the aerospace industry. These figures show that while the aircraft parts sector of the aerospace industry is by far the largest in terms of number of establishments, the finished aircraft sector has the largest value of shipments.

The aircraft-related portion of the aerospace industry is much larger than the space vehicle and missile portion. The aircraft portion comprises 93 percent of the establishments and 79 percent of the value of shipments. However, considering the small percentage of facilities engaged in guided missile and space vehicle manufacturing (2 percent), the value of shipments is relatively high (15 percent). In general, facilities which are responsible for assembling the final aerospace products are few and their production rates are low, but the value of each of their products greatly surpasses that of the supporting industries.

Figure 2: Number of Establishments and Value of Shipments for the Aerospace Industry



Source: *1992 Census of Manufacturers*, USDOC, 1995.

Aircraft Engines and Engine Parts and Aircraft Parts and Equipment

The aircraft engines, engine parts, and aircraft parts industry is classified under SIC 3724 and 3728. Facilities producing these parts employ processes similar to many other metal casting, fabricating, and finishing facilities, as well as processes from a wide range of other industries. Typical products manufactured by these facilities include: engines, exhaust systems, motors, brakes, landing gear, wing assemblies, propellers, and many other related products. The primary customers for these industries are the establishments involved in the assembly of aircraft, classified under SIC 3721.

Aircraft Assembly

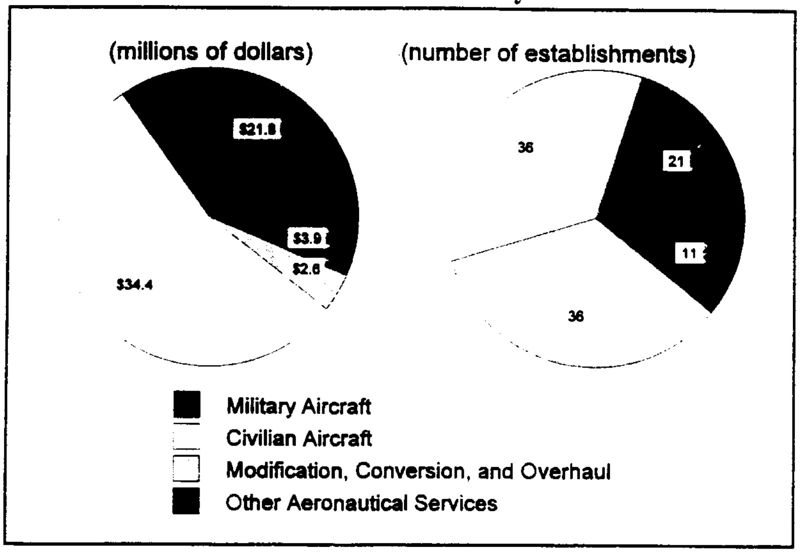
The aircraft industry is made up of establishments primarily engaged in manufacturing or assembling complete aircraft and is classified under SIC 3721. This industry also includes establishments owned by aircraft manufacturers and primarily engaged in research and development on aircraft, whether from enterprise funds or on a contract or fee basis (Census, 1995). There are many different types of aircraft included in this industry, from airplanes and helicopters to blimps and balloons. However, this profile focuses primarily on the production of airplanes since they represent the largest portion of the industry. Typical products include fixed wing aircraft, helicopters, gliders, balloons, and research and development on aircraft.

The major customers of the aircraft industry are commercial airlines and transport companies and the military. Figure 3 shows the distribution within

R0074627

the industry of value of shipments and number of establishments. Civilian aircraft represents the largest percentages in value of shipments and number of establishments. Approximately one-third of the establishments in this industry are involved in the repair and rework of aircraft. These facilities will be discussed in Section III.

Figure 3: Value of Shipments and Number of Establishments for the Aircraft Industry



Source: 1992 Census of Manufacturers, USDOC, 1995.

Guided Missiles and Space Vehicles and Associated Parts

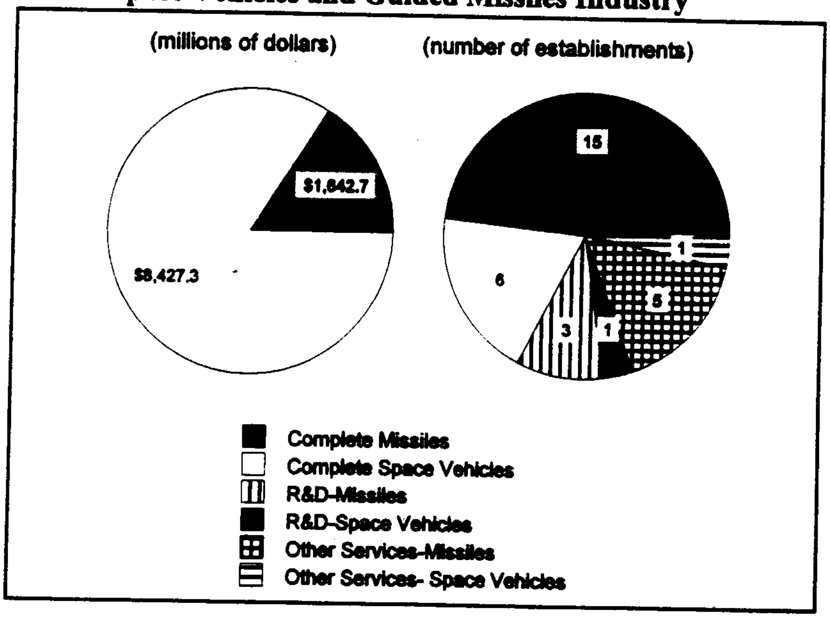
The guided missiles and space vehicles industry includes establishments primarily engaged in manufacturing and research and development on guided missiles and space vehicles, propulsion units, and parts. Typical products covered under SIC 3761, 3764, and 3769 include guided and ballistic missiles, space and military rockets, space vehicles, propulsion units and engines for missiles and space vehicles, airframe assemblies, and research and development on these products. The primary customer for this industry is the military, however space vehicles are also used by commercial entities for releasing communications satellites.

Figure 4 illustrates the specialization within the guided missile and space vehicle industry. The Census of Manufacturers identifies only 31 facilities in this sector. Value of shipment data is not available for facilities providing R&D and other services to protect individual facility confidentiality. Only six facilities, or less than a quarter of the facilities in this industry, are

R0074628

producing complete space vehicles. The value of shipments for these facilities, however, comprised more than three-quarters of the total value of shipments for the industry.

Figure 4: Value of Shipments and Number of Establishments for the Space Vehicles and Guided Missiles Industry



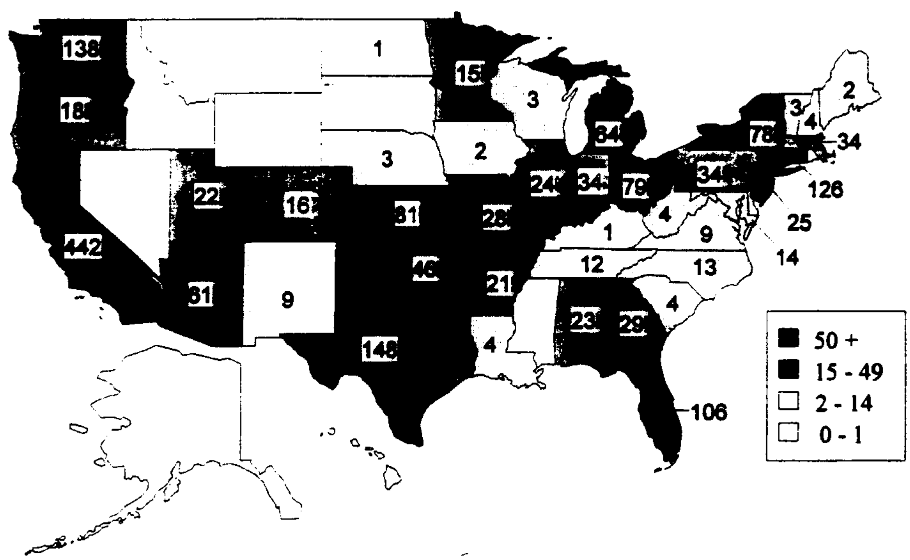
Source: *1992 Census of Manufacturers*, USDOC, 1995.

R0074629

II.B.2. Industry Size and Geographic Distribution

Figure 5 shows the U.S. distribution of aerospace facilities. Generally, the geographic distribution of aerospace facilities is determined by the location of industrialized areas of the country. As with many manufacturing industries, the ease of transportation of materials, products, and skilled workers influence facility location.

Figure 5: Geographic Distribution of Aerospace Manufacturing Facilities



Source: *1992 Census of Manufacturers*, USDOC, 1995.

Table 2 lists the facility size distribution within the aerospace sectors. As previously mentioned, the aircraft and aircraft parts industry (1,745 facilities) is more than ten times larger than the space vehicles, guided missiles, and parts industry (140 facilities). Aircraft and aircraft part manufacturing generally employs less people per facility than space vehicle and guided missile manufacturing. However, the number of employees in the aircraft industries still overshadows that of the missile and space vehicle industries, 645.9 thousand and 149.6 thousand respectively.

R0074630

Table 2: Facility Size Distribution for the Aerospace Industry

	Aircraft and Aircraft Engines and Parts (SIC 372)		Aircraft (SIC 3721)		Aircraft Engines and Engine Parts (SIC 3724)		Aircraft Parts and Equipment (SIC 3728)	
Employees per Facility	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities
1-9	652	37%	60	33%	112	26%	480	43%
10-49	543	31%	42	23%	130	29%	371	33%
50-249	340	19%	29	16%	129	29%	182	16%
250-2499	173	10%	32	18%	63	14%	78	7%
2500 +	37	2%	19	10%	8	2%	10	1%
Total	**1,745**	100%	182	100%	442	100%	1,121	100%

	Space Vehicles, Guided Missiles, and Parts (SIC 376)		Space Vehicles and Guided Missiles (SIC 3761)		Space Propulsion Units and Parts (SIC 3764)		Space Vehicle and Guided Missiles Parts (SIC 3769)	
Employees per Facility	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities
1-9	26	19%	4	10%	6	14%	16	27%
10-49	27	19%	5	13%	8	19%	14	23%
50-249	31	22%	5	13%	8	19%	18	30%
250-2499	37	26%	12	32%	15	36%	10	17%
2500 +	19	14%	12	32%	5	12%	2	3%
Total	**140**	100%	38	100%	42	100%	60	100%

Source: 1992 Census of Manufacturers, Industry Series: Aerospace Equipment, Including Parts, US Department of Commerce, Bureau of the Census, 1995.
Note: 1992 Census of Manufacturers data are the most recent available. Changes in the number of facilities, location, and employment figures since 1992 are not reflected in these data.

R0074631

Table 3 further divides the geographic distribution of aerospace facilities. The top states in which the aerospace industries are concentrated are given along with their respective number of establishments.

Table 3: States with the Largest Number of Aerospace Manufacturing Facilities				
	Aircraft and Aircraft Parts (SIC 372)		Space Vehicles, Guided Missiles and Associated Parts (SIC 376)	
	Top States	Establishments	Top States	Establishments
States in which industry is concentrated, based on number of establishments	California Texas Washington Connecticut	393 140 136 126	California Arizona Texas Alabama	49 9 8 7
Percent of Total	45%		52%	
Source: *1992 Census of Manufacturers, Industry Series: Aerospace Equipment, Including Parts*, US Department of Commerce, Bureau of the Census, 1995.				

Dun & Bradstreet's *Million Dollar Directory*, compiles financial data on U.S. companies including those operating within the aerospace industry. Dun & Bradstreet ranks U.S. companies, whether they are a parent company, subsidiary or division, by sales volume within their assigned 4-digit SIC code. Table 4 lists the top 10 aerospace companies by sales.

Table 4: Top U.S. Aerospace Companies

Rank	Company	1997 Sales (millions of dollars)	SIC Code(s) Reported
1	General Electric Co.- Fairfield, CT	79,179	3724, 3511, 3612, 3641, 3632, 4833
2	Lockheed Martin Co.- Bethesda, MD	26,875	3721, 3761, 3663, 3764, 3812, 3728
3	United Technologies Corp.- Hartford, CT	23,273	3724, 3585, 3534, 3721, 3842, 3714
4	The Boeing Co.- Seattle, WA	22,681	3721, 3663, 3761, 3764, 3812, 3728
5	Hughes Electronics Corp.- Los Angeles, CA	14,772	3761, 3812, 3714, 3651, 3663, 3699
6	Allied Signal Inc.- Morristown, NJ	13,971	3724, 3812, 3728, 3761, 3714, 2824, 2821
7	McDonnell Douglas Corp*-Saint Louis, MO	13,834	3721, 3761, 3764, 3812, 6159
8	Textron Inc.- Providence, RI	9,274	3721, 3714, 3452, 3711, 6141, 6159
9	Northrop Grumman Corp.- Los Angeles, CA	8,071	3721, 3761, 3728, 3812, 3825, 4581
10	The BF Goodrich Co.- Richfield, OH	2,238	3728, 3724, 7699, 2821, 2843

Source: Dunn & Bradstreet's Million Dollar Directory, 1997.
Note: Not all sales can be attributed to the companies' aerospace operations.
*McDonnell Douglas Corp. is now part of The Boeing Co.

R0074632

Readers should note that: (1) companies are assigned a 4-digit SIC code that resembles their principal industry most closely; and (2) sales figures include total company sales, including subsidiaries and operations (possibly not related to aerospace). Additional sources of company specific financial information include Standard & Poor's *Stock Report Service*, *Ward's Business Directory of U.S. Public and Private Companies*, Moody's Manuals, and company annual reports.

The Bureau of the Census publishes concentration ratios, which measure the degree of competition in a market. They compute the percentage of the value of products shipped by establishments classified within an industry of the total value of these products shipped from any establishment. Within the aerospace industry, the aircraft industry and the space vehicle and guided missile industry had the greatest coverage ratios in 1992: 97 percent each. The aircraft engine, aircraft parts, propulsion units, and auxiliary space vehicle equipment coverage ratios were 95, 74, 86, and 40 percent respectively.

II.B.3. Economic Trends

Growth in the U.S. aerospace industry will be influenced by several key factors, including constrained defense spending by the U.S. and foreign governments, increased productivity and technological innovation, foreign competition, continuing expansion of the global economy, investment in research and development, offsets and outsourcing, and support by foreign governments for their industries.

Domestic Trends

In recent years there has been considerable consolidation of aerospace companies, especially those supplying the military. This has resulted in some reductions in labor force and closing of some aerospace facilities in the U.S. However, in constant 1992 dollars, the value of U.S. shipments in 1996 of complete aircraft (all types, civil and military) rose by about six percent over the value of shipments in 1995. The value of those shipments was expected to rise further by about thirty percent in 1997 and about five percent in 1998.

<u>Military</u>
In September 1996, Congress passed a DOD budget for FY 1997 that, for the first time in more than a decade, did not reduce spending from the previous year. In addition, the legislation provided more funding for procurement of aircraft and missiles than DOD had requested. Also, DOD reduced funding for R&D, which means that private companies will have to increase their share of the total amount spent on R&D if the overall level of technology investment and advancement is to be maintained.

In the missiles sector, air-to-surface weapons should experience the most growth relative to other types of missiles. Strong focus will be placed on improving guidance capabilities, mainly through the use of the U.S. Global Positioning System (GPS) (USDOC, 1998).

Commercial

Of all the aerospace sectors, the large civil transport aircraft sector is expected to experience the fastest rate of growth from 1997 through 2001. With the significant increase in production rates undertaken by Boeing in 1996, the value of shipments in 1997 of large civil transports could be as much as sixty percent higher than that of 1996, with another increase of about ten percent expected in 1998 (USDOC, 1998).

Even as U.S. aerospace workers are being laid off because of consolidation in some companies, workers are being hired by other firms because of increasing orders. Sales of large transport aircraft are expected to come from the retirement and replacement of aircraft plus additional aircraft to allow for air traffic growth (USDOC, 1998).

The aircraft engines and parts sectors also should see production and shipments increase as suppliers respond to increased production rates by the manufacturers of commercial transports. The market for commercial transport engines alone is expected to total from $150 billion to $175 billion between 1996 and 2005 (USDOC, 1998).

International Trends

The internationalization of aerospace programs is increasing, and the U.S. aerospace industry is dependent on exports for a third of its market. The U.S. aerospace industry is affected significantly by the economies of foreign countries. The average annual increase in world GDP is expected to be three percent from 1996 through 2005. The main barriers facing U.S. manufacturers are foreign government support for their aerospace industries through direct and indirect subsidies, tariffs, and difficult and expensive licensing procedures. Additional access could be guaranteed if efforts succeed to expand membership and broaden the disciplines of several aircraft-related trade agreements (USDOC, 1998).

Military

The situation for firms in the defense industry is mixed. While some governments, such as those of North America and Europe (with the largest defense budgets), continue to seek ways to reduce their military expenditures, governments in South America (with relatively small defense budgets) are maintaining or increasing their defense spending. However, current economic crises in Asia may reduce exports to some countries. The pace of consolidation in Europe of aerospace and defense companies, which began later than in the U.S., is escalating just as the merger rate in the U.S. appears to be slowing (USDOC, 1998).

Commercial

Overall improvement in the global economy has buoyed the fortunes of the world's airlines. World air passenger traffic rose each year from 1994 to 1996, and increased traffic by airlines all over the world produced a significant turnaround in the large transport aircraft market, the largest part of the aircraft industry. The civil aircraft sector exports 60 percent of its total production and represents about 20 percent of the overall U.S. aerospace industry (USDOC, 1998).

Asian economic problems have not had serious widespread impacts on the aerospace industry to date. Companies such as Lockheed Martin and Boeing estimate that about five percent of their contracts for the next five years are tied to that region. It is possible that, considering the strength of the industry and the economy outside of Asia, other customers may step in and eliminate lower production rates (Smith, 1998).

Commercial space launch providers also are benefiting from the improved economic situation. Consumer demand for direct-to-home television, voice and data transmission, and other satellite services is increasing the demand for satellites and therefore for space launch vehicles to place them in orbit (USDOC, 1998).

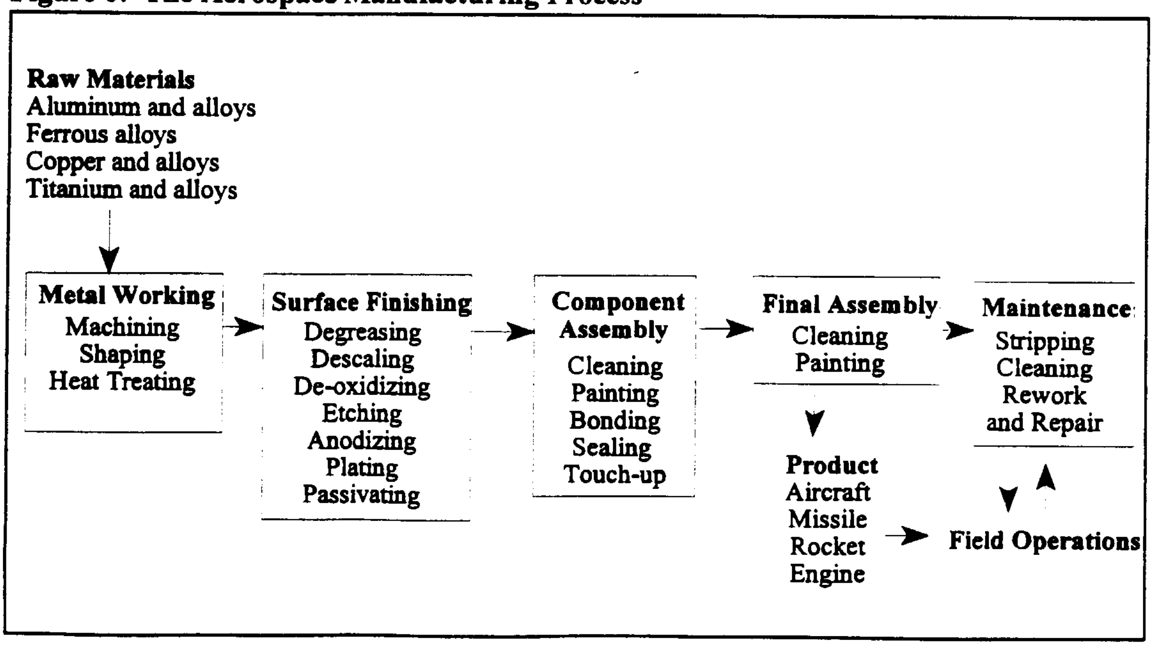
III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the aerospace industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of resource materials and contacts that are available.

It is important to note that the FAA places very strict "airworthiness" guidelines on manufacturing and rework facilities for safety and quality control purposes, thus new pollution prevention alternatives may require a full evaluation and permitting process before they may be used.

This section contains a description of commonly used production processes, associated raw materials, by-products produced or released, and materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products. Figure 6 shows a general aerospace manufacturing process diagram.

Figure 6: The Aerospace Manufacturing Process



Source: Aerospace Industries Association Newsletter, October 1994.

III.A. Aircraft Engines and Parts Industry

Manufacturing processes for aircraft engines and parts may consist of the following basic operations: materials receiving, metal fabricating, machining and mechanical processing, coating application, chemical milling, heat treating, cleaning, metal processing and finishing, coating removal (depainting), composite processing, and testing. Many facilities employ all of these processes in their operations, however, a facility may also employ only a subset of these operations, as with a facility that produces a single component or a facility that provides a service such as painting (EPA/OAQPS, 1997).

In addition, there are a number of operations that may be used at aircraft engine and parts facilities but are not typical and are performed in conjunction with a variety of industries, such as foundry operations and manufacturing of electronic components. For more information on foundry operations, see the *Profile of the Metal Casting Industry*, EPA, 1997. For more information on electronics and computers, see the *Profile of the Electronics and Computer Industry*, EPA, 1995.

III.A.1. Materials

There are many different materials involved in the production of engines and parts. The most common materials are alloys of aluminum, which are used primarily for aircraft structural components and exterior skin sections. Other materials are titanium, stainless steel, magnesium, and non-metallics such as plastics, fabrics, and composite materials. Typical forms of materials are honeycomb, wire mesh, plate, sheet stock, bar cast, and forged materials.

Metallic Alloys

Aluminum is used as a primary structural material in the aerospace industry because of its light weight, and because its alloys can equal the strength of steel. The ability to resist atmospheric corrosion also favors the use of aluminum. The type of alloy metal used depends on the desired characteristics of the finished product such as strength, corrosion resistance, machinability, ductility, or weldability (Horne, 1986).

High strength alloys typically contain copper, magnesium, silicon, and zinc as their alloying elements. Other alloying agents that may be used are: lithium for lightness; nickel for strength and ductility; chromium for tensile strength and elastic limit; molybdenum for strength and toughness; vanadium for tensile strength, ductility, and elastic limit; silicon as a deoxidizer; and powder metallurgy alloys for strength, toughness, and corrosion resistance (Horne, 1986).

R0074637

The development of the gas turbine and the evolution of engines required materials with great resistance to temperature, stress, and oxidation. Nickel-based alloys have a high resistance to oxidation and are used for compressor blades and guide vanes, discs, turbine blades, shafts, casings, combustion chambers, and exhaust systems. Titanium alloys have excellent toughness, fatigue strength, corrosion resistance, temperature resistance, and a lower density than steel. Titanium alloys are frequently used to make hot-end turbine components and turbine rotor blades (Horne, 1986).

Non-Metallic Materials

Plastics, carbon and glass fibers, and synthetic resins and polymers are all used in aerospace manufacturing. There are two types of plastics used, thermoplastics and thermosetting materials. Thermoplastic materials are softened by heating and will harden on cooling and can be extruded (material is pressure forced through a shaped hole), injection molded (soft material is forced into a mold through a screw injector and pressure), or thermoformed (material is cast in a mold with heat and pressure). Thermosetting plastics are hardened by heating and form rigid three dimensional structures through chemical reactions. They are typically compression molded (Horne, 1986). For more information on non-metallic materials, refer to the *Profile of the Rubber and Plastic Industry*, EPA, 1995.

Carbon and glass fibre strands are used to reinforce plastics for strength and stiffness while remaining lightweight. Synthetic resins and polymers are used as adhesives which produce smooth bonds and a stiff structure which propagates cracks more slowly than in a riveted structure (Horne, 1986).

III.A.2. Metal Shaping

Another major process in the manufacturing of aircraft and other aerospace equipment is metal shaping. Shaping operations take raw materials and alter their form to make the intermediate and final product shapes. There are two phases of shaping operations: primary and secondary. Primary shaping consists of forming the metal from its raw form into a sheet, bar, plate, or some other preliminary form. Secondary shaping consists of taking the preliminary form and further altering its shape to an intermediate or final version of the product. Examples of primary and secondary shaping are listed in Table 5 below. Brief descriptions of the most common operations follow the table.

Table 5: Primary and Secondary Shaping Operations

Primary Shaping Operations	Secondary Shaping Operations
Abrasive Jet Machining	Stamping
Casting	Turning
Drawing	Drilling
Electrochemical Machining	Cutting and Shaping
Electron Beam Machining	Milling
Extruding	Reaming
Forging	Threading
Impact Deformation	Broaching
LASER Beam Machining	Grinding
Plasma Arc Machining	Polishing
Pressure Deformation	Planing
Sand Blasting	Deburring
Ultrasonic Machining	

Source: Pollution Prevention Options in Metal Fabricated Products. USEPA, January 1992.

Primary Shaping Operations

The most common primary shaping operations include casting, forging, extruding, rolling, cutting, coining, shearing, drawing, and spinning. Each of these operations is briefly described below.

Metal casting involves the introduction of molten metal into a mold or die having the external shape of the desired cast part. The mold or die is removed when the metal has cooled and solidified. Metal casting operations can be classified as either foundries or diecasters. The primary difference is that foundries pour molten metal relying on gravity to fill the mold and die casters use machines to inject molten metal under pressure into the mold. Foundry molds are typically used only once for each part. They are often made of sand grains bound together with chemicals or clay. Die casting molds are often reused thousands of times and are part of a larger diecasting machine that can achieve very high production rates. Foundries typically produce larger airplane parts such as engine blocks, turbine and compressor parts, and other mechanical parts from both ferrous and non-ferrous metals. Die casters typically produce smaller intricate parts from non-ferrous metals (EPA/OECA, 1995). For a more detailed discussion of metal casting operations see the *Profile of the Metal Casting Industry*, USEPA, 1997.

Once the molten metal is formed into a workable shape, shearing and forming operations are usually performed. Shearing operations cut materials into a desired shape and size, while forming operations bend or form materials into

R0074639

specified shapes. Shearing operations include punching, piercing, blanking, cutoff, parting, and trimming. These operations produce holes, openings, blanks, or parts. Forming operations shape parts by forcing them into a specific configuration, and include bending, extruding, drawing, spinning, coining, and forging. Bending is the simplest forming operation; the part is simply bent to a specific angle or shape and normally produce flat-shapes (EPA/OECA, 1995).

Extruding is the process of forming a specific shape from a solid blank by forcing the blank through a die of the desired shape. Complicated and intricate cross-sectional shapes can be produced by extruding. Rolling is a type of extruding that passes the material through a set or series of rollers that bend and form the part into the desired shape. Coining, another type of extruding, alters the form of the part by changing its thickness, producing a three-dimensional relief on one or both sides of the part, as found on coins (EPA/OECA, 1995).

Drawing and spinning form sheet stock into three-dimensional shapes. Drawing uses a punch to force the sheet stock into a die, where the desired part shape is formed in the space between the punch and die. In spinning, pressure is applied to the sheet while it spins on a rotating form so that the sheet acquires the shape of the form (EPA/OECA, 1995).

Forging operations produce a specific part shape, much like casting. The forging process is used in the aerospace industry when manufacturing parts such as pistons, connecting rods, and the aluminum and steel portion of wheels. However, rather than using molten materials, forging uses externally applied pressure that either strikes or squeezes a heated blank into a die of the required shape. Forging operations use machines that apply repeated hammer blows to a red-hot blank to force the material to conform to the shape of the die opening. Squeezing acts in much the same way, except it uses pressure to squeeze rather than strike the blank. Forging typically uses a series of die cavities to change the shape of the blank in increments. Depending on the shape, a forging die can have from one to over a dozen individual cavities (EPA/OECA, 1995).

Secondary Shaping Operations

Shearing (or cutting) operations include punching, piercing, blanking, cutoff, parting, shearing, and trimming. Basically, these are operations that produce holes or openings, or that produce blanks or parts. The most common hole-making operation is punching. Piercing is similar to punching, but produces a raised-edge hole rather than a cut hole. Cutoff, parting, and shearing are similar operations with different applications: parting produces both a part and scrap pieces; cutoff and shearing produce parts with no scrap; shearing is used where the cut edge is straight; and cutoff produces an edge shape rather than a straight edge. Trimming is performed to shape or remove excess material from the edges of parts (EPA/OECA, 1995).

Turning, drilling, and reaming processes typically use a lathe, which holds and spins the workpiece against the edge of a cutting tool. Drilling machines are designed for making holes and for reaming, or enlarging or finishing existing holes. Milling machines use multiple edge cutters to cut unusual or irregular shapes into the workpiece (EPA/ORD, 1990).

Broaching is a process whereby internal surfaces such as holes of circular, square or irregular shapes, or external surfaces like keyways are finished. A many-toothed cutting tool called a broach is used in this process. The broach's teeth are graded in size in such a way that each one cuts a small chip from the workpiece as the tool is pushed or pulled either past the workpiece surface, or through a leader hole. Broaching of round holes often gives greater accuracy and better finish than reaming (EPA/ORD, 1990).

Deburring involves removing metal shavings and burrs clinging to the cut edges of parts after machining has been completed. Deburring is typically done by one of two processes. Small parts can be deburred in a tumbler where the burrs are smoothed off the part by the constant friction with the tumbling media. This process, however, is not appropriate for long parts. Instead, long parts are scrubbed with an abrasive pad by hand or buffed with a power tool. The buffing operation can be performed either by hand or in an automatic operation (EPA/OAQPS, 1994).

Parts may also be honed and buffed to smooth their surfaces; spray-washed with an alkaline cleaner; and blown dry using compressed air. A protective coating of oil may be applied to parts that are stored on-site or shipped off-site to a heat-treating facility (EPA/NRMRL, 1995).

The metal working process creates much heat and friction. If the heat and friction are not reduced, the tools used in the process are quickly damaged and/or destroyed. Also, the quality of the products made is diminished because of inefficient tools and damage to the product while it is being manufactured. Coolants reduce friction at the tool/substrate interface and transfer heat away from the tools and the material being processed, reducing the time to process the metal, increasing the quality of the workmanship, and increasing tool life. The ability to transfer the heat away from the metal working process is why metal working fluids are often called coolants (Ohio EPA, 1993).

Oils are natural lubricants and provide this quality to coolants that are petroleum-based. Other coolants' ability to reduce friction comes from lubricating additives. During the metal working process, heat diffuses into the coolant. The heated coolant flows off the work area into a collection container or sump, where it cools off and then enters the cycle again. Water has excellent cooling characteristics and many coolants contain water or are primarily water. Soluble oils and semi-synthetic oils have both water and oil components. Coolants containing both oil and water require surfactants to form and maintain emulsions, a mixture of the oil and water, so that both properties can work together (Ohio EPA, 1993).

Heat Treating

Heat treating is the modification of the material's or part's metallurgical properties through the application of controlled heating and cooling cycles. For example, aluminum outer skin panels undergo a low temperature oven bake after forming to provide greater stress tolerance. Heat treating can be performed either before or after machining and includes carburizing (impregnating the surface with carbon), annealing (softening), stress relief, tempering, air furnace treating, and salt pot treating. Chemicals, such as methanol, are often used in heat treating ovens to maintain a chemically reducing atmosphere in order to obtain the proper metallurgical properties on the surface of the part being treated. After heat treating, the parts can either be cooled in ambient air or placed in a liquid quenching bath. The quench bath is typically a glycol solution, a chromate solution, or an oil (EPA/OAQPS, 1994).

Heat-treated parts can also be machined, honed, and deburred after they are returned to the plant. After machining, the parts are typically sprayed with a protective oil coating that controls corrosion until they are further processed (EPA/NRMRL, 1995).

III.A.3. Metal Finishing

Metal finishing and electroplating activities are performed on a number of metals and serve a variety of purposes; the primary purpose being protection against corrosion. Without metal finishing, products made from metals would last only a fraction of their unfinished life-span. Metal finishing alters the surface of metal products to enhance properties such as corrosion resistance, wear resistance, electrical conductivity, electrical resistance, reflectivity, appearance, torque tolerance, solderability, tarnish resistance, chemical resistance, ability to bond to rubber (vulcanizing), and a number of other special properties (e.g. electropolishing sterilizes stainless steel) (EPA/ORD, 1994).

These plating processes involve immersing the article to be coated or plated into a series of baths consisting of acids, bases, salts, etc. A wide variety of materials, processes, and products are used to clean, etch, and plate metallic and non-metallic surfaces. Typically, metal parts or work pieces undergo one or more physical, chemical, and electrochemical processes. Physical processes include buffing, grinding, polishing, and blasting. Chemical processes include degreasing, cleaning, pickling, milling, etching, polishing, and electroless plating. Electrochemical processes include plating, electropolishing, and anodizing (EPA/ORD, 1994).

Cleaning/Preparing

Cleaning

Aerospace components are cleaned frequently during manufacturing to remove contaminants such as dirt, grease, and oil, and to prepare the components for the next operation. Cleaning is important in order to ensure the successful application of later surface treatments. There are three main types of cleaning: aqueous, organic solvent, and abrasive. Aqueous cleaning covers a wide variety of cleaning methods such as detergents, acids, and alkaline compounds to displace soil rather than dissolving it as in organic solvent cleaning. Aqueous cleaners are either sprayed or used in cleaning baths, ultrasonic baths, and in steam cleaning. Three types of aqueous cleaning favored by the aerospace industry are:

- emulsification cleaning- emulsification cleaning uses water-immiscible solvents, surfactants, and emulsifiers.
- acid cleaning- sulfuric acid or hydrochloric acid is used to remove scale from metal; acid cleaning is sometimes known as pickling baths.
- alkaline cleaning- alkaline cleaning solutions (usually hot) contain builders (sodium salts of phosphate, carbonate, and hydroxide) and surfactants (detergents and soap) (CARB, 1997).

Abrasive cleaning is mechanical cleaning using abrasives such as rough fabric scrubbing pads, sandpaper, tumbling barrels, buffing wheels, and blasting equipment. Abrasives may be added to acid or alkaline cleaning solutions to improve cleaning action (CARB, 1997).

Masking

Maskants are coatings that are applied to a part to protect the surface from chemical milling and surface treatment processes such as anodizing, plating, and bonding. Maskants are typically rubber- or polymeric-based substances applied to an entire part or subassembly by brushing, dipping, spraying, or flow coating. Two major types of maskants are used: solvent-based and waterborne. After an adequate thickness of maskant has been applied to the part, the maskant is cured in a bake oven. The maskant is then cut following a specific pattern and manually stripped away from selected areas of the part where metal is to be removed. The maskant remaining on the part protects those areas from the etching solution.

Chemical Milling

R0074643

Chemical milling is used to reduce the thickness of selected areas of metal parts in order to reduce weight. The process is typically used when the size or shape of parts precludes mechanical milling or when chemical milling is advantageous due to shorter processing time or its batch capability. Chemical milling is accomplished by submerging the component in an appropriate etchant. Commonly used etchants are sodium hydroxide for aluminum, nitric acid and hydrofluoric acid for titanium, dilute sulfuric acid for magnesium, and aqua regia (a mixture of nitric and hydrochloric acids) for stainless steel. The depth of the cut is closely controlled by the length of time the component is in the etchant and the concentration of the etchant. When the milling has been completed, the part is removed from the etchant and rinsed with water. Some metals may develop a smutty discoloration during the chemical milling process. A brightening solution, such as dilute nitric acid, is typically used as a final step in the process to remove the discoloration. After desmutting, the part either goes back to chemical milling for further metal removal or to the stripping area to have the maskant removed. The maskant may be softened in a solvent solution and then stripped off by hand (EPA/OAQPS, 1994).

Anodizing

Anodizing uses the piece to be coated, generally with an aluminum surface, as an anode in an electrolytic cell. Anodizing provides aluminum parts with a hard abrasion- and corrosion-resistant film. This coating is porous, allowing it to be dyed or to absorb lubricants. This method is used both in decorative application and in engineering applications such as aircraft landing gear struts. Anodizing is usually performed using either sulfuric, boric-sulfuric, or chromic acid often followed by a hot water bath, though nickel acetate or sodium potassium dichromate seal may also be used (EPA/OECA, 1995).

Passivation

Passivation is a chemical process in which parts are immersed in a solution containing a strong oxidizing agent. This forms a thin oxide layer on the part surface, providing corrosion protection and increasing adhesion of subsequent coatings. It is often used before maskant application in the chemical milling process (EPA/OAQPS, 1994).

Pickling

Pickling is a process of chemical abrasion/etching which prepares surfaces for good paint adhesion. The pickling process is used mainly for preparing pipe systems and small parts for paint. However, the process and qualities will vary by facility. The process involves a system of dip tanks. In pickling steel parts, The first tank is used to remove any oil, grease, flux, and other contaminants on the surface being pickled. The part is then immersed into a 5-8% caustic soda and water mixture (pH 8-13) maintained at temperatures of between 180°-200°F. Next, the steel is dipped into a 6-10% acid/water

R0074644

mixture maintained between 140°-160°F (EPA/OECA, 1997). Most carbon steel is pickled with sulfuric or hydrochloric acid, while stainless steel is pickled with hydrochloric, nitric, and hydrofluoric acids (EPA/OECA, 1995). The fourth tank contains an acid rinse tank that is maintained at a pH of 5-7. Finally, the steel part is immersed in a rust preventative 5% phosphoric mixture. The part is then allowed to fully dry prior to paint application (EPA/OECA, 1997).

Polishing

Polishing is used at some facilities to clean and finish the outer skin of the aircraft. The polish is a lightly abrasive metal cleaner that is buffed on the metal surface, then wiped off. The polish gives a mirror-like surface finish and is usually applied instead of paint. Polishing can also be used on other metal parts as a cleaning step.

Conversion Coatings

Conversion coating is the process of changing a metal's surface characteristics by applying a reactive chemical to the metal's surface or by reacting the metal in a chemical bath. The desired result is improved coating adhesion, increased corrosion resistance, or both (EPA/OAQPS, 1994).

Aluminum surfaces are treated with various conversion coatings depending upon the anticipated environmental conditions or performance requirements such as corrosion, electrochemical insulation, and abrasion. Conversion coatings are also used to enhance bond and paint adhesion. Typical treatments include chromate phosphates, chromate oxides, anodizing, and non-chromate formulations (CARB, 1997).

Cadmium surfaces require either a phosphate or a chromate conversion coating prior to painting. The phosphate conversion is designed to be painted; the chromate conversion is designed to add corrosion resistance to the cadmium and it may also be painted (CARB, 1997).

Magnesium must be treated with a conversion coating or anodized before painting to prevent corrosion and to prevent environmental damage by abrasion. Magnesium coatings utilize sodium dichromate solutions (CARB, 1997).

Titanium must be treated with a conversion coating or anodized to protect it from corrosion and to improve adhesion bonding strength. Emersion baths for applying a conversion coating to titanium typically contain sodium phosphate, potassium fluoride, and hydrofluoric acid (CARB, 1997).

Coating/Painting

A coating is a material that is applied to the surface of a part to form a decorative or functional solid film. Coatings are used for corrosion resistance, aircraft identification and improved visibility, and friction reduction. The most common coatings are nonspecialized primers and topcoats, however there are also many specialized primers that provide characteristics such as fire resistance, flexibility, substrate compatibility, antireflection, sealing, adhesion, and enhanced corrosion protection (EPA/OAQPS, 1997).

Coatings are applied by spraying, brushing, rolling, flow coating, and dipping using a variety of application equipment including conventional air spray, high volume low pressure (HVLP) spray, and electrostatic spray. Many of the conventional methods such as rolling, flow coating, dip coating, and brushing are limited to the size and configuration of the part being painted (CARB, 1997).

Painting involves the application of predominantly organic coatings to a work piece for protective and/or decorative purposes. It is applied in various forms, including dry powder, solvent-diluted formulations, and water-borne formulations. Various methods of application are used, the most common being spray painting and electrodeposition. Electrodeposition is the process of coating a work piece by either making it anodic or cathodic in a bath that is generally an aqueous emulsion of the coating material. When applying the paint as a dry powder, some form of heating or baking is necessary to ensure that the powder adheres to the metal. These processes may result in solvent waste (and associated still bottom wastes generated during solvent distillation), paint sludge wastes, paint-bearing wastewaters, and paint solvent emissions (EPA/OECA, 1995).

Spray painting is a process by which paint is placed into a pressurized cup or pot and is atomized into a spray pattern when it is released from the vessel and forced through an orifice. Differences in spray-painting equipment are based on how the equipment atomizes paint. The more highly atomized the paint, the more likely transfer efficiency is to decrease. Transfer efficiency is the amount of paint applied to the object being painted, divided by the amount of paint used. Highly atomized paint spray can more readily drift away from the painting surface due to forces such as air currents and gravity (Ohio EPA, 1994). Cleaning solvent can only be sprayed through a gun for nonatomized and atomized cleaning using specific equipment as specified in the NESHAP.

The viscosity of paint may need adjustment before it can be sprayed. This is accomplished by reduction with organic solvents, or with water for certain water-based coatings. Using solvents for reduction requires the purchase of additional materials and increases air emissions. An alternative method of reducing the viscosity is to use heat. Benefits from the purchase of paint heaters include lower solvent usage, lower solvent emissions, more consistent viscosities, and faster curing rates (Ohio EPA, 1994).

The following types of spray application equipment may be used in the aerospace industry:

- Conventional Spray
- High-Volume/Low-Pressure (HVLP)
- Airless
- Air-Assisted
- Electrostatics
- Rotary Atomization
- Spray Booths

Electroplating

The metals used in electroplating operations (both common and precious metal plating) include cadmium, lead, chromium, copper, nickel, zinc, gold, and silver. Cyanides are also used extensively in electroplating solutions and in some stripping and cleaning solutions (EPA/OECA, 1995).

Electroless plating is the chemical deposition of a metal coating onto a metal object, by immersion of the object in an appropriate plating solution. In electroless nickel plating, the source of nickel is a salt, and a reducer is used to hold the metal ion in the solution. Immersion plating produces a metal deposit by chemical displacement. Immersion plating baths are usually formulations of metal salts, alkalies, and complexing agents (typically cyanide or ammonia) (EPA/OECA, 1995).

Occasionally, touch-up plating is done on an in-house plating line that consists of six separate tanks for cleaning, rinsing, and plating. Following touch-up plating, the parts are typically cleaned in a cold solvent-cleaning tank (EPA/NRMRL, 1995).

Equipment/Line Cleaning

Spray guns and coating lines used to apply the various coatings used at aerospace facilities must be cleaned when switching from one coating to another and when they are not going to be immediately reused. Spray guns can be cleaned either manually or with enclosed spray gun cleaners. Manual cleaning involves disassembling the gun and placing the parts in a vat containing an appropriate cleaning solvent. The residual paint is brushed or wiped off the parts. After reassembling, the cleaning solvent may be sprayed through the gun for a final cleaning. Paint hoses/coating lines are cleaned by passing the cleaning solvent through the lines until all coating residue is removed. Enclosed spray gun cleaners are self-contained units that pump the cleaning solvent through the gun within a closed chamber. After the cleaning cycle is complete, the guns are removed from the chamber and typically undergo some manual cleaning to remove coating residue from areas not exposed to the cleaning solvent, such as the seals under the atomizing cap (EPA/OAQPS, 1997).

III.A.4. Composites Processing

The aerospace industry is increasingly substituting composites for metals in aircraft and space vehicles due to the superior strength-to-weight ratio, corrosion resistance, and fatigue life of composites. Composites are comprised of a resin matrix that bonds together layers of reinforcing material. The resultant structure has mechanical properties superior to each individual component. The resin matrix is usually a polymeric material such as epoxy, polyester, nylon, or phenolic. The reinforcing material or fiber is usually carbon (graphite), fiberglass, or Kevlar. The fibers are oriented at specific angles within the matrix to achieve desired strength characteristics. Methods of forming composites include: injection molding, compression molding, and hand lay-up (or wet lay-up). Hand lay-up can involve applying resin on pre-woven fibers or can involve stacking thin sheets of pre-impregnated (prepreg) fiber material. Steps in hand lay-up are typically: lay-up, debulking, curing, and tear-down (break-out).

Injection molding is the process of shaping a material by applying heat and utilizing the pressure created by injecting a resin into a closed mold. Compression molding is the process of filling a mold with molding compound, closing the mold, and applying heat and pressure until the material has cured. Lay-up is the process of assembling composite parts by positioning reinforcing material in a mold and impregnating the material with resin. With hand lay-up, reinforcing material with resin or prepreg can be added to an open mold until the design thickness and contours are achieved. Debulking is the simultaneous application of low-level heat and pressure to composite materials to force out excess resin, trapped air, vapor, and volatiles from between the layers of the composite, thus removing voids within the composite.

Curing is the process of changing the resin into a solid material so that the composite part holds its shape. This is accomplished by heating the lay-up assembly in order to initiate a polymerization reaction within the resin. Once the reaction is complete, the resin solidifies and bonds the layers of composite materials together. The curing process is typically performed in an autoclave (a pressurized oven), with the composite lay-up enclosed in a bag so that a vacuum can be applied. The vacuum removes air and volatilized components of the resin from within the composite structure which may otherwise be trapped and create voids. Key parameters for curing are time, pressure, vacuum, temperature, and heating and cooling rates.

Break-out is the removal of the composite materials from the molds or curing fixtures (includes the application of release agents prior to filling the mold).

III.B. Aircraft Assembly

Aircraft assembly requires the coordination of thousands of parts coming together to form one large final product. The total assembly process of a complete aircraft can be close to two years. The relatively small number of finished products does not allow for a great deal of automation in the assembly process. Considerable coordination is needed between materials delivery and the production schedule in order to achieve efficient assembly.

Assembly Equipment

Typical materials handling equipment includes conveyors, cranes, industrial vehicles (e.g., forklifts, flatbeds, carts, special lift vehicles, etc.), and containers (EPA/OECA, 1997). Assembly facilities may also use jigs to aid in lining up or joining pieces.

Assembly jigs are essential for the successful assembly or large aerospace products. Their main function is to identify the precise location of fittings for attachment of one component to another. Assembly jigs should be constructed in a manner which allows them to be removed upon completion of the work without breaking down the entire jig structure. They require materials which will not bend or distort over a period of time or during assembly operations. They must also provide easy access to locations where manual joining operations are needed (Horne, 1986).

Pin jigs are used to assemble the curved sheets that form the outside of the fuselage's curved surface. The pin jig is simply a series of vertical screw jacks that support curved pieces during construction. A pin jig is set up specifically for the curved piece under construction. The jig heights are determined from the engineering drawings and plans (EPA/OECA, 1997).

Specially designed locating jigs are required for skins to which stiffeners are to be riveted, such as airplane wings. Stiffeners are first placed in the jigs and then locked in the required position on the completed wings. Wing skins are then placed on the jig and held to a contoured shape with metal bands in order to make contact with the stringers. Holes are drilled through the skin and stringers by using templates to locate hole positions. When all of the holes have been drilled, they are filled with clamping bolts and the metal bands are released. The skin is taken out of the jig and the clamping bolts hold the skin in the desired shape until it is riveted together (Horne, 1986).

Fuselage assembly operations may follow these steps:

- bond stringers to fuselage skin
- fit formers to assembly jig
- assemble skin, drill flanges, and fit riveting clamps
- replace clamps with rivets and remove panel from the jig
- assemble panels and formers on fuselage assembly jig (Horne, 1986).

Welding/Riveting

Fusion Welding

Fusion welding is performed with a metal arc in the presence of an inert gas which prevents the oxidation of the metals to be welded. An alternating or direct current, depending on the type and thickness of the metal, is typically applied through an electrode. The ideal current and pulse duration is selected according to the wire composition, shielding gas, welding position, and wire size (Horne, 1986).

Resistance Welding

Resistance welding requires: a primary electrical circuit from a transformer; a secondary circuit and electrodes to conduct the current to the desired spot; a mechanical system to hold the components and apply force; and control equipment to measure duration and magnitude of the electrical current. Press-type machines have a moveable welding head and force is applied by air through hydraulic cylinders. Seam welding is performed by power-driven roller electrodes instead of the pointed electrodes used for spot welding. Leak-proof and pressure-tight welds are formed by the seam welding process, where each weld overlaps the previous one (Horne, 1986).

Pre-pressure jig welding uses a jig to clamp the components together to relieve the electrodes from clamping stress. This ensures that the desired electrode pressure is available (Horne, 1986).

Electron Beam Welding

Electron beam welding is achieved by concentrating a beam of high velocity electrons onto the surfaces to be joined. The electrons are produced and accelerated by an electron beam gun which consists of a filament emitter, a bias electrode, and a positively charged anode. The electrons are generated by thermionic emission from a filament. Their attraction to an anode gives them speed and direction, and a bias electrode cup surrounding the emitter electrostatically shapes ejected electrons into a beam. An electromagnetic lens system reconverges the beam once its left the anode and focusses it on the work piece (Horne, 1986).

Riveting

Riveted joints are usually in sheet metal parts where the rivets take a shearing load. Riveted joints may be in single, double, triple, or quadruple rows and either chain or zigzag (Horne, 1986).

Sealing/Bonding

Sealants, predominantly composed of polysulfide, are applied throughout the aerospace vehicle structure primarily to seal out moisture and contaminants. This helps prevent corrosion, particularly on faying (i.e., closely or tightly fitting) surfaces, inside holes and slots, and around installed fasteners. Sealants are also used to seal fuel tanks and pressurized components. They are applied using tubes, spatulas, brushes, rollers, or spray guns. Sealants are often stored frozen and thawed before use, and many are two-component mixtures that cure after mixing. Typically, a sealant is applied before assembly or fastener installation, and the excess is squeezed out or extruded from between the parts as the assembly is completed. This ensures a moisture-tight seal between the parts (EPA/OAQPS, 1997).

Adhesive bonding involves joining together two or more metal or nonmetal components. This process is typically performed when the joints being formed are essential to the structural integrity of the aerospace vehicle or component. Bonding surfaces are typically roughened mechanically or etched chemically to provide increased surface area for bonding and then treated chemically to provide a stable corrosion-resistant oxide layer. The surfaces are then thinly coated with an adhesive bonding primer to promote adhesion and protect from subsequent corrosion. Structural adhesives are applied as either a thin film or as a paste. The parts are joined together and cured either at ambient temperature, in an oven, or in an autoclave to cure the adhesive and provide a permanent bond between the components (EPA/OAQPS, 1997).

Nonstructural adhesives are used to bond materials that are not critical to the structural integrity of the aerospace vehicle or component, such as gaskets around windows and carpeting or to nonstructurally joined components. These adhesives are applied using tubes, brushes, and spray guns (EPA/OAQPS, 1997).

Testing

A wide variety of tests are performed by the aerospace industry to verify that parts meet manufacturing specifications. Leak tests are performed on assemblies such as wing fuel tanks. These parts are filled with an aqueous solution or a gas to check seams and seals. Dye penetrant is used following chemical milling and other operations to check for cracks, flaws, and fractures. Many different kinds of penetrants, fluids, dyes, and etchants can be applied to the surface of metal parts to aid in the detection of defects. Hydraulic and fuel system checks are other typical testing operations. Weight checks are performed to verify the balance of certain structures, such as propeller blades and vertical tail rudders. Some critical areas on the assembled components are checked for flaws, imperfections, and proper alignment of parts by X-ray (EPA/OAQPS, 1994).

III.C. Repair/Rework Operations

Repair operations generally include all conversions, overhauls, maintenance programs, major damage repairs, and minor equipment repairs. Although specific repair methods vary from job to job, many of the operations are identical to new construction operations. Repair operations, however, are typically on a smaller scale and are performed at a faster pace. Jobs can last anywhere from one day to over a year. Repair jobs often have severe time constraints requiring work to be completed as quickly as possible in order to get the aircraft, missile, or space vehicle back in service. In many cases, piping, ventilation, electrical, and other machinery are prefabricated prior to the major product's arrival. Typical maintenance and repair operations include:

- Cleaning and repainting the aircraft's surfaces, superstructure, and interior areas
- Major rebuilding and installation of equipment such as turbines, generators, etc.
- Systems overhauls, maintenance, and installation
- System replacement and new installation of systems such as navigational systems, combat systems, communication systems, etc.
- Propeller and rudder repairs, modification. and alignment (EPA/OECA, 1997)

The depainting operation involves the removal of coatings from the outer surface of the aircraft. The two basic types are chemical depainting and blast depainting. Methylene chloride is the most common chemical stripper solvent; however, the particular solvent used is highly dependent on the type of coating to be removed. Chemical depainting agents are applied to the aircraft, allowed to degrade the coating, and then scraped or washed off with the coating residue. Blast depainting methods utilize a media such as plastic, wheat starch, carbon dioxide (dry ice), or high pressure water to remove coatings by physically abrading the coatings from the surface of the aircraft. Grit blasting and sand/glass blasting are also included in this category. High intensity ultraviolet light stripping has been developed for use in conjunction with carbon dioxide methods and is under development at several facilities (EPA/OAQPS, 1994). However, FAA has strict guidelines for safety and quality control purposes which dictate the types of solvents and materials that may be used in aerospace operations. Thus, any alternative must go through a comprehensive study before it is approved for use. *(See Section V- Pollution Prevention Opportunities)*

In addition, some larger facilities are capable of large repair and conversion projects that could include: converting passenger planes to cargo planes, replacing segments of an aircraft that has been damaged, structural reconfiguration and outfitting of combat systems, major remodeling of interiors or exteriors (EPA/OECA, 1997).

III.D. Space Vehicles and Guided Missiles

Many of the industrial processes involved in the production of space vehicles and guided missiles are similar to those discussed above in the production of aircraft parts and assembly. Because the number of establishments involved in the production of space vehicles, guided missiles, and their associated parts is less than 10 percent of the total industry, no additional information on industrial processes will be presented here. Also, due to the confidential nature of some of these products, there is little information available on production technologies.

III.E. Raw Materials Inputs and Pollution Outputs

The Aerospace Industries Association estimates that there are 15,000 to 30,000 different materials used in manufacturing, many of which may be potentially toxic, highly volatile, flammable, contain chloroflourocarbons, or contribute to global warming (AIA, 1994). Material inputs for aerospace manufacturing include metals, solvents, paints and coatings, and plastics, rubbers, and fabrics. Metals used in manufacturing include steel, aluminum, titanium, and many specialty alloys. There is also a wide variety of paints, solvents, and coatings available to the aerospace industry. Many of these materials are specifically required by FAA guidelines.

Pollutants from metal fabricating processes are dependant on the metal and machining techniques being used. Larger pieces of scrap metal are usually recovered and reintroduced to the process, while smaller shavings may be sent off-site for disposal or recovery.

Surface preparation operations generate wastes contaminated with solvents and/or metals depending on the type of cleaning operation. Degreasing operations may result in solvent-bearing wastewaters, air emissions, and materials in solid form. Chemical surface treatment operations can result in wastes containing metals. Alkaline, acid, mechanical, and abrasive cleaning methods can generate waste streams such as spent cleaning media, wastewaters, and rinse waters. Such wastes consist primarily of the metal complexes or particles, the cleaning compound, contaminants from the metal surface, and water. In many cases, chemical treatment operations are used in conjunction with organic solvent cleaning systems. As such, many of these wastes may be cross-contaminated with solvents (EPA/OECA, 1995).

Surface finishing and related washing operations account for a large volume of wastes associated with aerospace metal finishing. Metal plating and related waste account for the largest volumes of metal (e.g., cadmium, chromium, copper, lead, mercury, and nickel) and cyanide bearing wastes (EPA/OECA, 1995).

Air Emissions

Air emissions, primarily volatile organic compounds (VOCs), result mainly from the sealing, painting, depainting, bonding, finishing application processes including material storage, mixing, applications, drying, and cleaning. These emissions are composed mainly of organic solvents which are used as carriers for the paint or sealant and as chemical coating removers. Most aerospace coatings are solvent-based, which contain a mixture of organic solvents, many of which are VOC's. The most common VOC solvents used in coatings are trichloroethylene, 1,1,1-trichloroethane, toluene, xylene, methyl ethyl ketone, and methyl isobutyl ketone. The most common VOC solvent used for coating removal is methylene chloride. The VOC content ranges differ for the various coating categories. Air emissions from cleaning and degreasing operations may result through volatilization during storage, fugitive losses during use, and direct ventilation of fumes. Releases to the air from metal shaping processes contain products of combustion (such as fly ash, carbon, metallic dusts) and metals and abrasives (such as sand and metallic particulates).

Wastewater

Wastewater is produced by almost every stage of the manufacturing process. Metalworking fluids, used in machining and shaping metal parts, are a common source of wastewater contamination. Metalworking fluids can be petroleum-based, oil-water emulsions, or synthetic emulsions that are applied to either the tool or the metal being tooled to facilitate the shaping operation. Waste cooling waters can be contaminated with metalworking fluids (EPA/OECA, 1995).

Surface preparation, cleaning, and coating removal often involves the use of solvents which can also contribute to wastewater pollution. The nature of the waste will depend upon the specific cleaning application and manufacturing operation. Solvents may be rinsed into wash waters and/or spilled into floor drains (EPA/OECA, 1995).

Wastewater may also be generated in operations such as quenching and deburring. Such wastewater can be high in oil and suspended solids. Wastewater from metal casting and shaping mainly consists of cooling water and wet scrubber effluent. The scrubber water is typically highly alkaline (EPA/OECA, 1997).

Wastewater contaminated with paints and solvents may be generated during equipment cleaning operations; however, water is typically only used in cleaning water-based paints. Wastewater is also generated when water curtains (water wash spray booths) are used during painting. Wastewater from painting water curtains commonly contains organic pollutants as well as certain metals (EPA/OECA, 1997).

Electroplating operations can result in solid and liquid waste streams that contain toxic constituents. Aqueous wastes result from work piece rinses and process cleanup waters. In addition to these wastes, spent process solutions and quench baths are discarded periodically when the concentrations of contaminants inhibit proper function of the solution or bath. When discarded, process baths usually consist of solid-phase and liquid-phase wastes that may contain high concentrations of toxic constituents, especially cyanide. Rinse water from the electroplating process may contain zinc, lead, cadmium, or chromium (EPA/OECA, 1995).

Solid/Hazardous/Residual Waste

Solid, hazardous, and residual wastes generated during aerospace manufacturing include contaminated metalworking fluids, scrap metal, waste containers, and spent equipment or materials. Scrap metal is produced by metal shaping operations and may consist of metal removed from the original piece (e.g., steel or aluminum). Scrap may be reintroduced into the process as a feedstock or recycled off-site.

Various solid and liquid wastes, including waste solvents, blast media, paint chips, and spent equipment may be generated throughout painting and depainting operations. These solid and liquid wastes are usually the result of the following operations:

- Paint applications- paint overspray caught by emissions control devices (e.g., paint booth collection systems, ventilation filters, etc.)
- Depainting- spent blast media, chips, and paint and solvent sludges
- Cleanup operations- cleaning of equipment and paint booth area
- Disposal- discarding of leftover and unused paint as well as containers used to hold paints, paint materials, and overspray

Solvents are also used during cleanup processes to clean spray equipment between color changes, and to clean portions of the spray booth. The solvent utilized during cleaning is generally referred as "purge solvent" and is often composed of a mixture of dimethyl-benzene, 2-propanone (acetone), 4-methyl-2-pentanone, butyl ester acetic acid, light aromatic solvent naphtha, ethyl benzene, hydrotreated heavy naphtha, 2-butanone, toluene, and 1-butanol (EPA/OECA, 1995).

Metalworking fluids typically become contaminated and spent with extended use and reuse. When disposed, these oils may contain toxics, including metals (cadmium, chromium, and lead), and therefore must be tested to determine if they are considered a RCRA hazardous waste. Many fluids may contain chemical additives such as chlorine, sulfur, phosphorous compounds, phenols, cresols, and alkalines. In the past, such oils have commonly been mixed with used cleaning fluids and solvents (including chlorinated solvents) (EPA/OECA, 1995).

If metal coating operations use large quantities of molding sand, spent sand may be generated. The largest waste by volume from metal casting operations is waste sand. Other residual wastes may include dust from dust collection systems, slag, and off-spec products. Dust collected in baghouses may include zinc, lead, nickel, cadmium, and chromium. Slag is a glassy mass composed of metal oxides from the melting process, melted refractories, sand, and other materials (EPA/OECA, 1997).

Centralized wastewater treatment systems are common and can result in solid-phase wastewater treatment sludges. Any solid wastes (e.g., wastewater treatment sludges, still bottoms, cleaning tank residues, machining fluid residues, etc.) generated by the manufacturing process may also be contaminated with solvents (EPA/OECA, 1995).

Table 6 summarizes the material inputs and pollutant outputs from the various aerospace manufacturing operations.

Table 6: Material Input and Pollutant Outputs

Process	Material Input	Air Emissions	Wastewater	Solid/Hazardous/ Residual Wastes
Metal Shaping	Cutting oils, degreasing and cleaning solvents, acids, metals	Solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)	Acid/alkaline wastes (e.g., hydrochloric, sulfuric, and nitric acids), waste coolant water with oils, grease, and metals	Scrap metal, waste solvents
Grinding/ Polishing	Metals, abrasive materials, machining oils	Metal shavings/ particulates, dust from abrasive materials	Wastewaters with oil, grease, and metal from machining	Abrasive waste (e.g., aluminum oxide, silica, metal), metal shavings, dust
Plating	Acid/alkaline solutions, metal bearing and cyanide bearing solutions	Volatized solvents and cleaners	Waste rinse water containing acids/alkalines cyanides, and solvents	Metal wastes, solvent wastes, filter sludges (silica, carbides) wasted plating material (copper, chromium, and cadmium)
Painting	Solvent based or water based paints	Paint overspray, solvents	Cleaning water containing paint and stripping solutions	Waste paint, empty containers, spent paint application equipment
Cleaning, depainting, and vapor degreasing	Acid/alkaline cleaners and solvents	Solvent wastes, acid aerosols, paint chips and particulates	Wastewater containing acids/alkalines, spent solvents	Spent solvents, paint/solvent sludges, equipment and abrasive materials, paint chips

Source: *Pollution Prevention Assessment for a Manufacturer of Aircraft Landing Gear,* EPA, August 1995 and Guides to Pollution Prevention, *The Fabricated Metal Products Industry*, EPA, July 1990.

R0074657

III.F. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of Toxic Release Inventory (TRI) chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1994-1997 and are meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention and compliance assistance activities.

While the quantities reported for 1995 and 1996 are estimates of quantities already managed, the quantities listed by facilities for 1997 and 1998 are projections only. The PPA requires these projections to encourage facilities to consider future source reduction, not to establish any mandatory limits. Future-year estimates are not commitments that facilities reporting under TRI are required to meet

Table 7 shows that the TRI reporting aerospace facilities managed about 37 million pounds of production related wastes (total quantity of TRI chemicals in the waste from routine production operations in column B) in 1996. Production related wastes were projected to continue to decrease slightly in 1997 and 1998. Note that the effects of production increases and decreases on the quantities of wastes generated are not evaluated here, but production has generally been increasing in recent years.

In 1995, about 34 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns C, D, and E, respectively. This decreased to 25 percent in 1996 and was expected to slightly increase to over 30 percent in 1998. The majority of these on-site managed wastes were recycled on-site in 1995. About 39 percent of the industry's TRI wastes were transferred off-site for recycling, energy recovery, or treatment as shown in columns F, G, and H. This increased to 50 percent in 1996. Most of the off-site managed wastes were recycled as well. The remaining portion of the production related wastes, shown in column I, (31 percent in 1995 and 27 percent in 1996) is either released to the environment through direct discharges to air, land, water, and underground injection, or is transferred off-site for disposal.

Table 7: Source Reduction and Recycling Activity for Aerospace Manufacturers Facilities (SICs 372 or 376) as Reported within TRI

A	B	On-Site			Off-Site			I
		C	D	E	F	G	H	
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	% Released and Disposed[c] Off-site
1995	40.6	22%	0%	12%	26%	3%	10%	31%
1996	36.5	14%	0%	11%	36%	4%	10%	27%
1997	35.2	14%	0%	12%	36%	4%	10%	24%
1998	33.3	19%	0%	12%	33%	3%	10%	21%

Source: *1996 Toxics Release Inventory Database.*
[a] Within this industry sector, non-production related waste < 1% of production related wastes for 1995.
[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes.
[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

R0074659

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. For industries that are required to report, the best source of comparative pollutant release information is the Toxic Release Inventory (TRI). A component of the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20 through 39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1996) TRI reporting year (which includes over 600 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries. TRI data provide the type, amount and media receptor of each chemical released or transferred.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1996 Toxic Release Inventory Public Data Release, reported onsite releases of toxic chemicals to the environment decreased by 5 percent (111.6 million pounds) between 1995 and 1996 (not including chemicals added and removed from the TRI chemical list during this period). Reported releases dropped by 48 percent between 1988 and 1996. Reported transfers of TRI chemicals to off-site locations increased by 5 percent (14.3 million pounds) between 1995 and 1996. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

Certain limitations exist regarding TRI data. Within some sectors, (e.g. dry cleaning, printing and transportation equipment cleaning) the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. For these sectors, release information from other sources has been included.

Reported chemicals are limited to the approximately 600 TRI chemicals. A portion of the emissions from aerospace facilities, therefore, are not captured by TRI.

In addition, many facilities report more than one SIC code reflecting the multiple operations carried out on-site. Therefore, reported releases and transfers may or may not all be associated with the industrial operations described in this notebook.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released or the potential exposure to surrounding populations. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by the industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) code, a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

R0074661

Releases -- are on-site discharges of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, vents, ducts, or pipes. Fugitive emissions include equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Releases due to runoff, including storm water runoff, are also reportable to TRI.

Releases to Land -- occur within the boundaries of the reporting facility. Releases to land include disposal of toxic chemicals in landfills, land treatment/application farming, surface impoundments, and other disposal on land (such as spills, leaks, or waste piles).

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal. Wastes containing TRI chemicals are injected into either Class I wells or Class V wells. Class I wells are used to inject liquid hazardous wastes or dispose of industrial and municipal wastewaters beneath the lowermost underground source of drinking water. Class V wells are generally used to inject non-hazardous fluid into or above an underground source of drinking water. TRI reporting does not currently distinguish between these two types of wells, although there are important differences in environmental impact between these two methods of injection.

Transfers -- are transfers of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. Chemicals reported to TRI as transferred are sent to off-site facilities for the purpose of recycling, energy recovery, treatment, or disposal. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, the reported quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewater transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment or removal of a chemical from the wastewater depends on the nature of the chemical, as well as the treatment methods present at the POTW. Not all TRI chemicals can be treated or removed by a POTW. Some chemicals, such as metals, may be removed but not destroyed and may be disposed of in landfills or discharged to receiving waters.

Transfers to Recycling -- are wastes sent off-site for the purposes of regenerating or recovery by a variety of recycling methods, including solvent recovery, metals recovery, and acid regeneration. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site to be treated through a variety of methods, including neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal, generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Aerospace Industry

This section summarizes TRI data of aerospace facilities reporting SIC codes within 372 and 376 as the primary SIC code for the facility.

According to the 1996 Toxics Release Inventory (TRI) data, 199 aerospace facilities released (to the air, water, or land) and transferred (shipped off-site or discharged to sewers) a total of approximately 27 million pounds of 65 different toxic chemicals during calendar year 1996. This represents approximately one half of one percent of the 5.6 billion pounds of releases and transfers from all manufacturers (SICs 20-39) reporting to TRI that year. Facilities released an average of 43,862 pounds per facility and transferred and average of 93,503 pounds per facility. The top four chemicals released by weight are solvents-- methyl ethyl ketone, 1,1,1-trichloroethane, trichloroethylene, and toluene. These four account for about 66 percent (5.8 million pounds) of the industry's total releases. Nickel, chromium, sulfuric acid, and methyl ethyl ketone were the four top chemicals transferred by weight. These four account for 55 percent (10.2 million pounds) of the total TRI chemicals transferred by the aerospace industry. Only 22 percent of the 65 chemicals reported to TRI as releases or transfers were reported by more than 10 facilities, evidence of the many different materials used by the industry and the variance between facilities on choice of these materials.

Releases

Table 8 presents the number and weights of chemicals released by aerospace facilities reporting SIC 372 and 376. The total quantity of releases was 8.7 million pounds or 32 percent of the total weight of chemicals released and transferred. The vast majority of air releases were solvents. Air emissions account for 98 percent of total releases, 44 percent as fugitive air emissions and 54 percent as point air releases. Methyl ethyl ketone was the top chemical released by the aerospace industry, accounting for 25 percent of total releases. Releases of 1,1,1-trichloroethane were the second greatest, representing 20 percent of the total. Twenty-four percent of fugitive air emissions were of 1,1,1-trichloroethane, and 32 percent of the point air releases were methyl ethyl ketone. Nitrate compounds accounted for 74 percent of water discharges.

Transfers

Table 9 presents the number and weights of chemicals transferred off-site by aerospace facilities reporting SIC 372 or 376 in 1996. The total amount of transfers was 18.6 million pounds or 68 percent of the total releases and transfers reported to the 1996 TRI by aerospace facilities. Transfers to recycling facilities accounted for the largest percentage, 70 percent, of transfers. The next greatest percentage was 17 percent to treatment facilities. The majority of transfers consisted of metals, spent acids, and solvents. Sixty-six percent (12.3 million pounds) of the total transfers were metals. Nickel represented the largest quantity of transfers, 5.3 million pounds or 29 percent of the total. Chromium composed the second largest quantity of transfers with 12 percent of the total. The chemical with the largest quantity of releases, methyl ethyl ketone, accounted for about 6 percent of the total transfers.

Table 8: 1996 TRI Releases for Aerospace Chemicals Facilities (SICs 372 or 376), By Number of Facilities Reporting (Releases Reported in Pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Methyl Ethyl Ketone	67	704,499	1,484,499	505	0	0	2,189,503	32,679
Nitric Acid	58	7,530	57,219	165	0	0	64,914	1,119
Nickel	48	15,778	8,421	972	0	20,557	45,728	953
Chromium	39	12,829	2,813	1,322	0	3,343	20,307	521
1,1,1-trichloroethane	36	938,383	769,346	5	0	11,280	1,719,014	47,750
Trichloroethylene	29	671,880	268,358	11	0	2,640	942,889	32,513
Chromium Compounds	25	1,685	9,815	422	0	15,866	27,788	1,112
Toluene	23	129,305	776,295	260	0	4,128	909,988	39,565
Tetrachloroethylene	21	237,547	388,663	34	0	0	626,244	29,821
Dichloromethane	20	591,048	99,403	18	0	0	690,469	34,523
Cobalt	18	740	1,905	476	0	2,774	5,895	328
Hydrogen Fluoride	16	2,841	14,889	0	0	0	17,730	1,108
Ammonia	14	3,166	205,300	21,646	0	0	230,112	16,437
Copper	12	311	255	26	0	0	592	49
Nitrate Compounds	10	145	499	77,000	0	0	77,644	7,764
Xylene (Mixed Isomers)	10	15,356	211,057	55	0	0	226,468	22,647
Nickel Compounds	9	265	616	58	0	0	939	104
Phosphoric Acid	9	923	1,301	0	0	0	2,224	247
Methanol	8	13,247	32,566	0	0	0	45,813	5,727
Aluminum (Fume or Dust)	8	282	112	0	0	0	394	49
Sulfuric Acid (1994 and after "Acid Aerosols" Only)	8	16	331	0	0	0	347	43
Hydrochloric Acid (1995 and after "Acid Aerosols" Only)	7	190,257	54,062	0	0	0	244,319	34,903
Diisocyanates	6	390	230	0	0	0	620	103
Certain Glycol Ethers	6	11,170	10,785	0	0	0	21,955	3,659
Freon 113	6	114,487	34,782	0	0	0	149,269	24,878
Methyl Isobutyl Ketone	6	26,191	78,205	0	0	0	104,396	17,399
Phenol	6	118	2,997	0	0	0	3,115	519
Lead	6	0	200	4	0	0	204	34
Manganese	5	15	11	250	0	0	276	55
Copper Compounds	4	0	281	543	0	0	824	206
Cobalt Compounds	3	0	250	0	0	0	250	83
Cyanide Compounds	3	0	0	0	0	0	0	0
Lead Compounds	3	65	96	0	0	0	161	54
Benzene	3	16,997	119,768	0	0	0	136,765	45,588
Naphthalene	3	65,993	250	0	0	0	66,243	22,081
Aluminum Oxide (Fibrous Forms)	3	290	784	0	0	45,000	46,074	15,358
Chlorine	3	0	0	98	0	0	98	33
Manganese Compounds	2	15	45	0	0	0	60	30
Zinc Compounds	2	0	250	0	0	0	250	125
Methyl Methacrylate	2	2,951	1,400	0	0	0	4,351	2,176
Styrene	2	11,488	16,500	0	0	0	27,988	13,994
Antimony	2	0	0	0	0	0	0	0
Zinc (Fume or Dust)	2	5	5	18	0	0	28	14
Antimony Compounds	1	5	4	0	0	0	9	9
Barium Compounds	1	0	1	0	0	0	1	1
Polychlorinated Alkanes	1	0	0	0	0	0	0	0
Formaldehyde	1	0	0	0	0	0	0	0
Isopropyl Alcohol (Manufacturing, Strong-acid Process Only, No Supplies)	1	90	2,172	0	0	0	2,262	2,262
N,n-dimethylformamide	1	250	250	0	0	0	500	500
N-butyl Alcohol	1	0	15,233	0	0	0	15,233	15,233
Bromotrifluoromethane	1	1,641	0	0	0	0	1,641	1,641
Trichlorofluoromethane	1	3,500	430	0	0	0	3,930	3,930
Sec-butyl Alcohol	1	14,000	8,800	0	0	0	22,800	22,800
Picric Acid	1	0	0	0	0	0	0	0
Biphenyl	1	0	0	0	0	0	0	0
1,2-dichlorobenzene	1	0	1,400	0	0	0	1,400	1,400
Ethylbenzene	1	0	0	0	0	0	0	0
Ethylene Glycol	1	0	0	0	0	0	0	0
Cyclohexane	1	0	904	0	0	0	904	904
Methyl Tert-butyl Ether	1	1,200	0	0	0	0	1,200	1,200
1,1-dichloro-1-fluoroethane	1	22,000	0	0	0	0	22,000	22,000
Mercury	1	0	0	0	0	0	0	0
Silver	1	0	0	0	0	0	0	0
Sodium Nitrite	1	250	4,200	0	0	0	4,450	4,450
Aluminum Phosphide	1	0	0	0	0	0	0	0
	199**	3,831,144	4,687,958	103,888	0	105,588	8,728,578	43,862

**Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

R0074665

Table 9: 1996 TRI Transfers for Aerospace Chemicals Facilities (SICs 372 or 376), By Number of Facilities Reporting (Transfers Reported in Pounds/year)

Chemical Name	# Reporting Chemical	Potw Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
Methyl Ethyl Ketone	67	10,350	2,368	85,457	98,407	905,400	1,101,982	16,447
Nitric Acid	58	50,018	13,963	122,824	741,790	0	928,595	16,010
Nickel	48	1,201	59,938	5,220,398	66,968	0	5,348,505	111,427
Chromium	39	906	23,073	2,130,107	46,840	423	2,201,349	56,445
1,1,1-trichloroethane	36	13	19,879	188,170	45,743	39,549	293,354	8,149
Trichloroethylene	29	10	215	154,717	55,071	5,542	215,555	7,433
Chromium Compounds	25	3,140	50,811	540,602	145,257	6,560	746,370	29,855
Toluene	23	25	5,244	13,660	18,302	153,115	190,346	8,276
Tetrachloroethylene	21	16	88	224,131	4,397	14,438	243,070	11,575
Dichloromethane	20	30	3,684	4,932	50,424	90,028	149,098	7,455
Cobalt	18	564	11,683	716,388	4,103	0	732,738	40,708
Hydrogen Fluoride	16	534	0	41,234	89,974	0	131,742	8,234
Ammonia	14	5	0	7,475	1,355	0	8,835	631
Copper	12	406	39,121	770,166	332	0	810,025	67,502
Nitrate Compounds	10	357,214	106,700	112	92,382	0	556,408	55,641
Xylene (Mixed Isomers)	10	0	160	7,420	27,148	26,723	61,451	6,145
Nickel Compounds	9	325	30,566	481,291	5,703	0	525,531	58,392
Phosphoric Acid	9	2,291	20,725	20,304	1,100	0	44,420	4,936
Methanol	8	0	2	24	295	25,192	25,513	3,189
Aluminum (Fume or Dust)	8	0	10,401	80,089	8,950	0	99,440	12,430
Sulfuric Acid (1994 and after "Acid Aerosols" Only)	8	250	55,261	0	1,490,000	0	1,545,511	193,189
Hydrochloric Acid (1995 and after "Acid Aerosols" Only)	7	250	77	0	250	0	577	82
Diisocyanates	6	0	0	51,000	15,050	0	66,050	11,008
Certain Glycol Ethers	6	23,200	505	2,505	925	15,113	42,248	7,041
Freon 113	6	0	0	2,224	5,900	690	8,814	1,469
Methyl Isobutyl Ketone	6	6	561	56	11,709	25,774	38,106	6,351
Phenol	6	15	939	0	16,859	16,487	34,300	5,717
Lead	6	250	2,543	942,255	3,550	5	948,603	158,101
Manganese	5	10	255	107,855	0	0	108,120	21,624
Copper Compounds	4	98	13,642	290,391	122	0	304,253	76,063
Cobalt Compounds	3	268	0	86,360	5	0	86,633	28,878
Cyanide Compounds	3	12	4,603	0	6,380	0	10,995	3,665
Lead Compounds	3	42	941	252,145	50,094	0	303,222	101,074
Benzene	3	0	0	0	0	0	0	0
Naphthalene	3	0	0	5	0	250	255	85
Aluminum Oxide (Fibrous Forms)	3	0	127,153	0	0	0	127,153	42,384
Chlorine	3	0	27	0	0	146	173	58
Manganese Compounds	2	0	3,600	170,481	6,550	0	180,631	90,316
Zinc Compounds	2	250	0	24,000	0	0	24,250	12,125
Methyl Methacrylate	2	0	0	16,000	0	0	16,000	8,000
Styrene	2	0	0	0	0	1,553	1,553	777
Antimony	2	0	5	135,000	1,958	0	136,963	68,482
Zinc (Fume or Dust)	2	251	90	14,000	0	0	14,341	7,171
Antimony Compounds	1	0	6,700	35,000	2	0	41,702	41,702
Barium Compounds	1	0	0	550	0	0	550	550
Polychlorinated Alkanes	1	0	0	0	23,495	15,079	38,574	38,574
Formaldehyde	1	0	0	0	0	0	0	0
Isopropyl Alcohol (Manufacturing, Strong-acid Process Only, No Supplies)	1	0	0	0	0	0	0	0
N,n-dimethylformamide	1	0	820	250	0	0	1,070	1,070
N-butyl Alcohol	1	0	209	0	460	5,025	5,694	5,694
Bromotrifluoromethane	1	0	0	0	0	0	0	0
Trichlorofluoromethane	1	0	0	8,300	0	0	8,300	8,300
Sec-butyl Alcohol	1	0	0	0	0	0	0	0
Picric Acid	1	0	0	0	0	0	0	0
Biphenyl	1	0	0	0	0	0	0	0
1,2-dichlorobenzene	1	0	0	0	9,200	0	9,200	9,200
Ethylbenzene	1	0	0	0	0	0	0	0
Ethylene Glycol	1	30,613	0	0	0	0	30,613	30,613
Cyclohexane	1	0	0	0	0	40,268	40,268	40,268
Methyl Tert-butyl Ether	1	0	0	0	0	0	0	0
1,1-dichloro-1-fluoroethane	1	0	0	0	460	0	460	460
Mercury	1	0	0	0	0	0	0	0
Silver	1	0	0	0	0	0	0	0
Sodium Nitrite	1	0	17,600	0	0	0	17,600	17,600
Aluminum Phosphide	1	0	0	0	0	0	0	0
	199**	482,563	634,152	12,947,878	3,147,510	1,387,360	18,607,109	93,503

**Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

R0074666

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases only and not transfers. The top reporting facilities for the aerospace industry are listed below in Tables 10 and 11. Facilities that have reported the primary SIC codes covered under this notebook appear on the first list. Table 11 contains additional facilities that have reported the SIC codes covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. However, only one additional facility appears on the second list, implying that the processes directly relating to the production of aerospace equipment is responsible for releases and transfers reported by aerospace facilities. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Table 10: Largest Quantity TRI Releasing Facilities Reporting Only 372 or 376 SIC Codes to TRI[1]

Rank	Facility	SIC Codes Reported in TRI	Total TRI Releases in Pounds
1	Boeing Commercial Airplane, Everett, WA	3721	784,581
2	Chem-fab Corp., Hot Springs, AR	3728	433,630
3	Raytheon Aircraft Co., Wichita, KS	3721	393,324
4	Douglas Aircraft Co.*, Long Beach, CA	3721	347,420
5	Pemco Aeroplex Inc., Birmingham, AL	3721	330,130
6	Thiokol Propulsion Group, Promontory,	3764	330,000
7	U.S. Air Force Plant 06 GA, Marietta, GA	3721	305,149
8	Cessna Aircraft, Wichita, KS	3721	266,709
9	Aerostructures Corp., Nashville, TN	3728, 3769	252,299
10	Menasco, Euless, TX	3728	240,000
	TOTAL		3,683,242

Source: *US EPA Toxics Release Inventory Database, 1996.*
*Douglas Aircraft Co. is now part of The Boeing Company.

[1] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Table 11: Largest Quantity TRI Releasing Facilities Reporting Aerospace SIC Codes to TRI[2]			
Rank	Facility	SIC Codes Reported in TRI	Total TRI Releases in Pounds
1	Boeing Wichita, Wichita, KS	3728,3679,3721,3724	1,254,080
2	Boeing Commercial Airplane, Everett, WA	3721	784,581
3	Chem-fab Corp., Hot Springs, AR	3728	433,630
4	Raytheon Aircraft Co., Wichita, KS	3721	393,324
5	Douglas Aircraft Co., Long Beach, CA	3721	347,420
6	Pemco Aeroplex Inc., Birmingham, AL	3721	330,130
7	Thiokol Propulsion Group, Promontory,	3764	330,000
8	U.S. Air Force Plant 06 GA, Marietta, GA	3721	305,149
9	Cessna Aircraft, Wichita, KS	3721	266,709
10	Aerostructures Corp., Nashville, TN	3728, 3769	252,299
	TOTAL		4,697,322

Source: *US EPA Toxics Release Inventory Database, 1996.*
*Douglas Aircraft Co. is now part of The Boeing Company.

[2] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1995 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reduction over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult these sources for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the Hazardous Substances Data Bank (HSDB) and the Integrated Risk Information System (IRIS). The discussions of toxicity describe the range of possible adverse health effects that have been found to be associated with exposure to these chemicals. These adverse effects may or may not occur at the levels released to the environment. Individuals interested in a more detailed picture of the chemical concentrations associated with these adverse effects should consult a toxicologist or the toxicity literature for the chemical to obtain more information. The effects listed below must be taken in context of these exposure assumptions that are explained more fully within the full chemical profiles in HSDB. For more information on TOXNET[3] , contact the TOXNET help line at 1-800-231-3766.

1,1,1-Trichloroethane (CAS: 71-55-6)

Sources. 1,1,1-Trichloroethane is used as an equipment and parts cleaning and degreasing solvent in aerospace manufacturing and is also used as a paint solvent.

[3] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

Toxicity. Repeated contact of 1,1,1-Trichloroethane (TCA) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCA causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCA leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsion and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCA to surface water or land will almost entirely volatilize. Releases of TCA to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCA degrades very slowly by photo oxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCA that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCA does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Physical Properties. TCA is a clear, colorless liquid with a mild, chloroform-like odor and slight solubility.

Methyl Ethyl Ketone (CAS: 78-93-3)

Sources. Methyl ethyl ketone (MEK) is used as an equipment and parts cleaning and degreasing solvent and as a paint solvent.

Toxicity. Breathing moderate amounts of methyl ethyl ketone for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes, nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. EPA does not consider methyl ethyl ketone to be a carcinogen.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a clear, colorless, flammable liquid which decomposes explosively at 230°F. It has a fragrant mint-like odor detectable at 2 to 85 parts per million.

Trichloroethylene (CAS: 79-01-6)

Sources. Trichloroethylene is used extensively as an equipment and parts cleaning and degreasing solvent and as a paint solvent.

Toxicity. Trichloroethylene was once used as an anesthetic, though its use caused several fatalities due to liver failure. Short term inhalation exposure to high levels of trichloroethylene may cause rapid coma followed by eventual death from liver, kidney, or heart failure. Short-term exposure to lower concentrations of trichloroethylene causes eye, skin, and respiratory tract irritation. Ingestion causes a burning sensation in the mouth, nausea, vomiting and abdominal pain. Delayed effects from short-tern trichlorethylene poisoning include liver and kidney lesions, reversible nerve degeneration, and psychic disturbances. Long-term exposure can produce headache, dizziness, weight loss, nerve damage, heart damage, nausea, fatigue, insomnia, visual impairment, mood perturbation, sexual problems, dermatitis, and rarely jaundice. Degradation products of trichloroethylene (particularly phosgene) may cause rapid death due to respiratory collapse.

Carcinogenicity. Trichloroethylene is considered by EPA to be a probable human carcinogen via both oral and inhalation exposure, based on limited human evidence and sufficient animal evidence.

Environmental Fate. Trichloroethylene breaks down slowly in water in the presence of sunlight and bioconcentrates moderately in aquatic organisms. The main removal of trichloroethylene from water is via rapid evaporation. Trichloroethylene does not photodegrade in the atmosphere, though it breaks down quickly under smog conditions, forming other pollutants such as phosgene, dichloroacetyl chloride, and formyl chloride. In addition, trichloroethylene vapors may be decomposed to toxic levels of phosgene in the presence of an intense heat source such as an open arc welder. When spilled on land, trichloroethylene rapidly volatilizes from surface soils. Some of the remaining chemical may leach through the soil to groundwater.

Physical Properties. Trichloroethylene is a colorless liquid with a chloroform-like odor. It is a combustible liquid, but burns with difficulty, and it has a very low solubility.

Toluene (CAS: 108-88-3)

Sources. Toluene is used as an equipment and parts cleaning and degreasing solvent and as a paint solvent.

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also effect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene, a volatile organic chemical (VOC), is a colorless liquid with a sweet, benzene-like odor. It is a Class IB flammable liquid.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures only about 237 of the facilities in the aerospace industry. However, it allows for a comparison across years and industry sectors. Reported chemicals are limited to the approximately 600 TRI chemicals. A significant portion of the emissions from aerospace facilities, therefore, are not captured by TRI. The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many manufacturing sources.

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Table 12 summarizes annual releases (from the industries for which a Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Table 12: Air Pollutant Releases by Industry Sector (tons/year)						
Industry Sector	CO	NO_2	PM10	PT	SO_2	VOC
Metal Mining	4,951	49,252	21,732	9,478	1,202	119,761
Oil and Gas Extraction	132,747	389,686	4,576	3,441	238,872	114,601
Non-Fuel, Non-Metal Mining	31,008	21,660	44,305	16,433	9,183	138,684
Textiles	8,164	33,053	1,819	38,505	26,326	7,113
Lumber and Wood Products	139,175	45,533	30,818	18,461	95,228	74,028
Wood Furniture and Fixtures	3,659	3,267	2,950	3,042	84,036	5,895
Pulp and Paper	584,817	365,901	37,869	535,712	177,937	107,676
Printing	8,847	3,629	539	1,772	88,788	1,291
Inorganic Chemicals	242,834	93,763	6,984	150,971	52,973	34,885
Plastic Resins and Man-made Fibers	15,022	36,424	2,027	65,875	71,416	7,580
Pharmaceuticals	6,389	17,091	1,623	24,506	31,645	4,733
Organic Chemicals	112,999	177,094	13,245	129,144	162,488	17,765
Agricultural Chemicals	12,906	38,102	4,733	14,426	62,848	8,312
Petroleum Refining	299,546	334,795	25,271	592,117	292,167	36,421
Rubber and Plastic	2,463	10,977	3,391	24,366	110,739	6,302
Stone, Clay, Glass and Concrete	92,463	335,290	58,398	290,017	21,092	198,404
Iron and Steel	982,410	158,020	36,973	241,436	67,682	85,608
Metal Castings	115,269	10,435	14,667	4,881	17,301	21,554
Nonferrous Metals	311,733	31,121	12,545	303,599	7,882	23,811
Fabricated Metal Products	7,135	11,729	2,811	17,535	108,228	5,043
Electronics and Computers	27,702	7,223	1,230	8,568	46,444	3,464
Motor Vehicle Assembly	19,700	31,127	3,900	29,766	125,755	6,212
Aerospace	**4,261**	**5,705**	**890**	**757**	**3,705**	**10,804**
Shipbuilding and Repair	109	866	762	2,862	4,345	707
Ground Transportation	153,631	594,672	2,338	9,555	101,775	5,542
Water Transportation	179	476	676	712	3,514	3,775
Air Transportation	1,244	960	133	147	1,815	144
Fossil Fuel Electric Power	399,585	5,661,468	221,787	13,477,367	42,726	719,644
Dry Cleaning	145	781	10	725	7,920	40

Source: U.S. EPA Office of Air and Radiation, AIRS Database, 1997.

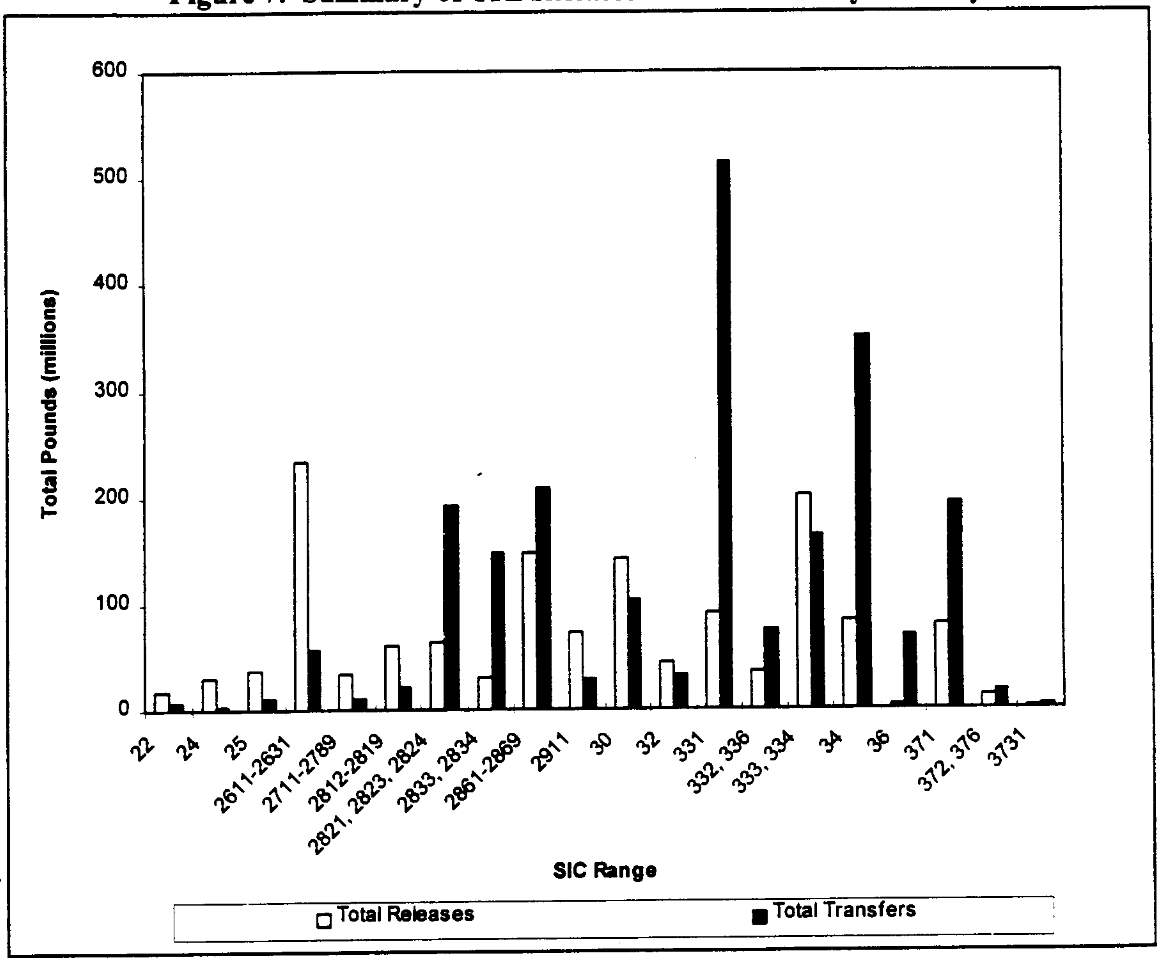
R0074674

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of TRI releases and transfers within each sector profiled under this project. Please note that the following figures and tables do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Figure 7 is a graphical representation of a summary of the TRI data for the aerospace industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the vertical axis. Industry sectors are presented in the order of increasing SIC code. The graph is based on the data shown in Table 13 and is meant to facilitate comparisons between the relative amounts of releases and transfers both within and between these sectors. Table 13 also presents the average releases per facility in each industry. The reader should note that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the aerospace industry, the 1995 TRI data presented here covers 237 facilities. These facilities listed SIC 3721, 3724, 3728, 3761, 3764, or 3769 (aerospace industry) as a primary SIC code(s).

Figure 7: Summary of TRI Releases and Transfers by Industry



Source: US EPA 1995 Toxics Release Inventory Database.

Key to Standard Industrial Classification Codes

SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
22	Textiles	2833, 2834	Pharmaceuticals	333, 334	Nonferrous Metals
24	Lumber and Wood Products	2861-2869	Organic Chem. Mfg.	34	Fabricated Metals
25	Furniture and Fixtures	2911	Petroleum Refining	36	Electronic Equip. and Comp.
2611-2631	Pulp and Paper	30	Rubber and Misc. Plastics	371	Motor Vehicles, Bodies, Parts, and Accessories
2711-2789	Printing	32	Stone, Clay, and Concrete	372, 376	Aerospace
2812-2819	Inorganic Chemical Manufacturing	331	Iron and Steel	3731	Shipbuilding and Repair
2821, 2823, 2824	Resins and Plastics	332, 336	Metal Casting		

Table 13: 1995 Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	TRI Releases		TRI Transfers		Total Releases + Transfers (million lbs.)	Average Releases + Transfers per Facility (lbs.)
			Total Releases (million lbs.)	Average Releases per Facility (lbs.)	Total Transfers (million lbs.)	Average Transfers per Facility (lbs.)		
Textiles	22	339	17.8	53,000	7.0	21,000	24.8	74,000
Lumber and Wood Products	24	397	30.0	76,000	4.1	10,000	34.1	86,000
Furniture and Fixtures	25	336	37.6	112,000	9.9	29,000	47.5	141,000
Pulp and Paper	2611-2631	305	232.6	763,000	56.5	185,000	289.1	948,000
Printing	2711-2789	262	33.9	129,000	10.4	40,000	44.3	169,000
Inorganic Chem. Mfg.	2812-2819	413	60.7	468,000	21.7	191,000	438.5	659,000
Resins and Plastics	2821,2823, 2824	410	64.1	156,000	192.4	469,000	256.5	625,000
Pharmaceuticals	2833, 2834	200	29.9	150,000	147.2	736,000	177.1	886,000
Organic Chemical Mfg.	2861-2869	402	148.3	598,000	208.6	631,000	946.8	1,229,000
Agricultural Chemicals	287	236	77.1	327,000	11.4	48,000	88.5	375,000
Petroleum Refining	2911	180	73.8	410,000	29.2	162,000	103.0	572,000
Rubber and Misc. Plastics	30	1,947	143.1	73,000	102.6	53,000	245.7	126,000
Stone, Clay, and Concrete	32	623	43.9	70,000	31.8	51,000	75.7	121,000
Iron and Steel	331	423	90.7	214,000	513.9	1,215,000	604.6	1,429,000
Metal Casting	332, 336	654	36.0	55,000	73.9	113,000	109.9	168,000
Nonferrous Metals	333, 334	282	201.7	715,000	164	582,000	365.7	1,297,000
Fabricated Metals	34	2,676	83.5	31,000	350.5	131,000	434.0	162,000
Electronic Equip. and Comp.	36	407	4.3	11,000	68.8	169,000	73.1	180,000
Motor Vehicles, Bodies, Parts, and Accessories	371	754	79.3	105,000	194	257,000	273.3	362,000
Aerospace	**372, 376**	**237**	**12.5**	**53,000**	**17.1**	**72,000**	**29.6**	**125,000**
Shipbuilding	3731	43	2.4	56,000	4.1	95,000	6.5	151,000

Source: *US EPA Toxics Release Inventory Database, 1995.*

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be implemented feasibly. In the waste management hierarchy, if source reduction is not feasible the next alternative is recycling of wastes, followed by energy recovery, and waste treatment as a last alternative.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the aerospace industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be used effectively. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Pollution Prevention Techniques

This section lists many pollution prevention techniques geared toward the aerospace industry and its related processes. Some techniques may be applicable to a number of different processes such as materials substitution of low-solvent and less hazardous materials exist, while others are specific to a single phase of aerospace manufacturing. Many of the techniques discussed below were obtained from the *Profile of the Shipbuilding and Repair Industry*, EPA, 1997. It is important to note that the FAA places very strict "airworthiness" guidelines on manufacturing and rework facilities for safety and quality control purposes, thus new pollution prevention alternatives may require a full evaluation and permitting process before they may be used. Because military facilities are not subject to FAA guidelines, they have a greater opportunity to implement P2 alternatives. As a result, studies have been conducted at various Air Force, Coast Guard, and Naval facilities which are referenced in Section IX. Excellent information on military facility P2 activities can be found at web sites of the Air Force Center for Environmental Excellence (http://www.afcee.brooks.af.mil), and at the Navy's P2 Library web site (http://enviro.nfesc.navy.mil/p2library).

V.A. Machining and Metalworking

Coolant, or metalworking, fluids account for the largest waste stream generated by machining operations. Waste metalworking fluids are created when the fluids are no longer usable due to contamination by oils or chemical additives. If the contamination rate of the metalworking fluids is reduced, the need to replace them will be less frequent. This will reduce the waste generated.

Preventing Fluid Contamination

Fluid can become hazardous waste if it is contaminated. Although it is not possible to eliminate contamination, it is possible to reduce the rate of contamination and thereby prolong its use.

The primary contaminant in these waste fluids is tramp oil. One way to postpone contamination is to promote better maintenance of the wipers and seals. A preventative maintenance program should be installed and enforced in the machine shop. Scheduled sump and machine cleaning as well as periodic inspections of the wipers and oil seals should be carried out. The responsibility for this should be assigned to some person or group in a position of authority to ensure its success.

Synthetic Fluids

Synthetic fluids have many advantages over their non-synthetic counterparts. Usually the synthetic varieties do not lubricate as effectively, but they are less susceptible to contamination and highly resistant to biological breakdown. Most synthetic fluids have superior longevity and can operate over a large temperature range without adverse side effects. Straight oils should be replaced with synthetic ones when possible.

Recycling Fluids

Once all of the source reduction options have been considered, it is time to explore the possibilities of reuse. It should be noted that in many cases, after the majority of the contaminants have been removed, further treatment with chemicals or concentrated fluid is necessary before the fluids can be recirculated through the machines.

Filtration Filtration is a common way to remove particles from the fluid as well as tramp oils or other contaminants. Many different types of filters can be used depending on the medium to be filtered and the amount of filtration desired. Contaminated cutting fluids can be passed through a bag, disc, or cartridge filter or separated in a centrifuge.

Skimming and Flotation Although it is a slow process, skimming of contaminants is inexpensive and can be very effective. The principle is to let the fluid sit motionless in a sump or a tank, and after a predetermined amount of time, the unwanted oils are skimmed off the surface and the heavier particulate matter is collected off the bottom. A similar technique, flotation, injects high pressure air into contaminated cutting fluid. As the air comes out of solution and bubbles to the surface, it attaches itself to suspended contaminants and carries them up to the surface. The resulting sludge is skimmed off the surface and the clean fluid is reused.

Centrifugation Centrifugation uses the same settling principles as flotation, but the effects of gravity are multiplied thousands of times due to the spinning action of the centrifuge. This will increase the volume of fluids which can be cleaned in a given amount of time.

Pasteurization Pasteurization uses heat treatment to kill microorganisms in the fluid and reduce the rate at which rancidity (biological breakdown) will occur. Unfortunately, heat can alter the properties of the fluid and render it less effective. Properties lost in this way are usually impossible to recover.

Downgrading Sometimes it is possible to use high quality hydraulic oils as cutting fluids. After the oils have reached their normal usable life, they no longer meet the high standards necessary for hydraulic components. At this time they are still good enough to be used for the less demanding jobs. It may be necessary to treat the fluid before it can be reused, but changing fluid's functions in this manner has proven successful in the past.

V.B. Surface Preparation

The majority of wastes generated during surface preparation are spent abrasives and solvents mixed with paint chips. One way the volume of waste generated can be reduced is by using blast media that is relatively easy to reuse.

Improving Recyclability of Abrasive Blasting Media

Often, air powered cleaning equipment is used to screen abrasive to separate it from large paint particles. These systems may also remove lighter dust from the heavy abrasive. This media separation can be especially important when the paint being removed contains heavy metals. An alternative to on-site reclamation is to send it for processing off-site. It is very important that waste streams, especially hazardous waste, are not mixed with used blasting media. Outside debris and other waste could render the media unfit for reuse.

Plastic Media Blasting

As a substitute for other blast media, the military has experimented extensively with plastic media stripping. This process is particularly good for stripping coatings from parts with fragile substrates often found in the aerospace industry such as zinc, aluminum, and fiberglass. It can be a lengthy process because it strips paint layer by layer. The same types and quantities of waste are generated as with grit blasting, but the plastic medium is more recyclable with the use of pneumatic media classifiers that are part of the stripping equipment. The only waste requiring disposal is the paint waste itself. However, the use of plastic media is fairly limited. Plastic blasting media do not work well on epoxy paints. In addition, the blasting equipment is expensive and requires trained operators.

Water Jet Stripping (Hydroblasting)

Hydroblasting is a cavitating high pressure water jet stripping system that can remove most paints. These system may use pressures as high as 50,000 psig. Hydroblasting is an excellent method for removing even hard coatings from metal substrates. Some systems automatically remove the paint chips or stripped material from the water and reuse the water for further blasting. By recirculating the water in this manner, the amount of waste is greatly reduced. Wastewater from this process is usually suitable for sewer disposal after the paint particles are removed. Although this process produces very little waste, it is not always as efficient as other blasting methods, has relatively high capital and maintenance costs, and may not be adequate for fragile substrates.

V.C. Solvent Cleaning and Degreasing

Aerospace manufacturers often use large quantities of solvents in a variety of cleaning and degreasing operations including parts cleaning, process equipment cleaning, and surface preparation for coating applications. The final cost of solvent used for various cleanup operations is nearly twice the original purchase price of the virgin solvent. The additional cost is primarily due to the fact that for each drum purchased, extra disposal cost, hazardous materials transportation cost, and manifesting time and expense are incurred. With the rising cost of solvents and waste disposal services, combined with continuously developing regulation, reducing the quantities of solvents used and solvent wastes generated can be extremely cost effective.

Eliminating the Use of Solvents

Eliminating the use of solvents avoids any waste generation associated with spent solvent. Elimination can be achieved by utilization of non-solvent cleaning agents or eliminating the need for cleaning altogether. Solvent elimination applications include the use of water-soluble cutting fluids, protective peel coatings, aqueous cleaners, and mechanical cleaning systems (USEPA/OECA, 1997).

Water-soluble Cutting Fluids Water-soluble cutting fluids can often be used in place of oil-based fluids. The cutting oils usually consist of an oil-in-water emulsion used to reduce friction and dissipate heat. If these fluids need to be removed after the machining process is complete, solvents may be needed.

In efforts to eliminate solvent degreasing and its subsequent waste, special water-soluble cutting fluids have been developed. Systems are available that can clean the cutting fluid and recycle the material back to the cutting operation. Obstacles to implementing this method are: cost (water-soluble fluids are generally more expensive), procurement (there are only a few suppliers available), and the inability to quickly switch between fluid types without thoroughly cleaning the equipment (USEPA/OECA, 1997).

Aqueous Cleaners Aqueous cleaners, such as alkali, citric, and caustic base, are often useful substitutes for solvents. There are many formulations that are suited for a variety of cleaning requirements. Many aqueous cleaners have been found to be as effective as the halogenated solvents that are commonly employed.

Aqueous stripping agents, such as caustic soda (NaOH), are often employed in place of methylene chloride based strippers. Caustic solutions have the advantage of eliminating solvent vapor emissions. A typical caustic bath consists of about 40 percent caustic solution heated to about 200 degrees Fahrenheit. Caustic stripping is generally effective on alkyl resins and oil paints (EPA, March 1997).

The Douglas Aircraft Division of McDonnell Douglas used a chromic acid solution to clean aluminum parts. However, the solution began to corrode the steel cleaning equipment parts. A scientist at McDonnell Douglas developed a sodium hydroxide-based process which cleaned parts sufficiently to detect cracks in the aluminum parts during testing. The new process saves an estimated $28,000 per year in chemical costs (Boeing, 1998).

In 1990, the Martin Marietta Astronautics Group (now Lockheed Martin) eliminated the use of 1,1,1-trichloroethane (TCA) and methyl ethyl ketone (MEK) for vapor degreasing. Six alternative aqueous cleaners were subjected to a screening process that evaluated health hazards, treatability of wastewater, corrosion potential, degreasing performance, and salt fog corrosion resistance. From this study, Lockheed Martin selected a nontoxic aqueous terpene cleaner. The substitution of this cleaner saves hundreds of thousands of dollars every year in material cost savings and ozone depletion taxes (Dykema, 1993).

Lockheed Martin Tactical Aircraft Systems in Fort Worth, Texas, has substituted low vapor pressure solvent and aqueous cleaning for CFC-113 in all aspects of aircraft manufacturing. The low vapor pressure solvent is a blend of propylene glycol methyl ether acetate, isoparaffins, and butyl acetate. The solvent is effective on a variety of organic soils and is used for wiping the surfaces of aircraft components and assemblies. The substitution of this cleaner completely eliminated CFC emissions and reduced solvent use, solvent cost, VOC emissions, and total air emissions (Evanoff, 1993).

The advantages of substituting aqueous cleaners include minimizing worker's exposure to solvent vapors, reducing liability and disposal problems associated with solvent use, and cost. Aqueous cleaners do not volatilize as quickly as other solvents, thereby reducing losses due to evaporation. Since most aqueous cleaners are biodegradable, disposal is not a problem once the organic or inorganic contaminants are removed (USEPA, March 1997).

The use of aqueous cleaners can also result in cost savings. Although some aqueous cleaners may cost less than an equivalent amount of solvent, the purchase price of each is about the same. The cost of disposal, loss due to evaporation, and associated liabilities, however, favor aqueous cleaners.

The disadvantages of aqueous cleaners in place of solvents may include: possible incompatibilities with FAA guidelines, possible inability of the aqueous cleaners to provide the degree of cleaning required, incompatibility between the parts being cleaned and the cleaning solution, need to modify or replace existing equipment, longer required cleaning time, and problems associated with moisture left on parts being cleaned. Oils removed from the parts during cleaning may float on the surface of the cleaning solution and may interfere with subsequent cleaning. Oil skimming is usually required (USEPA/OECA, 1997).

Mechanical Cleaning Systems Utilizing mechanical cleaning systems can also replace solvents in degreasing and cleaning operations. In many cases, a high pressure steam gun or high pressure parts washer can clean parts and surfaces quicker and to the same degree of cleanliness as that of the solvents they replace. Light detergents can be added to the water supply for improved

R0074683

cleaning. The waste produced by these systems is usually oily wastewater. This wastewater can be sent through an oil/water separator, the removed water discharged to the sewer, and the oil residue sent to a petroleum recycler. Some hot water wash and steam systems can be supplemented by emulsifying solutions to speed the process. Although these additives speed the cleaning process, they can make separation of the oil from the water very difficult and create problems with disposal of the waste.

Cryogenic stripping utilizes liquid nitrogen and non-abrasive plastic beads as blasting shot. This method relies on the freezing effect of the liquid nitrogen and the impact of the plastic shot. Subjecting the surface to extremely low temperatures creates stress between the coating and the substrate causing the coating to become brittle. When the plastic shot hits the brittle coating, debonding occurs. The process is non-abrasive, and will not damage the substrate, but effects of the metal shrinkage, due to extremely low temperatures, should be monitored. The process does not produce liquid wastes, and nitrogen, chemically inert, is already present in the atmosphere (USEPA/OECA, 1997).

Thermal stripping methods can be useful for objects that cannot be immersed. In this process, superheated air is directed against the surface of the object. The high temperatures cause some paints to flake off. The removal results from the drying effects of the air and the uneven expansion of the paint and the substrate. Some paints will melt at high temperatures, allowing the paint to be scraped off manually or with abrasives. Hand-held units are available that produce a jet of hot air. Electric units and open flame or torch units are also used. While this system is easy to implement, it is limited to items that are not heat sensitive and to coatings that are affected by the heat (USEPA/OECA, 1997).

McDonnell Douglas has developed two thermal stripping techniques. The first one, known as FLASHJET™, uses a high-intensity xenon lamp to heat the surface paint and disintegrate it. A stream of dry ice pellets follows to carry away the paint chips. FLASHJET™ was developed for use and tested on helicopters at the McDonnell Douglas Helicopter Systems plant in Mesa, Arizona. FLASHJET™ reduced the manual work required by 10 to 15 percent (Boeing, 1998).

The second technique was adapted from a technique to remove hydrocarbons from engines. The Hot Gaseous Nitrogen (GN2) Purge heats the critical engine surfaces, driving off the volatile hydrocarbons, which then leave the engine through the flow of nitrogen. This method eliminates the use of 1,1,1-trichloroethane for this type of engine cleaning (Boeing, 1998).

Hughes Aircraft Company developed a supercritical carbon dioxide ($SCCO_2$) cleaning system to be used in many cleaning applications in the aerospace industry. At temperatures and pressures close to or above its critical point (88°F and 1,073 psia), CO_2 acts as an ideal solvent. It is also inexpensive and inert, non-combustible, naturally occurring, and does not contribute to smog. Efficient removal of oils, greases, fingerprints, solder flux residues have been achieved by the SUPERSCRUB™ unit at Hughes (Chao).

Reducing the Use of Solvent

By eliminating the use or need for solvent cleaning, the problems associated with disposal of spent solvent are also eliminated. In cases where the elimination of solvent use is not possible or practical, utilization of various solvent waste reduction techniques can lead to a substantial savings in solvent waste.

Methods of reducing solvent usage can be divided into three categories: source control of air emissions, efficient use of solvent and equipment, and maintaining solvent quality. Source control of air emissions addresses ways in which more of the solvent can be kept inside a container or cleaning tank by reducing the chances for evaporation loss. Efficient use of solvent and equipment through better operating procedures can reduce the amount of solvent required for cleaning. Maintaining the quality of solvent will extend the life cycle effectiveness of the solvent.

<u>Source Control of Air Emissions</u> Source control of air emissions can be achieved through equipment modification and proper operation of equipment. Some simple control measures include installation and use of lids, an increase of freeboard height of cleaning tanks, installation of freeboard chillers, and taking steps to reduce solvent drag-out.

All cleaning units, including cold cleaning tanks and dip tanks, should have some type of lid installed. When viewed from the standpoint of reducing air emissions, the roll-type cover is preferable to the hinge type. Lids that swing down can cause a piston effect and force the escape of solvent vapor. In operations such as vapor degreasing, use of lids can reduce solvent loss from 24 percent to 50 percent. For tanks that are continuously in use, covers have been designed that allow the work pieces to enter and leave the tank while the lid remains closed.

In an open top vapor degreaser, freeboard is defined as the distance from the top of the vapor zone to the top of the tank. Increasing the freeboard will substantially reduce the amount of solvent loss. A freeboard chiller may also be installed above the primary condenser coil. This refrigerated coil, much like the cooling jacket, chills the air above the vapor zone and creates a secondary barrier to vapor loss. Reduction in solvent usage, by use of freeboard chillers, can be as high as 60 percent. The major drawback with a freeboard chiller is that it can introduce water (due to condensation from air) into the tank.

In addition to measures that reduce air emissions through equipment modification, it is also possible to reduce emissions through proper equipment layout, operation, and maintenance. Cleaning tanks should be located in areas where air turbulence and temperature do not promote vapor loss.

Maximize the Dedication of the Process Equipment In addition to reduction in vapor loss, reducing the amount of solvent used can be achieved through better operating practices that increase the efficiency of solvent cleaning operations. Maximizing the dedication of the process equipment reduces the need for frequent cleaning. By using a mix tank consistently for the same formulation, the need to clean equipment between batches is eliminated.

Avoid Unnecessary Cleaning Avoiding unnecessary cleaning also offers potential for waste reduction. For example, paint mixing tanks for two-part paints are often cleaned between batches of the same product. The effect of cross-contamination between batches should be examined from a product quality control viewpoint to see if the cleaning step is always necessary.

Proper Production Scheduling Proper production scheduling can reduce cleaning frequency by eliminating the need for cleaning between the conclusion of one task and the start of the next. A simple example of this procedure is to have a small overlap between shifts that perform the same operation with the same equipment. This allows the equipment that would normally be cleaned and put away at the end of each shift, such as painting equipment, to be taken over directly by the relief.

Clean Equipment Immediately Cleaning equipment immediately after use prevents deposits from hardening and avoids the need for consuming extra solvent. Letting dirty equipment accumulate and be cleaned later can also increase the time required for cleaning.

Better Operating Procedures Better operating procedures can minimize equipment clean-up waste. Some of the methods already discussed are examples of better operating procedures. Better operator training, education, closer supervision, improved equipment maintenance, and increasing the use of automation are very effective in waste minimization.

Reuse Solvent Waste Reuse of solvent waste can reduce or eliminate waste and result in a cost savings associated with a decrease in raw material consumption. The solvent from cleaning operations can be reused in other cleaning processes in which the degree of cleanliness required is much less. This will be discussed in more detail in the next section.

Solvent Recycling

Although not as preferable as source reduction, solvent recycling may be a viable alternative for some facilities. The goal of recycling is to recover from the waste solvent, a solvent of a similar purity to that of the virgin solvent for eventual reuse in the same operation, or of a sufficient purity to be used in another application. Recycling can also include the direct use of solvent waste from one waste stream in another operation. There are a number of techniques that facilities can use onsite to separate solvents from contaminants including distillation, evaporation, sedimentation, decanting, centrifugation, filtering, and membrane separation.

V.D. Metal Plating and Surface Finishing

Pollution prevention opportunities in metal plating and surface finishing operations are discussed in the *Profile of the Fabricated Metal Products Industry Sector Notebook*. Readers are encouraged to consult this document for pollution prevention information relating to metal plating and surface finishing. An additional resource for pollution prevention information regarding metal finishing can be found at the National Metal Finishing Resource Center (http://www.nmfrc.org).

V.E. Painting and Coating

Painting and coating operations are typically the largest single source of VOC emissions from aerospace manufacturing and rework facilities. In addition, paint waste can account for more than half of the total hazardous waste generated. Paint waste may include leftover paint in containers, overspray, paint that is no longer usable (Non-spec paint), and rags and other materials contaminated with paint. In many cases, the amount of paint waste generated can be reduced through the use of improved equipment, alternative coatings, and good operating practices. An additional resource for pollution prevention information regarding painting and coating can be found at the Paint and Coatings Resource Center (http://www.paintcenter.org).

Application Equipment

In order to effectively reduce paint waste and produce a quality coating, proper application techniques should be supplemented with efficient application equipment. Through the use of equipment with high transfer efficiencies, the amount of paint lost to overspray is minimized.

High Volume Low Pressure (HVLP) Spray Guns The HVLP spray gun is basically a conventional air spray gun with modifications and special nozzles that atomize the paint at very low air pressures. The atomizing pressure of HVLP systems is often below 10 psi. The design of this gun allows better transfer efficiency and reduced overspray than that of conventional air guns. The low application pressure decreases excessive bounceback and allows better adhesion of the coating to the substrate.

Although improvements are consistently being made to overcome its limitations, most HVLP systems have some definite drawbacks, including difficulty atomizing viscous coatings, sensitivity to variations in incoming pressure, sensitivity to wind, and slow application rates.

Airless Spray Guns Instead of air passing through the spray gun, an airless system applies static pressure to the liquid paint. As the paint passes through the nozzle, the sudden drop in pressure atomizes the paint and it is carried to the substrate by its own momentum. Pressure is applied to the paint by a pump located at a remote supply. These systems have become favorable over conventional air-spray systems for three main reasons:

1) reduced overspray and rebound,
2) high application rates and transfer efficiency,
3) permits the use of high-build coatings with the result that fewer coats are required to achieve specific film thickness.

One major disadvantage of some airless spray systems is the difficulty applying very thin coats. If coatings with less than a millimeter in thickness are required, such as primers applied to objects that require weldability, it may be difficult to use an airless system.

Electrostatic Spray Electrostatic spray systems utilize paint droplets that are given a negative charge in the vicinity of a positively charged substrate. The droplets are attracted to the substrate and a uniform coating is formed. This system works well on cylindrical and rounded objects due to its "wrap-around" effect that nearly allows the object to be coated from one side. Very little paint is lost to overspray, and it has been noted to have a transfer efficiency of over 95%.

In order for an electrostatic system to operate properly, the correct solvent balance is needed. The evaporation rate must be slow enough for the charged droplets to reach the substrate in a fluid condition to flow out into a smooth film, but fast enough to avoid sagging. The resistivity of the paint must also be low enough to enable the paint droplets to acquire the maximum charge.

Although the operating costs of electrostatic spray systems are relatively low, the initial capital investment can be high. This system has been found to work extremely well in small parts painting applications. Sometimes the installation of an electrostatic powder coating system can replace a water curtain spray paint booth.

Heated Spray When paint is heated, its viscosity is reduced allowing it to be applied with a higher solids content, thus requiring less solvent. When the paint is heated in a special container and supplied to the gun at 140° to 160°F, coatings of 2 to 4 millimeters dry-film thickness can be applied in one operation, resulting in considerable savings in labor cost. In addition, much of the associated solvent emissions are eliminated.

Heating the coating prior to application can be used with both conventional and airless spray applications. An in-line heater is used to heat the coating before it reaches the gun. As the coating is propelled through the air, it cools rapidly and increases viscosity after it hits the surface, allowing for better adhesion to the substrate.

Plural Component Systems A common problem that facilities face when working with two-part coatings is overmixing. Once the component parts of a catalyst coating are mixed, the coating must be applied. Otherwise, the excess unused coating will cure and require disposal. Additionally, the coating equipment must be cleaned immediately after use.

One large advantage of plural component technology is the elimination of paint waste generated by mixing an excess amount of a two part coating. This is achieved through the use of a special mixing chamber that mixes the pigment and catalyst seconds before the coating is applied. Each component is pumped through a device that controls the mixing ratio and then is combined in a mixing chamber. From the mixing chamber, the mixed coating travels directly to the spray guns. The only cleaning that is required is the mixing chamber, gun, and the length of supply hose connecting them.

Wet Booth Generally, small-volume painting operations will find the lower purchase cost of a dry filter booth will meet their requirements. One disadvantage in the use of a dry-filter booth is in the disposal of the waste. Typically the majority of this waste is the filter media itself which has been contaminated by a relatively small amount of paint. Reusable filters may decrease waste volume and reduce disposal cost. In some applications, overspray can be collected for reuse.

If overall painting volume can justify the investment, a wet booth eliminates disposal of filter media and allows waste to be reduced in weight and volume. This is achieved by separating the paint from the water through settling, drying, or using a centrifuge or cyclone (Ohio EPA, 1994).

Recycle Paint Booth Water Various methods and equipment are used to reduce or eliminate the discharge of the water used in water-wash booths (water curtain). These methods and equipment prevent the continuous discharge of booth waters by conditioning (i.e., adding detacifiers and paint-dispersing polymers) and removing paint solids. The most basic form of water maintenance is the removal of paint solids by manual skimming and/or raking. This can be performed without water conditioning since some portion of solvent-based paints usually float and/or sink. With the use of detacifiers and paint-dispersing polymer treatments, more advanced methods of solids removal can be implemented. Some common methods are discussed below.

Wet-Vacuum Filtration Wet-vacuum filtration units consist of an industrial wet-vacuum head on a steel drum containing a filter bag. The unit is used to vacuum paint sludge from the booth. The solids are filtered by the bag and the water is returned to the booth. Large vacuum units are also commercially available that can be moved from booth to booth by forklift or permanently installed near a large booth.

Tank-Side Weir A weir can be attached to the side of a side-draft booth tank, allowing floating material to overflow from the booth and be pumped to a filtering tank for dewatering.

Consolidator A consolidator is a separate tank into which booth water is pumped. The water is then conditioned by the introduction of chemicals. Detacified paint floats to the surface of the tank, where it is skimmed by a continuously moving blade. The clean water is recycled to the booth.

Filtration Various types of filtration units are used to remove paint solids from booth water. This is accomplished by pumping the booth water to the unit where the solids are separated and returning the water to the booth. The simplest filtration unit consists of a gravity filter bed utilizing paper or cloth media. Vacuum filters are also employed, some of which require precoating with diatomaceous earth.

Centrifuge Methods Two common types of centrifugal separators are the hydrocyclone and the centrifuge. The hydrocyclone is used to concentrate solids. The paint booth water enters a cone-shaped unit under pressure and spins around the inside surface. The spinning imparts an increased force of gravity, which causes most of the solid particles to be pulled outward to the walls of the cone. Treated water exits the top of the unit and the solids exit from the bottom. Some systems have secondary filtration devices to further process the solids. The centrifuge works in a similar manner, except that the booth water enters a spinning drum, which imparts the centrifugal force needed for separating the water and solids. Efficient centrifugation requires close control of the booth water chemistry to ensure a uniform feed. Also, auxiliary equipment such as booth water agitation equipment may be needed (EPA, 1995).

Alternative Coatings

The use of solvent-based coatings can lead to high costs to meet air and water quality regulations. In efforts to reduce the quantity and toxicity of waste paint disposal, alternative coatings have been developed that do not require the use of solvents and thinners. FAA guidelines may prohibit use of such coatings.

Powder Coatings Metal substrates can be coated with certain resins by applying the powdered resin to the surface, followed by application of heat. The heat melts the resin, causing it to flow and form a uniform coating. The three main methods in use for applying the powder coating are fluidized bed, electrostatic spray, and flame spraying.

In flame spraying, the resin powder is blown through the gun by compressed air. The particles are melted in a high temperature flame and propelled against the substrate. This process is used widely with epoxy powders for aluminum surfaces.

The electrostatic application method uses the same principles as the electrostatic spray. The resin powder is applied to the surface electrostatically. Heat is applied to the covered surface and the powder melts to form the coating. The transfer efficiency and recyclability of this method is very high.

The elimination of environmental problems associated with many liquid based systems is one of the major advantages of powder coatings. The use of powder coatings eliminates the need for solvents and thereby emits negligible volatile organic compounds (VOCs). Powder coatings also reduce the waste associated with unused two-part coatings that have already been mixed. Since powder overspray can be recycled, material utilization is high and solid waste generation is low. Recent case studies demonstrate that powder coating systems can be cleaner, more efficient, and more environmentally acceptable, while producing a higher quality finish than many other coating systems.

Water-Based Paints Water-based coatings are paints containing a substantial amount of water instead of volatile solvents. Alkyd, polyester, acrylic, and epoxy polymers can be dissolved and dispersed by water. In addition to reduction in environmental hazards due to substantially lower air emissions, a decrease in the amount of hazardous paint sludge generated can reduce disposal cost.

UV / EB Coatings Powder coatings require high temperatures for their cure and hence are not applicable to temperature sensitive substrates, such as paper, wood or plastics. For such materials, the use of coatings systems curable by ultra violate light or electron beams (UV/EB) have been developed. The resins used in these coatings are basically the same as those used in conventional high performance coatings which have been modified to make them polymerizable by UV or EB energy. Thus they are liquids that can be applied by conventional techniques such as spraying, roller coating, curtain coating, etc. (in contrast to powder coating which requires specialized application techniques). When exposed to the low level radiant energy, they are instantly and completely cured with no heat application. Because of the diversity of raw materials that can be adapted to this technology, a tremendous range of performance characteristics can be achieved. In addition, because no solvents are used in the coating formulations, there are virtually no volatile organic compounds (VOCs) emitted, making them ecologically preferred. Other advantages include the elimination of curing ovens and incinerators which further aid the cleansing of the air as well as substantial savings of space and fuel costs. The rapid curing cycle without the need of a cool-down cycle allows for higher production rates and therefore lower costs. UV/EB coatings can be used on metals, and are especially useful when coating complex metal products that might contain paper, plastic or wood parts, because of the low temperature curing required by UV/EB. In addition, these, and other advantages which UV/EB provides, have led to rapid increase in their use in the manufacture of electronic components.

Good Operating Practices

In many cases, simply altering a painting process can reduce wastes through better management.

A good manual coating application technique is very important in reducing waste. If not properly executed, spraying techniques have a high potential for creating waste; therefore, proper application techniques are very important.

Reducing Overspray One of the most common means of producing paint waste at facilities is overspray. Overspray not only wastes some of the coating, it also presents environmental and health hazards. It is important that facilities try to reduce the amount of overspray as much as possible. Techniques for reducing overspray include:

1) triggering the paint gun at the end of each pass instead of carrying the gun past the edge of the surface before reversing directions,
2) avoiding excessive air pressure,
3) keeping the gun perpendicular to the surface being coated.

Uniform Finish Application of a good uniform finish provides the surface with quality coating with a higher performance than an uneven finish. An uneven coating does not dry evenly and commonly results in using excess paint.

Overlap An overlap of 50 percent can reduce the amount of waste by increasing the production rate and overall application efficiency. Overlap of 50 percent means that for every pass that the operator makes with the spray gun, 50 percent of the area covered by the previous pass is also sprayed. If less than a 50 percent overlap is used, the coated surface may appear streaked. If more than a 50 percent overlap is used, the coating is wasted and more passes are required to coat the surface.

Paint Proportioning Mixing batches of paint on an as-needed basis, whether through the use of a paint proportioning machine or otherwise, can reduce the amount of paint wasted. Recordkeeping requirements to track the amount of paint and thinner used can also help conserve materials and prevent waste.

General Housekeeping Small quantities of paint and solvents are frequently lost due to poor housekeeping techniques. There are a variety of ways that can be implemented to control and minimize spills and leaks. Specific approaches to product transfer methods and container handling can effectively reduce product loss.

The potential for accidents and spills is at the highest point when thinners and paints are being transferred from bulk drum storage to the process equipment. Spigots, pumps, and funnels should be used whenever possible.

Evaporation can be controlled by using tight fitting lids, spigots, and other equipment. The reduction in evaporation will increase the amount of available material and result in lower solvent purchase cost.

Paint Containers A significant portion of paint waste is the paint that remains inside a container after the container is emptied, and paint that is placed in storage, not used, and becomes outdated or non-spec. By consolidating paint use and purchasing paint in bulk, large bulk containers have less surface area than an equivalent volume of small cans, and the amount of drag-on paint waste is reduced. Large bulk containers can sometimes be returned to the paint supplier to be cleaned for reuse.

If the purchase of paint in bulk containers is not practical, the paint should be purchased in the smallest amount required to minimize outdated or non-spec paint waste. Workers should not have to open a gallon can when only a quart is required. Usually, any paint that is left in the can will require disposal as hazardous waste.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities must obtain a permit either from EPA or from a State agency which EPA has authorized to implement the permitting program if they store hazardous wastes for more than 90 days before treatment or disposal. Facilities may treat hazardous wastes stored in less-than-ninety-day tanks or containers without a permit. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 States and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

•**Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator must follow to determine whether the material in question is considered a hazardous waste, solid waste, or is exempted from regulation.

•**Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

•**Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet LDR treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

•**Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

•RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities that store such waste, including large quantity generators accumulating waste prior to shipment off-site.

•**Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that must be met by December 22, 1998.

•**Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

***EPA's RCRA, Superfund and EPCRA Hotline,** at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.*

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law known commonly as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as removals. EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

•**EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

•**EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release equaling or exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

•**EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

•**EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, known commonly as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The National Pollutant Discharge Elimination System (NPDES) program (CWA §502) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized 42 States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set the conditions and effluent limitations on the facility discharges.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated the NPDES storm water permit application regulations. These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.
Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal

R0074699

mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national pretreatment program (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities that could reasonably be expected to discharge oil in harmful quantities prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR §112.20) and for PCB transformers and PCB-containing items were revised and finalized in 1995.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, VOCs, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under section 110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and will become effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (see 40 CFR 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title I, section 112(c) of the CAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV of the CAA establishes a sulfur dioxide nitrous oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs) and chloroform, were phased out (except for essential uses) in 1996.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Requirements

The aerospace industry is affected by several major federal environmental statutes. A summary of the major federal regulations affecting the aerospace industry follows. Other resources which are useful in understanding industry specific requirements are:

1. The Paint and Coatings Resource Center web page (http://www.paintcenter.org)
2. The Self Audit & Inspection Guide; For Facilities Conducting Cleaning, Preparation, and Organic Coating of Metal Parts, published by the EPA (call NCEPI at 800-490-9198, EPA Doc. #305-B-95-002).
3. California EPA Air Resources Board Web Pages;
   Compliance Handbooks and Pamphlets
   - http://www.arb.ca.gov/cd/cap/handbks.htm

   Compliance Training Courses
   - http://www.arb.ca.gov/cd/training.htm
   - http://www.arb.ca.gov/html/all.htm

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) was enacted in 1976 to address problems related to hazardous and solid waste management. RCRA gives EPA the authority to establish a list of solid and hazardous wastes and to establish standards and regulations for the treatment, storage, and disposal of these wastes. Regulations in Subtitle C of RCRA address the identification, generation, transportation, treatment, storage, and disposal of hazardous wastes. These regulations are found in 40 CFR Part 124 and 40 CFR Parts 260-279. Under RCRA, persons who generate waste must determine whether the waste is defined as solid waste or hazardous waste. Solid wastes are considered hazardous wastes if they are listed by EPA as hazardous or if they exhibit characteristics of a hazardous waste: toxicity, ignitability, corrosivity, or reactivity.

Some wastes potentially generated at aerospace facilities that are considered hazardous wastes are listed in 40 CFR Part 261. Some of the handling and treatment requirements for RCRA hazardous waste generators are covered under 40 CFR Part 262 and include the following: determining what constitutes a RCRA hazardous waste (Subpart A); manifesting (Subpart B); packaging, labeling, and accumulation time limits (Subpart C); and record keeping and reporting (Subpart D).

Several common aerospace manufacturing operations have the potential to generate RCRA hazardous wastes. Some of these wastes are identified below by process.

Machining and Other Metalworking
•Metalworking fluids contaminated with oils, phenols, creosol, alkalies, phosphorus compounds, and chlorine

Cleaning and Degreasing
•Solvents (F001, F002, F003, F004, F005)
•Alkaline and Acid Cleaning Solutions (D002)
•Cleaning filter sludges with toxic metal concentrations

Metal Plating and Surface Finishing and Preparation
•Wastewater treatment sludges from electroplating operations (F006)
•Spent cyanide plating bath solutions (F007)
•Plating bath residues from the bottom of cyanide plating baths (F008)
•Spent stripping and cleaning bath solutions from cyanide plating operations (F009)

Surface Preparation, Painting and Coating
•Paint and paint containers containing paint sludges with solvents or toxic metals concentrations
•Solvents (F002, F003)
•Paint chips with toxic metal concentrations
•Blasting media contaminated with paint chips

Aerospace manufacturing and rework facilities may also generate used lubricating oils which are regulated under RCRA but may or may not be considered a hazardous waste (40 CFR 266).

Many aerospace facilities store some hazardous wastes at the facility for more than 90 days, and are therefore, a storage facility under RCRA. Storage facilities are required to have a RCRA treatment, storage, and disposal facility (TSDF) permit (40 CFR Part 262.34). Some aerospace facilities are considered TSDF facilities and therefore may be subject to the following regulations covered under 40 CFR Part 264: contingency plans and emergency procedures (40 CFR Part 264 Subpart D); manifesting, record keeping, and reporting (40 CFR Part 264 Subpart E); use and management of containers (40 CFR Part 264 Subpart I); tank systems (40 CFR Part 264 Subpart J); surface impoundments (40 CFR Part 264 Subpart K); land treatment (40 CFR Part 264 Subpart M); corrective action of hazardous waste releases (40 CFR Part 264 Subpart S); air emissions standards for process vents of processes that process or generate hazardous wastes (40 CFR Part 264 Subpart AA); emissions standards for leaks in hazardous waste handling equipment (40 CFR Part 264 Subpart BB); and emissions standards for containers, tanks, and surface impoundments that contain hazardous wastes (40 CFR Part 264 Subpart CC).

Many aerospace manufacturing and rework facilities are also subject to the underground storage tank (UST) program (40 CFR Part 280). The UST regulations apply to facilities that store either petroleum products or hazardous substances (except hazardous waste) identified under the Comprehensive Environmental Response, Compensation, and Liability Act. UST regulations address design standards, leak detection, operating practices, response to releases, financial responsibility for releases, and closure standards.

A number of RCRA wastes have been prohibited from land disposal unless treated to meet specific standards under the RCRA Land Disposal Restriction (LDR) program. The wastes covered by the RCRA LDRs are listed in 40 CFR Part 268 Subpart C and include a number of wastes that could potentially be generated at aerospace manufacturing facilities. Standards for the treatment and storage of restricted wastes are described in Subparts D and E, respectively.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) provide the basic legal framework for the federal "Superfund" program to clean up abandoned hazardous waste sites (40 CFR Part 305). Metals and metal compounds often found in the aerospace industry's air emissions, water discharges, or waste shipments for off-site disposal include chromium, manganese, aluminum, nickel, copper, zinc, and lead. Metals are frequently found at CERCLA's problem sites. When Congress ordered EPA and the Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR) to list the hazardous substances most commonly found at problem sites and that pose the greatest threat to human health, lead, nickel, and aluminum were all included.

Title III of the 1986 SARA amendments (also known as Emergency Response and Community Right-to-Know Act, EPCRA) requires all manufacturing facilities, including aerospace facilities, to report annual information to the public about over 600 toxic substances as well as release of these substances into the environment (42 U.S.C. 9601). This is known as the Toxic Release Inventory (TRI). EPCRA also establishes requirements for Federal, State, and local governments regarding emergency planning.

Clean Air Act (CAA)

Under Title III of the 1990 Clean Air Act Amendments (CAAA), EPA is required to develop national emission standards for 189 hazardous air pollutants (NESHAP). EPA is developing maximum achievable control technology (MACT) standards for all new and existing sources. The National

R0074707

Emission Standards for Aerospace Manufacturing and Rework Facilities (40 CFR Part 63 Subpart GG) were finalized in 1996 and apply to major source aerospace manufacturing and rework facilities. Facilities that emit ten or more tons of any one HAP or 25 or more tons of two or more HAPs combined are major sources, and therefore are subject to the MACT (NESHAP) requirements. The MACT requirements apply to solvent cleaning operations, primer and topcoat application operations, depainting operations, chemical milling maskant application operations, and handling and storage of waste. The standards set VOC emissions and content limits for different types of solvents, chemical strippers and coatings. In addition, performance standards are set to reduce spills, leaks, and fugitive emissions. Aerospace facilities may also be subject to National Emissions Standards for: Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks (40 CFR Part 63 Subpart N) if they perform chromium electroplating or anodizing; and Halogenated Solvent Cleaning if they operate a solvent cleaning machine using a halogenated HAP solvent. These NESHAPs require emission limits, work practice standards, record keeping, and reporting.

Under Title V of the CAAA 1990 (40 CFR Parts 70-72) all of the applicable requirements of the Amendments are integrated into one federal renewable operating permit. Facilities defined as "major sources" under the Act must apply for permits within one year from when EPA approves the state permit programs. Since most state programs were not approved until after November 1994, Title V permit applications, for the most part, began to be due in late 1995. Due dates for filing complete applications vary significantly from state to state, based on the status of review and approval of the state's Title V program by EPA.

A facility is designated as a major source for Title V if it releases a certain amount of any one of the CAAA regulated pollutants (SOx, NOx, CO, VOC, PM_{10}, hazardous air pollutants, extremely hazardous substances, ozone depleting substances, and pollutants covered by NSPSs) depending on the region's air quality category. Title V permits may set limits on the amounts of pollutant emissions; require emissions monitoring, and record keeping and reporting. Facilities are required to pay an annual fee based on the magnitude of the facility's potential emissions. It is estimated that as many as 2,869 aerospace facilities will be designated as major sources and therefore must apply for a Title V permit.

Under section 112(r) of CAA, owners and operators of stationary sources who produce, process, handle, or store substances listed under CAA section 112(r)(3) or any other extremely hazardous substance have a "general duty" to initiate specific activities to prevent and mitigate accidental releases. Since the general duty requirements apply to stationary sources regardless of the quantity of substances managed at the facility, many aerospace manufacturing and reworking facilities are subject. Activities such as identifying hazards which may result from accidental releases using appropriate hazard assessment techniques; designing, maintaining and operating a safe facility; and minimizing the consequences of accidental releases if they occur are considered essential activities to satisfy the general duty requirements. These statutory requirements have been in affect since the passage of the Clean Air Act Amendments in 1990. Although there is no list of "extremely hazardous substances," EPA's Chemical Emergency Preparedness and Prevention Office provides some guidance at its website: http://www.epa.gov/swercepp.html.

Also under section 112(r), EPA was required to develop a list of at least 100 substances that, in the event of an accidental release, could cause death, injury, or serious adverse effects to human health or the environment. The list promulgated by EPA is contained in 40 CFR 68.130 and includes acutely toxic chemicals, flammable gases and volatile flammable liquids, and Division 1.1 high explosive substances as listed by DOT in 49 CFR 172.101. Under section 112(r)(7), facilities handling more than a threshold quantity (ranging from 500 to 20,000 pounds) of these substances are subject to chemical accident prevention provisions including the development and implementation of a risk management program (40 CFR 68.150-68.220). The requirements in 40 CFR Part 68 begin to go into effect in June 1999. Some of the chemicals on the 112(r) list could be handled by aerospace manufacturers and reworkers in quantities greater than the threshold values.

Clean Water Act

Aerospace manufacturing and rework facility wastewater released to surface waters is regulated under the CWA. National Pollutant Discharge Elimination System (NPDES) permits must be obtained to discharge wastewater into navigable waters (40 Part 122). Facilities that discharge to a POTW may be required to meet National Pretreatment Standards for some contaminants. General pretreatment standards applying to most industries discharging to a POTW are described in 40 CFR Part 403. In addition, effluent limitation guidelines, new source performance standards, pretreatment standards for new sources, and pretreatment standards for existing sources may apply to some aerospace manufacturing and rework facilities that carry out electroplating or metal finishing operations. Requirements for the Electroplating Point Source Category and the Metal Finishing Point Source Category are listed under 40 CFR Part 413 and 40 CFR Part 433, respectively.

Storm water rules require certain facilities with storm water discharge from any one of 11 categories of industrial activity defined in 40 CFR 122.26 be subject to the storm water permit application requirements (see Section VI.A). Many aerospace facilities fall within these categories. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

VI.C. Pending and Proposed Regulatory Requirements

Clean Water Act

Effluent limitation guidelines for wastewater discharges from metal products and machinery (MP&M) industries are being developed. MP&M industries have been divided into two groups that originally were to be covered under two separate phases of the rulemaking. Effluent guidelines for Phase I industries and Phase II industries (which includes the aerospace industry) will now be covered under a single regulation to be proposed in October 2000 and finalized in December 2002. (Steven Geil, U.S. EPA, Office of Water, Engineering and Analysis Division, (202)260-9817, email: geil.steve@epamail.epa.gov)

Clean Air Act

In December 1997, EPA published Control Technique Guidelines (CTG) for the control of VOC emissions from coating operations at aerospace manufacturing and rework operations. The CTG was issued to assist states in analyzing and determining reasonably available control technology (RACT) standards for major sources of VOCs in the aerospace manufacturing and rework operations located within ozone NAAQS nonattainment areas. EPA estimates that there are approximately 2,869 facilities that could fall within this category. Within one year of the publication of the CTG, states must adopt a RACT regulation at least as stringent as the limits recommended in the CTG. Under Section 183(b)(3) of the Clean Air Act, EPA is required to issue the CTG for aerospace coating and solvent application operations based on "best available control measures" (BACM) for emissions of VOCs. (Barbara Driscoll, U.S. EPA, Office of Air Quality Planning and Standards, (919) 541-0164)

Several National Emission Standards for Hazardous Air Pollutants (NESHAPs) relating to the aerospace industry are being developed for promulgation by November of 2000. They include: Rocket Engine Test Firing, Engine Test Facilities, Miscellaneous Metal Parts and Products, and Plastic Parts and Products. (Contact: In the U.S. EPA Office of Air Quality Planning and Standards, George Smith for information pertaining to the former two, (919)541-1549; and Bruce Moore for the latter two, (919)541-5460)

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within

the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (April 1, 1992 to March 31, 1997) and the other for the most recent twelve-month period (April 1, 1996 to March 31, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across EPA Regions for certain sectors.[4] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of

[4] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

records for that facility. Some of the data systems accessible through IDEA are: AFS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes.

A facility with multiple enforcement actions is counted multiple times, e.g., a facility with 3 enforcement actions counts as 3.

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total

Actions" column.

VII.A. Aerospace Industry Compliance History

Table 14 provides an overview of the reported compliance and enforcement data for the aerospace industry over the past five years (April 1992 to April 1997). These data are also broken out by EPA Regions thereby permitting geographical comparisons. A few points evident from the data are listed below.

• Region IX and Region I had the most enforcement actions (43 and 36 respectively), accounting for 62 percent of the total enforcement actions and only 29 percent of the total inspections. Thus, these two Regions had the highest enforcement/inspection ratios (0.26 and 0.19).

• Region IV had significantly more inspections (325) than the other Regions, 27 percent of the total, but only 13 percent of enforcement actions.

• Enforcement actions were primarily state-lead (75 percent), especially in Regions with the greatest number of enforcement actions.

• Region V had the highest average time between inspections (23 months), which means that fewer inspections, in relation to the number of facilities, were done in Region V than in other Regions.

Table 14: Five-Year Enforcement and Compliance Summary for the Aerospace Industry									
A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	34	28	185	11	16	36	50%	50%	0.19
II	7	6	29	14	3	3	67%	33%	0.10
III	12	9	117	6	4	6	83%	17%	0.05
IV	38	34	325	7	12	16	94%	6%	0.05
V	37	27	97	23	2	3	67%	33%	0.03
VI	37	27	134	17	7	14	79%	21%	0.10
VII	8	7	54	9	2	2	50%	50%	0.04
VIII	7	4	29	14	2	2	100%	0%	0.03
IX	47	33	163	17	17	43	93%	7%	0.26
X	10	9	73	8	2	2	0%	100%	0.03
TOTAL	237	184	1206	12	67	127	75%	25%	0.10

VII.B. Comparison of Enforcement Activity Between Selected Industries

Tables 15 and 16 allow the compliance history of the aerospace sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Tables 15 and 16 permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering the last five years (April 1992 to April 1997) to that of the past year (April 1996 to April 1997). Some points evident from the data are listed below.

• The one-year enforcement/inspection ratio (0.05) is only half of the five-year ratio (0.10).

• The aerospace industry data approximate the averages of the industries shown for enforcement/inspection ratios, state-lead versus federal-lead actions, and facilities with one or more violations and enforcement actions.

Tables 17 and 18 provide a more in-depth comparison between the aerospace industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Tables (Tables 15 and 16), the data cover the last five years (Table 17) and the last one year (Table 18) to facilitate the identification of recent trends. A few points evident from the data are listed below.

• The aerospace industry has the highest percentage of RCRA inspections (54 percent of total) of any industry.

• The one-year versus five-year breakdowns in terms of percent of total inspections do not differ significantly. However, the percent of total actions pertaining to RCRA increased from 42 percent to 55 percent in the past year. CWA actions decreased from 11 percent to zero percent in the last year.

Table 15: Five-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Aerospace	**237**	**184**	**1,206**	**12**	**67**	**127**	**75%**	**25%**	**0.10**
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

R0074718

Table 16: One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Aerospace	**237**	**119**	**216**	**105**	**88%**	**8**	**7%**	**11**	**0.05**
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions*

R0074719

Table 17: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Aerospace	**184**	**1,206**	**127**	**34%**	**38%**	**10%**	**11%**	**54%**	**42%**	**2%**	**9%**
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

Table 18: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Aerospace	**119**	**216**	**11**	**37%**	**36%**	**7%**	**0%**	**54%**	**55%**	**1%**	**9%**
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

R0074721

VII.C. Review of Major Legal Actions

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

VII.C.1. Review of Major Cases

As indicated in EPA's *Enforcement Accomplishments Report, FY1995 and FY1996* publications, one significant enforcement action was resolved between 1995 and 1996 for the aerospace industry.

U.S. v. General Electric Company General Electric (GE) operates a facility in Lynn. MA at which the company tests and manufactures aircraft. The enforcement issues arose from GE's failure to obtain prevention of significant deterioration (PSD) permits for one boiler and for four test cells used for the testing of jet engines. The boiler and the test cells emit NOx in quantities that trigger the PSD new source review requirements of the Clean Air Act. GE installed/constructed two new test cells in the early 1980s and modified two test cells in the late 1980s, without obtaining required permits. GE installed/constructed the boiler without obtaining an adequate permit. The boiler also emitted NOx in excess of the levels permissible in EPA's New Source Performance Standards (NSPS).

VII.C.2. Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the internet at the SEP National Database, http://es.epa.gov/oeca/sep/sepdb.

Aerospace Techniques, Inc., in Cromwell, Connecticut, performed a SEP in return for failing to submit a Toxic Release Inventory Form R for 1,1,1-trichloroethane. Aerospace Techniques achieved a 4,500 pound reduction in 1,1,1-trichloroethane releases by replacing the larger of its two vapor degreasers with jet washing machines using heated aqueous cleaning solution. They also plan to scale back degreasing operations to final rinses and replace six interim part-rinsing stations that utilize aqueous cleaner. The cost of this project was $9,766.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those initiated independently by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

VIII.A.1. Federal Activities

Propulsion Environmental Working Group

The Propulsion Environmental Working Group (PEWG) was formally chartered in 1994 by the Joint Propulsion Coordinating Committee (JPCC), a consortium of industry and Department of Defense participants. PEWG is composed of members from the Army, Navy, and Air Force, and of companies such as Allied Signal, GE Aircraft Engines, Allison Engine, Williams Intl., P&W UTC, Teledyne, Continental, and Sundstrand.

PEWG's chartered objectives include:

•providing an open forum for information exchange on possible technologies to eliminate HAZMATs,

•assisting team members with decisions regarding HAZMATs, identifying HAZMATs, and assisting in prevention and control of HAZMATs,

•assisting engine manufacturers and reworkers with compliance of state and federal regulations,

•ensuring and assisting in the completion of required environmental documentation such as EAs or EIAs,

•establishing committees to address topics of interest for the team members.

Propulsion Product Group

The Air Force Propulsion Product Group (PPG) works to incorporate environmental, safety, and occupational health concerns into multiple weapon systems. The PPG is a participant in the Propulsion Environmental Working Group discussed above. Some of the accomplishment of the PPG are:

•eliminating the use of Class I Ozone Depleting Substances (ODS)

•reducing the use of EPA-17 materials

•facilitating the annual reduction of EPA-17 materials and Class I ODS's used by OEM's.

Airworthiness Assurance Center of Excellence

The FAA created the Airworthiness Assurance Center of Excellence (AACE) in September 1997 in an effort to "make a significant contribution to the reduction of accident rates over the next five years." AACE is based at Iowa State University and Ohio State University. The five principal areas of research are maintenance, inspection and repair, propulsion and fuel systems safety, crashworthiness, advanced materials, and landing gear systems performance and safety. A focus of the work is to develop crack detection methods for particularly small cracks which may be under several layers of skin. Major airlines are also pushing for inspection techniques which do not require disassembly, thus preserving sealants and coatings (*AW&ST*, 3/30/98).

Joint EPA/NASA/USAF Interagency Depainting Study

NASA is conducting a technical assessment of alternative technologies for aerospace depainting operations on behalf of the EPA and the US Air Force. Such technologies are to be used as paint stripping processes which do not adversely affect the environment and which specifically do not involve the use of methylene chloride. The nine techniques subdivided into five removal method categories (abrasive, impact, cyrogenic, thermal, and molecular bonding disassociation).

Thai Airways/Government of Thailand/USEPA Solvent Elimination Project

The Government of Thailand, Thai Airways, and the USEPA Solvent Elimination Project studied methods of eliminating CFC-113 and methyl chloroform use. This project was undertaken as part of the World Bank Global Solvents Project under the Multilateral Fund of the Montreal Protocol. The manual developed under this project describes a step-by-step approach for characterizing the use of ozone-depleting solvents and identifying and evaluating alternatives. For case studies on this topic, see *Eliminating CFC-113 and Methyl Chloroform in Aircraft Maintenance Procedures*, published by the Office of Air and Radiation of the USEPA in October 1993.

VIII.B. EPA Voluntary Programs

33/50 Program

The 33/50 Program is a groundbreaking program that has focused on reducing pollution from seventeen high-priority chemicals through voluntary partnerships with industry. The program's name stems from its goals: a 33% reduction in toxic releases by 1992, and a 50% reduction by 1995, against a baseline of 1.5 billion pounds of releases and transfers in 1988. The results have been impressive: 1,300 companies joined the 33/50 Program (representing over 6,000 facilities) and reached the national targets a year ahead of schedule. The 33% goal was reached in 1991, and the 50% goal -- a reduction of 745 million pounds of toxic wastes -- was reached in 1994. The 33/50 Program can provide case studies on many of the corporate accomplishments in reducing waste (Contact 33/50 Program Director David Sarokin -- 202-260-6396).

Table 19 lists those companies participating in the 33/50 program that reported four-digit SIC codes within 372 and 376 to TRI. Some of the companies shown also listed facilities that are not producing aerospace products. The number of facilities within each company that are participating in the 33/50 program and that report aerospace SIC codes is shown. Where available and quantfiable against 1988 releases and transfers, each company's 33/50 goals for 1995 and the actual total releases and transfers and percent reduction between 1988 and 1995 are presented. Thirteen of the seventeen 33/50 target chemicals were reported to TRI by aerospace facilities in 1995. These 13 chemicals accounted for 77 percent of the total releases and 65 percent of the total transfers reported to the 1995 TRI by aerospace facilities.

Table 19 shows that 47 companies comprised of 506 facilities reporting SIC 372 and 376 participated in the 33/50 program. For those companies shown with more than one aerospace facility, all facilities may not have participated in 33/50. The 33/50 goals shown for companies with multiple aerospace facilities, however, are company-wide, potentially aggregating more than one facility and facilities not carrying out aerospace operations. In addition to company-wide goals, individual facilities within a company may have had their own 33/50 goals or may be specifically listed as not participating in the 33/50 program. Since the actual percent reductions shown in the last column apply to all of the companies' aerospace facilities and only aerospace facilities, direct comparisons to those company goals incorporating non-aerospace facilities or excluding certain facilities may not be possible. For information on specific facilities participating in 33/50, contact David Sarokin (202-260-6907) at the 33/50 Program Office.

With the completion of the 33/50 program, several lessons were learned. Industry and the environment benefitted by this program for several reasons. Companies were willing to participate because cost savings and risk reduction were measurable and no additional record keeping and reporting was required. The goals of the program were clear and simple and EPA allowed industry to achieve the goals in whatever manner they could. Therefore, when companies can see the benefits of environmental programs and be an active part of the decision-making process, they are more likely to participate.

Table 19: Aerospace Industry Participation in the 33/50 Program

Parent Company (Headquarters Location)	Company-Owned Aerospace Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988-1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	1995 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	Actual % Reduction for Aerospace Facilities (1988-1995)
Aeroforce Corp.- Muncie, IN	1	0	1,500	8,601	-473%
Aerothrust Corp.- Miami, FL	1	100	72,500	9,995	86%
Allied-Signal Inc.- Morristown, NJ	91	50	6,018,249	1,535,148	74%
Aluminum Co. of America- Pittsburgh, PA	1	51	220,733	83,830	62%
Arkwin Industries- Westbury, NY	1	50	134,100	0	100%
Arrowhead Holdings Corp.- Bala Cynwyd, PA	1	0	39,855	24,800	38%
BF Goodrich Co.- Akron, OH	30	49	2,251,997	1,109,800	51%
Boeing Commercial Airplane- Seattle, WA	24	50	13,471,898	2,251,461	83%
Chemical Milling Intl. Corp.- Rosamond, CA	2	0	234,356	0	100%
Chrysler Corp.- Auburn Hills, MI	2	80	43,155	154,561	-258%
Ciba-Geigy Corp.- Tarrytown, NY	1	50	81,555	17,650	78%
Dassault Falcon Jet Corp.- Paramus, NJ	2	40	355,070	34,005	90%
Dynamic Metal Prods. Co.- Manchester, CT	1	0	0	0	---
Eaton Corp.- Cleveland, OH	1	50	22,199	0	100%
FR Holdings Inc.- Aurora, CO	2	32	124,250	0	100%
Gencorp Inc.- Akron, OH	14	33	7,639,190	3,412,754	55%
General Dynamics Corp.- Falls Church, VA	3	81	291,110	24,755	91%
General Electric Corp.- Fairfield, CT	130	50	19,129,041	4,557,753	76%
General Motors Corp.- Detroit, MI	3	0	483,255	0	100%
Globe Engineering Co.- Wichita, KS	1	0	0	15,740	---
Howmet Corp.- Greenwich, CT	5	0	56,240	15,905	72%
Interlake Corp.- Lisle, IL	1	37	224,486	5,116	98%
JT Slocomb Co.- South Glastonbury, CT	2	50	41,001	0	100%
K Systems Inc.- Foster City, CA	2	0	0	0	---
Kimberly-Clark Corp.- Irving, TX	1	50	0	0	---
Large Structrals Business Ops.- Portland, OR	5	26	89,890	68,538	24%
Lockheed Martin Corp.- Bethesda, MD	41	42	6,121,565	520,120	92%
Lucas Industries- Troy, MI	7	14	229,051	47,555	79%
McDonnell Douglas Corp.- St. Louis, MO	14	50	4,619,458	903,626	80%
Meco Inc. Paris, IL	1	0	36,162	78,792	118%
NMB USA Inc.- Chatsworth, CA	1	0	0	0	---
Northrop Grumman Corp.- Los Angeles, CA	11	35	2,339,803	731,032	69%
Pall Rai Inc.- Hauppauge, NY	2	31	43,900	46,763	-7%
Parker Hannifin Corp.- Cleveland, OH	6	50	143,380	0	100%
Raytheon Co.- Lexington, MA	3	50	1,036,083	355,298	66%
Rockwell Intl. Corp.- Seal Beach, CA	2	50	150,513	0	100%
Rohr Industries Inc.- Chula Vista, CA	7	25	1,849,382	436,056	76%

R0074726

Parent Company (Headquarters Location)	Company-Owned Aerospace Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988-1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	1995 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	Actual % Reduction for Aerospace Facilities (1988-1995)
SEGL Inc.- Los Angeles, CA	1	13	75,000	23,005	69%
SKF USA Inc.- King of Prussia, PA	1	0	0	0	---
Skyline Products- Harrisburg, OR	1	0	0	0	---
Sundstrand Corp.- Rockford, IL	3	0	494,750	4,293	85%
Talley Industries Inc.- Phoenix, AZ	9	0	133,323	177,213	-33%
Thiokol Corp.- Ogden, UT	14	40	2,687,295	788,979	71%
Trinova Corp.- Maumee, OH	1	50	0	14,400	---
United Technologies Corp.- Hartford, CT	60	50	8,496,888	952,497	89%
US Air Force- Washington, DC	4	0	1,643,050	460,159	72%
Total	**517**	—	**81,125,233**	**18,940,200**	77%

Source: U.S. EPA 33/50 Program Office, 1996.
[1] Company-Wide Reduction Goals aggregate all company-owned facilities which may include facilities not producing aerospace products.
[2] Releases and Transfers are from aerospace facilities only.

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Fax-on-Demand Hotline 202-260-8590, Web: http://www.epa.gov/ProjectXL, or Christopher Knopes in EPA's Office of Reinvention 202-260-9298)

Energy Star® Buildings and Green Lights® Partnership

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy-efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings-- a strategy that optimizes whole-building energy-efficiency opportunities.

The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of 110 billion dollars a year. If implemented in every U.S. commercial and industrial building, Energy Star® Buildings' upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to 25 billion dollars annually.

The over 2,500 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. As of January 1, 1998, Energy Star®Buildings and Green Lights® Program participants have reduced their annual energy use by 7 billion kilowatt hours and annually save more than 517 million dollars. By joining, participants agree to upgrade 90 percent of their owned facilities with energy-efficient lighting and 50 percent of their owned facilities with whole-building upgrades, where profitable, over a seven-year period. Energy Star participants first reduce their energy loads with the Green Lights approach to building tune-ups, then focus on "right sizing" their heating and cooling equipment to march their new energy needs. EPA predicts this strategy will prevent more than 5.5 MMTCE of carbon dioxide by the year 2000. EPA's Office of Air and Radiation is responsible for operating the Energy Star Buildings and Green Lights Program. (Contact the Energy Star Hotline number, 1-888-STAR-YES (1-888-872-7937) or Maria Tikoff Vargas, Co-Director at (202) 564-9178 or visit the website at http://www.epa.gov/buildings.)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1998, the program had about 700 business, government, and institutional partners. Partners agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports for a three year period. EPA, in turn, provides partners with technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at 1-800-372-9473 or Joanne

Oxley, EPA Program Manager, 703-308-0199)

NICE³

The U.S. Department of Energy sponsors a grant program called *National Industrial Competitiveness through Energy, Environment, and Economics* (NICE³). The NICE³ program provides funding to state and industry partnerships (large and small business) for projects demonstrating advances in energy efficiency and clean production technologies. The goal of the NICE³ program is to demonstrate the performance and economics of innovative technologies in the U.S., leading to the commercialization of improved industrial manufacturing processes. These processes should conserve energy, reduce waste, and improve industrial cost-competitiveness. Industry applicants must submit project proposals through a state energy, pollution prevention, or business development office. The following focus industries, which represent the dominant energy users and waste generators in the U.S. manufacturing sector, are of particular interest to the program: Aluminum, Chemicals, Forest Products, Glass, Metal-casting, and Steel. Awardees receive a one-time, three-year grant of up to $400,000, representing up to 50 percent of a project's total cost. In addition, up to $25,000 is available to support the state applicant's cost share. (Contact: http//www.oit.doe.gov/Access/nice3, Steve Blazek, DOE, 303-275-4723 or Eric Hass, DOE, 303-275-4728)

Design for the Environment (DfE)

DfE is working with several industries to identify cost-effective pollution prevention strategies that reduce risks to workers and the environment. DfE helps businesses compare and evaluate the performance, cost, pollution prevention benefits, and human health and environmental risks associated with existing and alternative technologies. The goal of these projects is to encourage businesses to consider and use cleaner products, processes, and technologies. For more information about the DfE Program, call (202) 260-1678. To obtain copies of DfE materials or for general information about DfE, contact EPA's Pollution Prevention Information Clearinghouse at (202) 260-1023 or visit the DfE Website at http://www.epa.gov/dfe.

Several DfE projects have been completed pertaining to the aerospace industry. Brief descriptions follow.

The National Science Foundation (NSF), the State of Massachusetts, the Biodegradable Polymer Research Center, the Toxics Use Reduction Institute, and the Center for Environmentally Advanced Materials were partners in a DfE project on aerospace metal degreasing.

EPA established an interagency agreement with the Department of Energy, in partnership with the Joint Association for the Advancement of Supercritical Technology, to determine the suitability of supercritical carbon dioxide as an alternative method for cleaning and degreasing parts. The degree of contaminant removal of the cleaners as well as human health and environmental effects were evaluated under this project. In another agreement with the Department of Energy, EPA obtained the services of the Oak Ridge National Laboratory to perform research and prepare toxicity summaries in support of EPA risk assessment activities conducted on all segments of the aerospace DfE project.

The Experimental Aircraft Association (EAA) was awarded by the EPA for a demonstration project in small aircraft paint stripping. This project, begun as a DfE project jointly run by OPPT and the Coast Guard, explored alternatives to methylene chloride and other hazardous solvent paint strippers. In the summer of 1997, the EAA completely stripped and repainted a small plane using products that contained no chemicals on the EPA's Hazardous Air Pollutant list and that met the definition of low volatile organic chemical (VOC) releases (P2 Newsletter, 1997).

Small Business Compliance Assistance Centers

The Office of Compliance, in partnership with industry, academic institutions, environmental groups, and other federal and state agencies, has established national Compliance Assistance Centers for four specific industry sectors heavily populated with small businesses that face substantial federal regulation. These sectors are printing, metal finishing, automotive services and repair, agriculture, painted coatings, small chemical manufacturers, municipalities, and transportation.

The purpose of the Centers is to improve compliance of the customers they serve by increasing their awareness of the pertinent federal regulatory requirements and by providing the information that will enable them to achieve compliance. The Centers accomplish this by offering the following:

•"First-Stop Shopping" - serve as the first place that small businesses and technical assistance providers go to get comprehensive, easy to understand compliance information targeted specifically to industry sectors.

•"Improved Information Transfer" - via the Internet and other means, create linkages between the small business community and providers of technical and regulatory assistance and among the providers themselves to share tools and knowledge and prevent duplication of efforts.

•"Compliance Assistance Tools" - develop and disseminate plain-English guides, consolidated checklists, fact sheets, and other tools where needed by small businesses and their information providers.

•"Links Between Pollution Prevention and Compliance Goals" - provide easy access to information and technical assistance on technologies to help minimize waste generation and maximize environmental performance.

•"Information on Ways to Reduce the Costs of Compliance" - identify technologies and best management practices that reduce pollution while saving money.

For general information regarding EPA's compliance assistance centers, contact Lynn Vendinello at (202)564-7066, or go to http://www.epa.gov/oeca/mfcac.html.

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Industry Research Programs

NASA Langley Research Center and the Tidewater Interagency P2 Program

NASA's Langley Research Center (LaRC) is devoted to aeronautics and space research and has initiated a broad-based pollution prevention program guided by a Pollution Prevention Program Plan and implemented through specific projects. The Program Plan contains an environmental baseline, opportunities for P2, and establishes a framework to plan, implement, and monitor specific prioritized P2 projects. LaRC is one of the participants in the Tidewater Interagency Pollution Prevention Program (TIPPP). TIPPP was developed under an interagency agreement and designed to integrate P2 concepts and practices at Federal installations in the Tidewater, Virginia area.

Air Force Center for Environmental Excellence

The Air Force Center for Environmental Excellence (AFCEE) is working toward environmental leadership and pollution prevention. The Environmental Quality Directorate of the AFCEE has developed a Base Pollution Prevention Management Action Plan (PPMAP). Each base environmental manager must submit a PPMAP for his/her shop. Many Air Force Bases have also completed Pollution Prevention Opportunity Assessment Reports (OARs) which outline alternative approaches that a Base can use for P2 in Base-specific operations, including rework of aircraft.

Lean Aircraft Initiative Program

The Lean Aircraft Initiative (LAI) is a three-year program which strives to define and foster dynamic, fundamental change in both the U.S. defense aircraft industry and government operations over the next decade. LAI is a cooperative venture of private industry, the U.S. Air Force, and the EPA, supported by the analytical and research expertise of the Massachusetts Institute of Technology. By building on and extending the "lean" paradigm through an organized process of research, the program seeks to develop the knowledge base that will lead to greater affordability of systems, higher quality, and increased efficiency including efficient use of materials.

Chemical Strategies Partnership

The Chemical Strategies Partnership (CSP), funded by the Pew Charitable Trusts, began a pilot project with Hughes Missile Systems Company and Nortel. The CSP project aims to reduce their use and release of toxic chemicals in manufacturing while improving production efficiency and competitiveness.

Joint Depot Environmental Panel (JDEP)

The Joint Policy Coordinating Group on Depot Maintenance in the Department of Defense chartered the Joint Depot Environmental Panel (JDEP) in 1988 to facilitate information exchange on environmental issues, technologies, and processes with potential application in the depot maintenance community. The JDEP's functions are to review the depot's current environmental program, compile information on techniques and processes with potential application, coordinate the development and implementation of environmental initiatives, and establish liaisons with federal agencies. The JDEP has hosted over 37 meetings and distributed over 500 technical briefings. Total dismantling of JDEP will occur in October 1998. *(see JASPPA below.)*

Joint Group on Acquisition Pollution Prevention (JGAPP)

The Department of Defense has developed the Joint Group on Acquisition Pollution Prevention (JGAPP) as a military/industry initiative to reduce the use of hazardous material in manufacturing processes. The initiative involves seven major corporations and their related services. The JGAPP is working with manufacturers at their facilities to reduce the use of specific hazardous materials in all of the programs at the facility.

Joint Acquisition & Sustainment Pollution Prevention Activity (JASPPA)

The Joint Logistics Commanders of the Department of Defense tasked the JGAPP and JDEP to explore the possibility of a single pollution prevention activity. Since then the JDEP and the Joint Pollution Prevention Advisory Board (JPPAB, which JGAPP is part of) have been working and meeting together to develop various avenues of consideration for that tasking. As a result, the JDEP and JPPAB have decided to merge to form a single integrated group called the Joint Acquisition & Sustainment Pollution Prevention Activity (JASPPA). The JASPPA will function as a single integrating activity for all pollution prevention efforts for both the acquisition and sustainment communities. (For more information, contact Carl Adams in the Joint Depot Maintenance Activities Group, (937)656-2771.)

Aerospace Environmental Roundtable

The Aerospace Environmental Roundtable is an informal monthly meeting coordinated by the Aerospace Industries Association(AIA). Attendees include other trade associations, contractors, and anyone else interested in discussing environmental issues, increasing awareness, and sharing information pertaining to the aerospace industry. (For more information, contact Glynn Rountree, (202)371-8401.)

VIII.C.2. Trade Associations

Aerospace Industries Association of America (AIA)
1250 Eye St. NW, Suite1200 (202)371-8400
Washington, DC 20005 (202)371-8401 FAX
John Douglass, Pres.

AIA was founded in 1919 as a trade association which represents the nation's manufacturers of commercial, military and business aircraft, helicopters, aircraft engines, missiles, space craft, and related components and equipment. AIA maintains the AIA Aerospace Research Center to compile statistics on the industry. AIA's annual budget is roughly seven million dollars. They publish *Aerospace Facts and Figures* annually which contains statistical and analytical information on aircraft production, missile programs, space programs, and air transportation, as well as an annual report and an AIA newsletter.

Aircraft Electronics Association (AEA)
PO Box 1963 (816)373-6565
Independence, MO 64055-0963 (816)478-3100 FAX
Monte Mitchell, Pres.

AEA was founded in 1958 by companies engaged in the sales, engineering, installation, and service of electronic aviation equipment and systems. AEA works to advance the science of aircraft electronics, promote uniform and stable regulations and standards of performance, gather and disseminate technical data, and educate the aircraft electronics community and the public. They publish *Avionics News*, a monthly trade magazine. The annual budget is one million dollars.

American Helicopter Society (AHS)
217 N. Washington St. (703)684-6777
Alexandria, VA 22314 (703)739-9279 FAX
Morris E. Flatter, Exec. Dir.

AHS was founded in 1943 and is composed of aircraft designers, engineers, government personnel, operators, and industry executives in over forty countries interested in V/STOL aircraft. AHS conducts research and educational and technical meetings concerning professional training and updated information. They publish an annual composite of technical papers presented at the AHS forum, a quarterly journal, *Journal of the American Helicopter Society,* A bimonthly magazine, *VertFlite*, and other technical papers. They operate on a one million dollar budget.

Aviation Distributors and Manufacturers Association (ADMA)
1900 Arch St. (215)564-3484
Philadelphia, PA 19103-1498 (215)564-2175 FAX
Patricia A. Lilly, Exec. Dir.

ADMA was founded in 1943 as an association of wholesalers and manufacturers of general aviation aircraft parts, supplies, and equipment. They publish *ADMA News* bimonthly, *Aviation Education News Bulleting* bimonthly, and an annual directory.

Council of Defense and Space Industry Associations (CODSIA)
2111 Wilson Blvd., Suite 400 (703)247-9490
Arlington, VA 22201-3061
Peter Scrivner, Exec. Sec.

CODSIA was founded in 1964 and is comprised of the Aerospace Industries Association of America, Contract Services Association of America, Electronic Industries Association, National Security Industrial Association, Shipbuilders Council of America, American Electronics Association, Professional Services Council, and Manufacturers' Alliance for Productivity and Innovation. CODSIA holds three meetings per year in order to simplify, expedite, and improve industry-wide communications regarding policies, regulations, and problems.

Flight Safety Foundation (FSF)
2200 Wilson Blvd. Ste. 500 (703)522-8300
Arlington, VA 22201 (703)525-6047 FAX
Stuart Matthews, Pres.

FSF was founded in 1945 to represent aerospace manufacturers, domestic and foreign airlines, insurance companies, fuel and oil companies, schools, and miscellaneous organizations having an interest in the promotion of safety in flight. They have an annual budget of 2.5 million dollars and publish several bimonthly newsletters, studies, and an annual membership directory.

General Aviation Manufacturers Association (GAMA)
1400 K St. NW, Ste. 801 (202)393-1500
Washington, DC 20005 (202)842-4063 FAX
Edward W. Simpson, Pres.

GAMA was founded in 1970 as an association of manufacturers of aviation airframes, engines, avionics, and components. They strive to create a better climate for the growth of general aviation. GAMA publishes quarterly and annual reports as well as films and printed material on the aviation industry.

Helicopter Safety Advisory Conference (HSAC)
PO Box 60220 (713)960-7654
Houston, TX 77205 (713)960-7660 FAX
Dick Landrum, Chm.

HSAC is comprised of helicopter operators, manufacturers, and others involved in the transport of workers by helicopter. HSAC promotes safety and seeks to improve operations through establishment of standards of practice. HSAC was founded in 1979.

International Society of Transport Aircraft Trading (ISTAT)
5517 Talon Ct. (703)978-8156
Fairfax, VA 22032-1737 (703)503-5964 FAX
Dawn O'Day Foster, Exec. Dir.

ISTAT was founded in 1983 as a society of professionals engaged in the purchase, sale, financing, manufacturing, appraising, and leasing of new and used commercial aircraft. ISTAT publishes a quarterly newsletter, *JeTrader*, and an annual membership directory.

Light Aircraft Manufacturers Association (LAMA)
22 Deer Oaks Ct. (510)426-0771
Pleasanton, CA 94588
Lawrence P. Burke, Pres.

LAMA was founded in 1984 as an association of manufacturers of experimental and ultralight aircraft, suppliers to the homebuilt aircraft community, media and other professionals involved with the light aircraft industry. LAMA works to assure that the interests of the industry are properly represented to the FAA and to Congress and provides uniform standards of manufacturing quality and airworthiness. Lama publishes newsletters, standards, and a membership directory.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the aerospace industry a list of contacts and publications are provided below.

Contacts[5]

Name	Organization	Telephone	Subject
Anthony Raia	USEPA, OECA	(202)564-6045	General notebook contact
Linda Nunn	California Air Resources Board	(916)323-1070	Risk Reduction
Glynn Rountree	Aerospace Industries Association	(202)371-8401	Industry Activities
Steven Geil	USEPA, OW	(202)260-9817	Clean Water Act
Barbara Driscoll	USEPA, OAQPS	(919)541-0164	Clean Air Act
George Smith	USEPA, OAQPS	(919)541-1549	Rocket Engine Test Firing/ Engine Test Facilities NESHAPs
Bruce Moore	USEPA, OAQPS	(919)541-5460	Micellaneous Metal Parts/ Plastic Parts NESHAPs
Ric Peri	National Air Transport Association	(703)845-9000	Industry Activities
Mary Dominiak	USEPA	(202)260-7768	Design for the Environment
Lieutenant Commander Michelle Fitzpatrick	US Coast Guard	(860)441-2859	Aircraft Rework P2

[5] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

R0074737

Section II: Introduction to the Aerospace Industry

Aerospace Source Book, Aviation Week & Space Technology, January 12, 1998.

Smith, Bruce A., "Industry Outlook Is Mix of Growth, Stabilization," *Aviation Week & Space Technology*, March 23, 1998.

USDOC, *1992 Census of Manufactures Industry Series, Aerospace Equipment, Including Parts*, Bureau of the Census, Economics and Statistics Administration, US Department of Commerce, 1995.

USDOC, *U.S. Industry & Trade Outlook '98*, International Trade Commission, US Department of Commerce, McGraw-Hill, 1998.

USEPA/OAQPS, *National Emission Standards for Hazardous Air Pollutants for Source Categories: Aerospace Manufacturing and Rework-- Background Information for Proposed Standards*, Office of Air Quality Planning and Standards, USEPA, Research Triangle Park, NC, May 1994.

Section III: Industrial Process Description

California Air Resources Board, *Guidelines for the Aerospace Industry Facilities*, Emissions Assessment Branch, California Environmental Protection Agency, November 1997.

Horne, D.F. *Aircraft Production Technology*, Cambridge University Press, Cambridge, 1986.

Ohio EPA, *Extending the Life of Metal Working Fluids*, Fact Sheet Number 11, Office of Pollution Prevention, March 1993.

Ohio EPA, *Pollution Prevention in Painting and Coating Operations*, Fact Sheet Number 23, Office of Pollution Prevention, September 1994.

USEPA, *Guide to Cleaner Technologies, Alternative Metal Finishes*, Office of Research and Development, USEPA, September 1994.

USEPA/NRMRL, *Environmental Research Brief, Pollution Prevention Assessment for a Manufacturer of Aircraft Landing Gear*, National Risk Management Research Library, USEPA, Cincinnati, OH, August 1995.

USEPA/OAQPS, *Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework Operations*, Office of Air Quality Planning and Standards, USEPA, Research Triangle Park, NC, December 1997.

USEPA/OAQPS, *National Emission Standards for Hazardous Air Pollutants for Source Categories: Aerospace Manufacturing and Rework-- Background Information for Proposed Standards*, Office of Air Quality Planning and Standards, USEPA, Research Triangle Park, NC, May 1994.

USEPA/OPPT, *Pollution Prevention Options in Metal Fabricated Products Industries*, Office of Pollution Prevention and Toxics, USEPA, January 1992.

USEPA/ORD, *Guides to Pollution Prevention, The Fabricated Metal Products Industry*, Office of Research and Development, USEPA, Washington, DC, July 1990.

USEPA/OW, *Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products and Machinery Phase I Point Source Category*, Office of Water, USEPA, April 1995.

USEPA/OECA, *Profile of the Motor Vehicle Assembly Industry*, Office of Enforcement and Compliance Assurance, USEPA, September 1995.

Section IV: Chemical Release and Transfer Profile

1995 Toxics Release Inventory Public Data Release, USEPA Office of Pollution Prevention and Toxics, April 1997. (EPA 745-R-97-005)

NIOSH Pocket Guide to Chemical Hazards, US Department of Health and Human Services, Center for Disease Control and Prevention, June 1994.

ChemFinder Database, <chemfinder.camsoft.com>

Section V: Pollution Prevention Opportunities

Air Force Center for Environmental Excellence, Environmental Quality Directorate, *Pollution Prevention Model Shop Report, Flightline Maintenance Shops*, Brooks Air Force Base, November 30, 1994, modified June 30, 1995.

Boeing Company Web Site, <www.boeing.com/company/offices/aboutus/environment>.
California Department of Health Services, *Waste Reduction for the Aerospace Industry*, Toxic Substances Control Program, Alternative Technology Division, April 1990.

Chao, S.C. and McHardy, J., *Progress in Supercritical CO_2 Cleaning*, Electro-Optical and Data Systems Group, Hughes Aircraft Company.

Dykema, Kevin J., and Larsen, George R., "The Greening of Corporate Culture: Shifting the Environmental Paradigm at Martin Marietta Astronautics Group," *Pollution Prevention Review*, Spring 1993.

Evanoff, Stephen P., "Environmental Resources Management, Case Study #4: Substitution of Low Vapor Pressure Organic Solvents and Aqueous Cleaners for CFC-113 Based Cleaning Solvents," *EPA/ICOLP Eliminating CFC-113 and Methyl Chloroform in Aircraft Maintenance Procedures*, October 1993.

Ohio EPA, *Extending the Life of Metal Working Fluids*, Fact Sheet Number 11, Office of Pollution

Prevention, March 1993.

Ohio EPA, *Source Reduction and Metal Recovery Techniques for Metal Finishers*, Fact Sheet Number 24, Office of Pollution Prevention, September 1994.

State of Michigan, *Fact Sheet, Waste Reduction Checklist,* Office of Waste Reduction Services, Departments of Commerce and Natural Resources, December 1989.

USEPA, *Guide to Cleaner Technologies, Alternative Metal Finishes*, Office of Research and Development, USEPA, September 1994.

USEPA/NRMRL, *Environmental Research Brief, Pollution Prevention Assessment for a Manufacturer of Aircraft Landing Gear*, National Risk Management Research Library, USEPA, Cincinnati, OH, August 1995.

USEPA/OAQPS, *Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework Operations*, Office of Air Quality Planning and Standards, USEPA, Research Triangle Park, NC, December 1997.

USEPA/OAR, *Eliminating CFC-113 and Methyl Chloroform in Aircraft Maintenance Procedures*, Office of Air and Radiation, USEPA, October 1993.

USEPA/OECA, *Profile of the Shipbuilding and Repair Industry*, Office of Enforcement and Compliance Assurance, USEPA, September 1997.

USEPA/OPPT, *Pollution Prevention Options in Metal Fabricated Products Industries*, Office of Pollution Prevention and Toxics, USEPA, January 1992.

USEPA/ORD, *Guides to Pollution Prevention, The Fabricated Metal Products Industry*, Office of Research and Development, USEPA, Washington, DC, July 1990.

Section VIII: Compliance Activities and Initiatives

Air Force Center for Environmental Excellence, *Pollution Prevention Model Shop Report, Flightline Maintenance Shops*, Environmental Quality Directorate, AFCEE, Brooks AFB, June 30, 1995.

Dominiak, Mary, "EPA Award Presented to the Experimental Aircraft Association," *P2 Newsletter*, December 1997.

Jaszczak, Sandra, ed. *Gale Encyclopedia of Associations*. 31st ed., International Thomson Publishing Co., 1996.

NASA, *Joint EPA/NASA/USAF Interagency Depainting Study*, Fifth Progress Report, November 1997.

"Project May Offer New Model for Supplier Relationships," *Business and the Environment*, August 1997.

USEPA/OAR, *Eliminating CFC-113 and Methyl Chloroform in Aircraft Maintenance Procedures*, Office of Air and Radiation, October 1993.

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Order Processing Code:
* 3212

Charge your order.
It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Qty	GPO Stock #	Title	Price (each)	Total
		Published in 1995		
	055-000-00512-5	Profile of the Dry Cleaning Industry, 104 pages	$6.50	
	055-000-00513-3	Profile of the Electronics and Computer Industry, 160 pp.	$11.00	
	055-000-00518-4	Profile of the Fabricated Metal Products Industry, 164 pp.	$11.00	
	055-000-00515-0	Profile of the Inorganic Chemical Industry, 136 pages	$9.00	
	055-000-00516-8	Profile of the Iron and Steel Industry, 128 pages	$8.00	
	055-000-00517-6	Profile of the Lumber and Wood Products Industry, 136 pp.	$9.00	
	055-000-00519-2	Profile of the Metal Mining Industry, 148 pages	$10.00	
	055-000-00520-6	Profile of the Motor Vehicle Assembly Industry, 156 pages	$11.00	
	055-000-00521-4	Profile of the Nonferrous Metals Industry, 140 pages	$9.00	
	055-000-00522-2	Profile of the Non-Fuel, Non-Metal Mining Ind., 108 pages	$6.00	
	055-000-00523-1	Profile of the Organic Chemical Industry, 152 pages	$11.00	
	055-000-00524-9	Profile of the Petroleum Refining Industry, 160 pages	$11.00	
	055-000-00525-7	Profile of the Printing Industry, 124 pages	$7.50	
	055-000-00526-5	Profile of the Pulp and Paper Industry, 156 pages	$11.00	
	055-000-00527-3	Profile of the Rubber and Plastic Industry, 152 pages	$11.00	
	055-000-00528-1	Profile of the Stone, Clay, Glass and Concrete Ind., 124 pp.	$7.50	
	055-000-00529-0	Profile of the Transportation Equipment Cleaning Ind., 84 pp.	$5.50	
	055-000-00514-1	Profile of the Wood Furniture and Fixtures Industry, 132 pp.	$8.00	
		Published in 1997		
	055-000-00570-2	Profile of the Air Transportation Industry, 90 pages	$7.50	
	055-000-00576-1	Profile of the Fossil Fuel Electric Power Generation Ind., 160	$14.00	
	055-000-00571-1	Profile of the Ground Transportation Industry, 130 pages	$10.00	
	055-000-00573-7	Profile of the Metal Casting Industry, 150 pages	$13.00	
	055-000-00574-5	Profile of the Pharmaceutical Manufacturing Industry, 147	$13.00	
	055-000-00575-3	Profile of the Plastic Resin & Man-made Fiber Industry, 180	$15.00	
	055-000-00577-0	Profile of the Shipbuilding and Repair Industry, 120 pages	$9.50	
	055-000-00578-8	Profile of the Textile Industry, 130 pages	$10.00	
	055-000-00572-9	Profile of the Water Transportation Industry, 90 pages	$7.50	
		Published in 1998:		
	055-000-00579-6	Sector Notebook Data Refresh-1997, 210 pages	$17.00	
	055-000-00619-9	Profile of the Aerospace Industry, 130 pages	$10.00	
		Published in 1999:		
	055-000-00620-2	Profile of Local Government Operations, 310 pages	$25.00	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change. International orders add 25 percent.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) ***Thank you for your order!***

Authorizing signature 2/98

Mail to: Superintendent of Documents
PO Box 371954, Pittsburgh, PA 15250-7954

Important: Please include completed order form with payment.

R0074742

United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2223A)

EPA

Profile Of The Air Transportation Industry

SECTOR NOTEBOOKS 19

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 18 1997

THE ADMINISTRATOR

Message from the Administrator

Since EPA's founding over 25 years ago, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and those as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper and smarter. As a result, we no longer have rivers catching fire. Our skies are clearer. American environmental technology and expertise are in demand around the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

The Environmental Protection Agency has undertaken its Sector Notebook Project to compile, for major industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with an extensive series covering other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to understand better their regulatory requirements, and learn more about how others in their industry have achieved regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that we together achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-97-001

EPA Office of Compliance Sector Notebook Project

Air Transportation Industry

February 1998

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, and local governments, and the media from EPA's National Center for Environmental Publications and Information at (800) 490-9198. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Stephen Delaney, EPA

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Questions relating to the Sector Notebook Project can be directed to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Jane Engert	564-5021
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Robert Lischinsky	564-2628
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Seth Heminway	564-7017
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Industry	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Manmade Fiber Industry	Sally Sasnett	564-7074
EPA/310-R-97-007.	Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017

AIR TRANSPORTATION INDUSTRY

TABLE OF CONTENTS

LIST OF EXHIBITS

LIST OF ACRONYMS

AFS	AIRS Facility Subsystem (CAA database)
AIRS	Aerometric Information Retrieval System (CAA database)
BIFs	Boilers and Industrial Furnaces (RCRA)
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CATC	Clean Air Technology Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	CERCLA Information System
CFCs	Chlorofluorocarbons
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSI	Common Sense Initiative
CWA	Clean Water Act
D&B	Dun and Bradstreet Marketing Index
DOT	U.S. Department of Transportation
ELP	Environmental Leadership Program
EMS	Environmental Management System
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FWPCA	Federal Water Pollution Control Act
HAP	Hazardous Air Pollutant (CAA)
HSDB	Hazardous Substances Data Bank
HSWA	Hazardous and Solid Waste Amendments
ICAO	International Civil Aviation Organization
IDEA	Integrated Data for Enforcement Analysis
LDR	Land Disposal Restriction (RCRA)
LEPC	Local Emergency Planning Committee
MACT	Maximum Achievable Control Technology (CAA)
MCLG	Maximum Contaminant Level Goal
MCL	Maximum Contaminant Level
MEK	Methyl Ethyl Ketone
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards (CAA)
NAFTA	North American Free Trade Agreement
NAICS	North American Industrial Classification System
NCDB	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC	National Enforcement Investigation Center
NESHAP	National Emission Standards for Hazardous Air Pollutants

NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NOV	Notice of Violation
NO_X	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System (CWA)
NPL	National Priorities List
NRC	National Response Center
NSPS	New Source Performance Standards (CAA)
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
OPA	Oil Pollution Act
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
P2	Pollution Prevention
PCS	Permit Compliance System (CWA Database)
PM_{10}	Particulate matter of 10 microns or less
PMN	Premanufacture Notice
POTW	Publicly Owned Treatments Works
PT	Total Particulates
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEP	Supplemental Environmental Project
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxide
SPCC	Spill Prevention Control and Countermeasures
TOC	Total Organic Carbon
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TSCA	Toxic Substances Control Act
TSD	Treatment, storage, and disposal
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
UST	Underground Storage Tank (RCRA)
VOC	Volatile Organic Compound

AIR TRANSPORTATION INDUSTRY
(SIC 45)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Integrated environmental policies based upon comprehensive analysis of air, water, and land pollution are a logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was originally initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information on major industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded to its current form. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process who enabled us to develop more complete, accurate and up-to-date summaries.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at (202) 564-2395.

II. INTRODUCTION TO THE AIR TRANSPORTATION INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the air transportation industry. Facilities described within this document are described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

This notebook pertains to the transportation industry as classified within SIC code 45 (Transportation by Air). (Please note that this section provides both the SIC code and the new North American Industrial Classification System (NAICS) code, which went into effect January 1, 1997. While the NAICS code is identified in this section, the remainder of the document will refer to the SIC codes for specific air transportation activities.)

The transportation industry includes other modes of transport, such as trucking, railroad, pipeline, and water, which make up an important portion of overall transportation activity in the United States. These modes are addressed in two sector notebooks. Trucking, railroad, and pipeline transportation are addressed in *Ground Transportation Industry* [EPA/310-R-97-002], and water transportation is addressed in *Water Transportation Industry* [EPA/310-R-97-003].

The air transportation industry (SIC 45) includes establishments engaged in furnishing domestic and foreign transportation by air and also operating airports and flying fields and furnishing terminal services. Specifically, this notebook includes the following groups:

SIC 4512 - Air Transportation, Scheduled (NAICS 481111 and 481112). This sector includes establishments primarily engaged in furnishing air transportation over regular routes and on regular schedules. This industry includes Alaskan carriers operating over regular or irregular routes.

SIC 4513 - Air Courier Services (NAICS 49211). This sector includes establishments primarily engaged in furnishing air delivery of individually addressed letters, parcels, and packages (generally under 100 pounds), except by the U.S. Postal Service. Separate establishments of air courier companies which provide pick-up and delivery only, "drop-off points," or distribution centers are all classified in this industry.

SIC 4522 - Air Transportation, Nonscheduled (NAICS 481211, 481212, 48799, 62191). This sector includes establishments engaged in furnishing nonscheduled air transportation. Also included in this industry are establishments primarily engaged in furnishing airplane sightseeing services, air taxi services, and helicopter passenger transportation services to, from, or between local airports, whether scheduled or not scheduled.

SIC 4581 - Airports, Flying Fields, and Airport Terminal Services (NAICS 488111, 488119, 56172, 48819). This sector includes establishments primarily engaged in operating and maintaining airports and flying fields; in servicing, repairing (except on a factory basis), maintaining, and storing aircraft: and in furnishing coordinated handling services for airfreight or passengers at airports. This industry also include private establishments primarily engaged in air traffic control operations (except government).

II.B. Characterization of the Air Transportation Industry

II.B.1. Industry Characterization

The transportation industry affects nearly every American. Either through the necessity of traveling from one place to another, shipping goods and services around the country, or working in a transportation-related job, transportation's share of the national economy is significant. According to the Eno Transportation Foundation, for all transportation-related industries, total transportation expenditures in the U.S. accounted for 16.1 percent of the gross national product in 1993.

The airline industry in particular provides transportation of passengers, cargo, mail and perishable goods. American citizens have come to rely on domestic and international air transportation more and more every year. Airline travel in the United States has been getting safer over the years and is the safest in the world. The National Safety Council's latest fatality totals for 1995 show 175 deaths caused by United States airline accidents. By contrast, five times as many people died in boating accidents and accidents involving bicycles and tricycles.

II.B.1.1. Types of Aircrafts and Airports

Generally, the air transportation sector can be broken down into two categories: (1) facilities providing scheduled, non-scheduled, and air courier services using aircraft, and (2) airports and airport operations. It is these two major topics (i.e., aircraft facilities and airports) and the activities and operations that occur within each of these areas that are the primary focus of this notebook.

Categories of Aircraft

There are five types of aircraft that compose the aviation industry: commercial, air taxi operations, commuter, general, and military.

Commercial aircraft encompass air carriers and air taxi flights. Air carriers are airlines holding a certificate issued of public convenience and necessity under Section 401 of the Federal Aviation Act of 1958 authorizing them to perform passenger and cargo services. Air carriers operate aircraft designed to have a maximum seating capacity of more than 60 seats, to have a maximum payload capacity of more than 18,000 pounds, or to conduct international operations. The four different types of air carriers (and their annual operating revenues) are:

- Majors (greater than $1 billion)
- Nationals ($100 million to $1 billion)
- Large regionals ($20 million to $100 million)
- Medium regionals (Up to $20 million).

Air taxi operations are those in which departure time, departure location, and arrival location are specifically negotiated with the customer or by the customer's representative and are conducted with airplanes or rotorcraft having a seating configuration of 30 or fewer seats.

Commuter aircraft are noncertified small regionals who perform scheduled service to smaller cities and serve as feeders to the major hub airports. They generally carry 60 or fewer passengers.

General aviation is all aviation that is not commercial or military. General aviation is the segment of civil aviation that encompasses all facets of aviation except air carriers and commuters. General aviation includes corporate-executive transportation, instruction, rental, aerial application, aerial observation, business, pleasure, and other special uses.

Military refers to the operators of all military (e.g., Air Force, Army, Navy, U.S. Coast Guard, Air National Guard, and military reserve organizations) aircraft using civil airports.

Classification of Airports

The system of airports in the U.S. is the largest and most complex in the world. As of 1990, there were 17,451 civil landing areas (e.g., airports, heliports, seaplane bases, etc.) in the U.S. The activity and services at individual airports vary greatly. Regardless of size, many activities occur at airports including fueling, aircraft maintenance, aircraft washing, and deicing. In addition, two primary activities at most airports are enplaning passengers and enplaning air cargo. Enplaning passengers is defined as the total number of passengers departing on aircraft at the airport. Enplaning air cargo includes the total tonnage of priority, nonpriority, and foreign mail, express, and freight (property other than baggage accompanying passengers) departing on aircraft at an airport.

Airport Ownership. Public airports in the U.S. are owned and operated under a variety of organizational and jurisdictional arrangements. Commercial airports might be owned and operated by a city, county, or State; or by more than one jurisdiction. Additionally, some airports may be operated by a separate public body, such as an airport authority. Regardless of ownership, legal responsibility for day-to-day operations can be vested in any of five kinds of governmental or public entities:

- Municipal or county government. Municipally operated airports are city owned and run as a department of the city.
- A multipurpose port authority. Port authorities are legally chartered institutions with the status of public corporations.
- An airport authority.
- State government.

Classification of airports with scheduled services. Airports with scheduled passenger service have several classifications:

- Commercial service airports are those airports receiving passenger service and having 2,500 or more annual enplanements.

- Primary airports are commercial service airports having 10,000 or more enplanements.

- Hub airports are airports that serve as a transfer point for passengers changing flights. Commercial service airports are classified as large, medium, or small hub airports or non-hub airports, depending on the percentage of total national enplanements for which they account.

- General aviation airports encompass the bulk of civil aircraft operations. The general aviation system includes 98% of all registered civil aircraft and 95% of all airports.

- Reliever airports are a special category of general aviation airports. Located in the vicinity of major air carrier airports and classified by the Federal Aviation Administration as a reliever, these airports are designed to provide relief to congested major airports.

Terminal Facilities. The terminal and associated landside facilities such as the parking areas and access roads provide the transition zone for passengers between surface and air transportation. Landside facilities are long-term installations and are largely independent of activities that occur airside. Concession and food service operations provide food and materials goods for passengers.

II.B.1.2. Requirements Pertaining to the Aviation Industry

The Federal Aviation Administration's (FAA's) major responsibilities include overseeing aircraft safety and the competency of pilots and mechanics. The FAA does this by providing mandatory safety rules, conducting safety inspections, and setting high standards for civil aviation.

Noise Abatement. In addition to safety, the FAA also addresses issues such as noise abatement. As a result of complaints against aircraft noise, which increased dramatically with the introduction of jet aircraft, the *Federal Aviation Act of 1958* was amended to include noise abatement regulations designed to establish noise levels which aircraft manufacturers cannot exceed in the development of new aircraft. In 1979, the *Aviation Safety and Noise Abatement Act* authorized the FAA to help airport operators develop noise mitigation abatement programs.

The *Airport Noise and Capacity Act of 1990* authorized DOT/FAA to reduce aircraft engine noise by requiring an aircraft fleet replacement program. The estimated effect of the phase out of larger, noisier aircraft is estimated to reduce the number of people exposed to significant noise levels of aircraft noise in the U.S. from 2.7 million in 1990 to 400,000 by the year 2000, when the phaseout is complete. The law also limited airport operators' abilities to place noise or access restrictions on airports in the interest of avoiding an overly burdensome patchwork of individual operating limitations across the United States.

Standards for Aircraft Design. The FAA works closely with aircraft manufacturers while examining designs for new planes. The FAA sets very high standards for aircraft designs. Once the design has been thoroughly examined and the first model has completed a grueling series of flight tests and evaluations, the model is certificated for production by the FAA (http://www.faa.gov/publicinfo.htm).

Monitoring and Maintenance of Existing Aircraft. Once the aircraft has been certified and put into service, the FAA continues to monitor its performance. When necessary, the FAA will issue repair notices known as "Airworthiness Directives" to the manufacturers and airlines when problems are spotted. The FAA issues several hundred notices a year. In addition, manufacturers often issue Service Bulletins to advise aircraft carriers of safety improvements or procedures that will enhance safety.

FAA airworthiness requirements specify materials to be used during maintenance or other technical specifications and standards (e.g., cleaning, deicing) that limit the airlines' ability to change materials, procedures, or processes.

Flight Personnel. The FAA sets standards for training, health, experience, number of hours worked, and qualifications for pilots and other flight personnel. Because pilots play such a vital role in maintaining aircraft operations safety, they are especially heavily regulated by the FAA. Pilots must have their health examined every six months. They must pass special examinations and flight tests, and those serving as captains are required to possess hundreds of hours of additional flying time. FAA tests their flying skills on a regular basis. DOT and FAA safety policies and rules expressly place the ultimate legal authority for aircraft operation fully and solely on the pilot in command of the aircraft (14 CFR §91.3(a)).

Air Traffic Control Operations. FAA is responsible for developing, maintaining, and operating the nation's Air Traffic Control System, which is in charge of ensuring the safe separation of aircraft during flight and sequencing aircraft for taxiing, takeoff, and landing.

Maintenance Personnel. Airline mechanics and technicians must be certified by the FAA. In addition, repair stations must obtain an FAA operating certificate and are subject to regular inspection by the agency.

For more information about FAA airworthiness requirements, see the FAA website at http://www.faa.gov/publicinfo.htm.

II.B.1.3. International Aviation

After 1945, commercial air transportation began to transcend domestic markets into the international arena, therefore, the standardization of operational practices for international services, such as navigational aids and weather reporting systems, became essential. There were also many political and technical problems that needed to be solved. For example, there was the issue of commercial rights: what arrangements were needed for the airlines of one country to fly into and through territories of another? For more information relating to International Civil Aviation Organization (ICAO) and other international milestones, refer to *Memorandum on ICAO,* January 1994.

II.B.2. Industry Size and Geographic Distribution

Industry Size

According to Dun & Bradstreet, there were an estimated 16,282 air transportation establishments in the U.S. as of April 1997. Exhibit 1 provides information on each of the SIC codes in the air transportation industry, including total number of establishments and employees, and total annual sales.

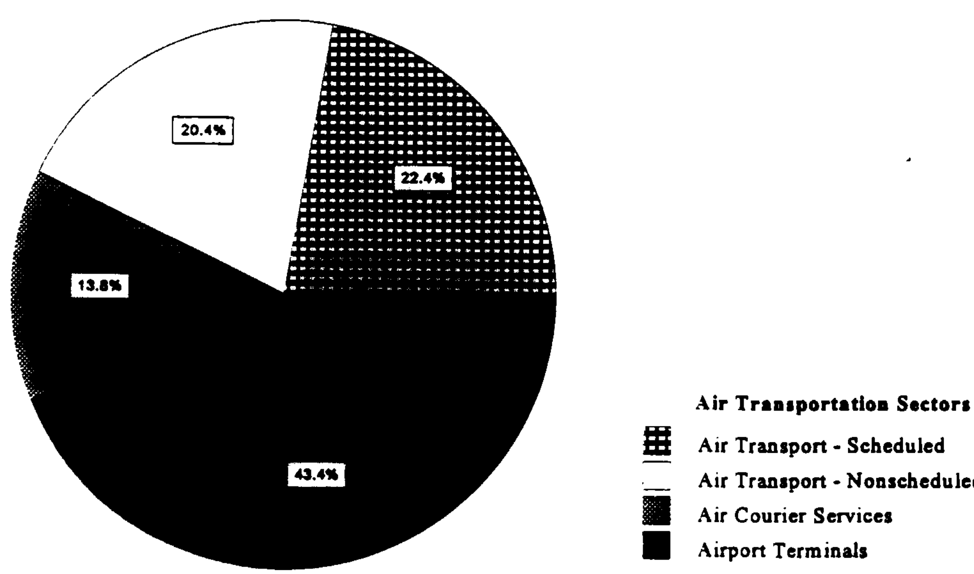
Exhibit 1. Market Size Analysis of Air Transportation Industry

SIC Code	No. of Establishments	No. of Employees	Annual Sales (millions)
4512	3,638	320,837	147,858.6
4513	2,252	75,493	15,172.9
4522	3,321	39,253	7,019.0
4581	7,071	220,986	15,616.8
Total	16,282	656,569	185,667.3

Source: Dun & Bradstreet Marketplace (www.dnb.imarketinc.com), December 1997

Exhibit 2 displays the percentages of establishments per air transportation sector discussed above.

Exhibit 2: Distribution of Establishments by Sector



Source: Dun & Bradstreet Marketplace, December 1997 (www.dnb.imarketinc.com)

R0074761

Exhibit 3 lists the busiest airports in terms of the total passengers and cargo. Keep in mind that 99% of the nation's airports are much smaller than these airports, but conduct the same activities to a lessor extent or volume.

Exhibit 3. Activity at the 10 Busiest Airports (1996)

Leading Airports in Passengers Arriving & Departing (Millions)		Leading Airport in Cargo Tons Enplaned & Deplaned (Thousands)	
Chicago O'Hare	69.2	Memphis	1934
Atlanta	63.3	Los Angeles	1719
Dallas/Ft. Worth	58	Miami	1710
Los Angeles	57.9	New York Kennedy	1636
San Francisco	39.3	Louisville	1369
Miami	33.5	Anchorage	1269
Denver	32.3	Chicago O'Hare	1259
New York Kennedy	31.2	Newark	958
Detroit	30.6	Atlanta	800
Las Vegas	30.5	Dallas/Ft. Worth	774

Source: 1997 Air Transport Association Annual Report

The activity and services of the aviation industry vary greatly. Exhibit 4 presents the top 10 airlines of scheduled service in the U.S.

Exhibit 4. Top 10 Airlines of Scheduled Service (1996)

Airline	Passengers (millions)
Delta	97.2
United	81.9
American	79.3
US Airways	56.6
Southwest	55.3
Northwest	52.7
Continental	35.7
Trans World	23.3
America West	18.1
Alaska	11.8

Source: 1997 Air Transport Association Annual Report

R0074762

Company size varies greatly among air transportation facilities. Exhibit 5 presents an analysis of the number of businesses compared to the number of employees per air transportation sector. The distribution of establishments with a specific employee size varies from one SIC code to another.

Exhibit 5. Number of Businesses by Company Size

No. of Employees	Number of Businesses			
	Scheduled	Nonscheduled	Air courier	Airports
1	147	381	104	854
2 to 4	436	1533	985	1699
5 to 9	415	572	265	1092
10 to 24	484	450	244	837
25 to 49	286	172	148	386
50 to 99	219	64	151	217
100 to 249	252	41	208	189
250 to 499	75	6	7	79
500 to 999	31	2	5	27
1,000 to 9,999	43	3	2	25
>=10,000	6		1	3
Unknown	1244	97	131	1674
Totals	3638	3321	2252	7071

Source: Dun & Bradstreet Marketplace, December 1997 (www.dnb.imarketinc.com)

Geographic Distribution

The air transportation industry is widely dispersed. Of the total of 16,282 U.S. establishments in the air transportation industry, most are located in California, Texas, Florida, Illinois, and New York. Exhibits 6 and 7 identify the five states with the most establishments and employees by air transportation SIC code.

Exhibit 6. Top Five States with Air Transportation Establishments					
SIC Code	States (Number of Establishments)				
Air transportation, scheduled (SIC 4512)	CA (426)	FL (369)	NY (321)	TX (258)	IL (200)
Air transportation, nonscheduled (SIC 4522)	CA (348)	FL (314)	TX (236)	NY (151)	AK (146)
Air courier services (SIC 4513)	CA (328)	NY (308)	FL (208)	TX (194)	IL (91)
Airports, flying fields, & services (SIC 4581)	CA (747)	TX (641)	FL (551)	NY (304)	IL (264)

Source: Dun & Bradstreet Marketplace, December 1997 (www.dnb.imarketinc.com)

Exhibit 7. Top Five States with Air Transportation Industry Employees					
SIC Code	States (Number of Employees)				
Air transportation, scheduled (SIC 4512)	TX (37,691)	CA (31,396)	MN (31,363)	GA (30,484)	NY (18,111)
Air transportation, nonscheduled (SIC 4522)	FL (3,662)	CA (3,580)	MN (2,546)	IN (2,437)	MI (2,428)
Air courier services (SIC 4513)	TN (20,374)	CA (6,299)	OH (6,299)	NY (5,762)	TX (5,143)
Airports, flying fields, & services (SIC 4581)	FL (36,414)	CA (35,225)	TX (15,755)	NY (15,702)	IL (15,762)

Source: Dun & Bradstreet Marketplace, December 1997 (www.dnb.imarketinc.com)

Exhibit 8 presents the top five states for each SIC code with the highest total sales in millions of dollars. California, Florida, New York, and Texas are consistently among the top five for these sectors.

Exhibit 8. Top Five States with Highest Air Transportation Sales					
SIC Code	States (Total sales in millions)				
Air transportation, scheduled (SIC 4512)	TX (41,080.5)	IL (36,807)	MN (27,512)	VA (13,859)	GA (13,109.7)
Air transportation, nonscheduled (SIC 4522)	IN (1,019.9)	OR (776.7)	FL (516.2)	CA (534.70)	NY (506.1)
Air courier services (SIC 4513)	TX (8,867.3)	CA (2,793.6)	WA (1,976)	OH (602.1)	NY (353.9)
Airports, flying fields, & services (SIC 4581)	FL (3,426.5)	NY (2,544.7)	TX (1,762.8)	VA (1,639)	CA (596.4)

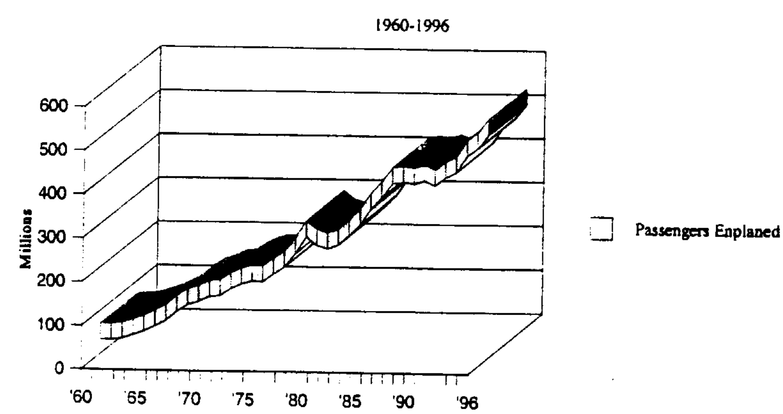
Source: Dun & Bradstreet Marketplace, December 1997 (www.dnb.imarketinc.com)

II.B.3. Economic Trends

Aviation Trends and Forecasts

The aviation industry has been growing steadily and is expected to continue. U.S. commercial air carrier passenger enplanements, which had averaged less than 1.0 percent growth between 1990 and 1993, grew at an annual rate of 6.2 percent over the last 3 years. In 1996, the large U.S. air carriers increased their system capacity by only 2.9 percent, while passenger demand increased by 6.1 percent. Exhibit 9 presents the trends for U.S. scheduled airlines in passengers enplaned and domestic cargo from 1960 to 1996.

Exhibit 9: Summary of Domestic Passenger Traffic



Source: ATA Airline Traffic Stats 1960-1996

R0074765

The FAA predicts that domestic departures for commercial carriers will increase from 7.1 in 1997 to 9.2 million by 2008. Exhibit 10 presents additional FAA forecasts for the aviation industry.

Exhibit 10. Forecast for U.S. Commercial Carriers and Regionals/Commuters FY1998 - 2009

Year	Passengers (Millions) [1]	Revenue Passenger Miles (Billions) [1]	Jet Aircraft[2]	Aircraft Operations (Millions)[3]
1998	656.1	635.3	5,092	24.7
1999	676.3	660.7	5,224	25.1
2000	699.1	688.5	5,444	25.5
2001	724.7	720.3	5,698	26.2
2002	753.2	755.2	5,913	26.9
2003	782.9	791.7	6,119	27.5
2004	813.7	829.7	6,361	28.1
2005	845.6	869.7	6,574	28.7
2006	878.8	911.6	6,778	29.4
2007	913.4	955.6	6,983	30.0
2008	949.4	1,001.9	7,203	30.7
2009	986.7	1,050.2	7,419	31.4

Source: Federal Aviation Administration.

1 U.S. commercial air carriers and regionals/commuters, domestic plus international.

2 Commercial air carriers.

3 Landings and takeoffs of air carriers and air taxi/commuters at FAA and contract tower airports.

Impacts of Deregulation

Before 1978, the United States airline economy was tightly regulated by the federal government. However, due to complaints of high airfares and growing concerns that government regulation was inhibiting the growth of the airline industry, the Deregulation Act of 1978 was passed. Since then, several important trends have characterized the airline industry.

Rapid expansion of overnight delivery of mail. Air cargo was deregulated a year before the passenger airlines. Deregulation was responsible for dramatic results for all aspects of the cargo business, but particularly for express package delivery for high value and time sensitive packages. Deregulation gave express carriers operating freedom, and the direct result was outstanding growth for that part of the aviation industry over the next decade.

Increase of Total Revenue Sales. Total sales revenues for the industry as a whole (in adjusted dollars) have increased each consecutive year except for a brief decline from 1989 through 1991. This brief decline can be explained largely by two factors: (1) Northwest Air Lines was private during those same years, so its revenues were not included in the industry data, and (2) Eastern Air Lines experienced a major labor strike that began in March 1989. As indicated by its financial data from 1989 to 1991, Eastern was able to continue operation, in spite of the labor strike, by charging fares below its costs. Eastern's unusually low fares may have caused other airlines to reduce fares in a similar fashion, and this reduced the total revenue earned by the industry as a whole. Current projections are that industry revenues will continue to rise due to the strengthened economy and a predicted 5% increase in airline traffic.

Increased number of airlines. Following deregulation in 1978, the number of companies increased dramatically from about 36 carriers in 1978 to a total of 123 such carriers in 1984. This initial increase resulted from the market becoming more accessible to new companies that sought to operate below the costs of older, established airlines with higher cost structures. However, a clear decline in the number of air carriers in the late 1980s followed this initial increase due to weaker airlines being forced out of business or being taken over by the stronger companies. Then by 1993, the numbers increased again as numerous small airlines emerged, offering direct, low cost, no-frills service. To compete with these lower cost airlines, many of the larger airlines are initiating their own low cost divisions. The Brookings 1986 Report estimated that the traveling public was saving $5.7 billion a year (measured in 1977 dollars) as a result of deregulation (www.air-transport.org/handbk/chaptr02.htm).

Expanded market. A major development since deregulation was the creation of hub and spoke networks. The hubs are strategically located airports used as transfer points for passengers traveling from one location to another. The hub and spoke systems were developed in order to enable airlines to serve far more markets, with the same size fleet, than the traditional direct, point-to-point service.

Deregulation also sparked marketing innovations used by most major airlines and many smaller airlines that equate to fare discounts, such as the frequent flyer program that is designed to reward repeat customers with free tickets and other benefits.

The appearance of new airlines, combined with the rapid expansion into new markets by many of the established airlines, resulted in unprecedented popularity and competition in the airline industry. In 1977, the last full year of government regulation of the airline industry, the US airlines carried 240 million passengers. By 1993 they were carrying nearly 490 million. A study by the Department of Transportation a decade after deregulation found that well over 90% of airline passengers had a choice of carriers compared to only two-thirds in 1978 (www.air-transport.org/handbk/chaptr02.htm)

III. DESCRIPTION OF OPERATIONS

This section describes the major operations and maintenance activities within the air transportation industry. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the relationship between the industrial process associated with air transportation, and the associated environmental aspects and potential impacts of the processes. This section is not exhaustive; the operations and maintenance activities discussed are intended to represent the air transportation practices and activities with potentially significant environmental impacts. These activities are presented in two categories:

(1) *Aircraft operations*, including maintenance, cleaning, fueling, and deicing; and

(2) *Airport operations*, including terminal activities, loading and off loading.

This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section VIII for a list of resource materials that are available.

III.A. Aircraft Operations and Associated Environmental Aspects

III.A.1. Aircraft and Aviation-Support Vehicle Maintenance

Aircraft maintenance activities include scheduled preventive maintenance, repairs required as a result of inspections, and aircraft refurbishing. When an aircraft is built, the manufacturer creates a maintenance program for the operator of the plane. Representatives from the manufacturer, the Federal Aviation Administration (FAA), subcontractors, and the airline that purchases the aircraft form a review board that develops minimum requirements of a maintenance program. This maintenance program is then documented and followed throughout the aircraft's life.

Together, scheduled maintenance and day-to-day preventive activities are necessary to keep the aircraft safe and reliable. In general, aircraft maintenance is the function of three factors: (1) hours of flight time, (2) number of landing and take off cycles, and (3) calendar length of time from prior maintenance. Aircraft preventive maintenance starts with daily inspections of items such as tires, brakes, and fluid levels. The aircraft then continues to receive many levels of maintenance that include fluid and filter changes, detailed testing, inspections for cracks and corrosion, and after many hours of flying (usually over 100,000), complete refurbishing of the aircraft to return the plane to its original condition.

Aviation-support vehicles undergo a similar, yet less rigorous schedule of inspections, testing, and maintenance that includes oil and fluid changes, battery replacement, and repairs including metal machining.

Environmental Aspects and Potential Impacts of Aircraft Maintenance

Environmental aspects of aircraft maintenance include the use and disposal of aircraft and vehicle fluids such as:

- Wastewater from parts cleaning, metal finishing, or coating applications
- Generation of hazardous wastes consisting of flammable and metals-contaminated solvents, used hand-wipes, and sludges collected during all maintenance operations
- Hazardous air pollutant (HAP) emissions from solvent-based cleaners and coatings used in all activities.

Wastes generated as a result of aircraft and aviation-support vehicle maintenance and repair activities can include used oil, spent fluids, batteries, metal machining wastes, organic solvents, and tires. Some of these wastes can be toxic or otherwise hazardous, and uncontrolled releases can contaminate surface water, groundwater, and soils. Typical materials used in each operation and the potential impacts of use and disposal of these materials are identified in Exhibit 11. A description of these operations and associated environmental impacts appear below.

Lubrication and Fluid Changes. Lubrication and fluid changes are part of the aircraft standard maintenance program. These activities occur at regular intervals, and as inspections indicate they are necessary. In conducting aircraft lubrication and fluid changes, these operations may generate waste oil and greases. These materials have the potential to contaminate water supplies and soil if not properly stored. By storing these materials in secure containers or tanks with secondary containment, the potential for releases to impact the environment is significantly reduced.

Exhibit 11. Maintenance and Refurbishing Operations: Activities and Potential Environmental Impacts		
Operation	**Activities**	**Environmental Aspects and Potential Impacts**
Lubrication and Fluid Changes	Storage, transfer, and disposal of petroleum products	Potential to contaminate soil, groundwater, and surface waters, if spilled or allowed to enter storm drains
Battery repair and replacement	Storage of batteries containing sulfuric acid	Potential to contaminate soil, groundwater, and surface waters with hazardous material, if not contained and covered from weather
Chemical Milling Maskant Application and Chemical Milling	Use and disposal of maskants containing either toluene/xylene mixture or perchloroethylene	Air pollution from organic HAP emissions, waste maskant
Parts Cleaning	Aqueous, semi-aqueous, and solvent-based cleaner use and disposal	Water pollution from wastewater containing cleaners, waste solvents; metals, oil, and grease Air pollution from organic HAP emissions
Metal Finishing	Use and disposal of processing solutions, cyanide, heavy metal baths	Air pollution from HAP emissions; contaminated wastewater including cyanide solutions, corrosive acid and alkali solutions; heavy metal sludges
Coating Application	Primer and topcoats application and disposal	Air pollution from organic HAP emissions; waste paint; waste solvent thinner
Depainting	Chemical or blast depainting agents use and disposal	Contaminated sludge (stripper solution and paint residue); air contamination from VOC emissions from paints; solid waste containing paint chips and spent blasting media.
Painting	Paint use, storage, and disposal	Soil or water contamination from disposal of waste paint, thinners, solvents, resins; air contamination by VOC emissions.

Battery repair and replacement. Battery repair and replacement involve removing, repairing, and recharging aircraft and vehicle batteries. These operations have the potential to impact the environment if sulfuric acid in the batteries is released. Acid has the potential to contaminate soil and groundwater supplies, and to cause personnel injury if used batteries are not properly handled. By using proper safety equipment during handling, and storing batteries in a contained and covered area that is not exposed to rain water, batteries are less likely to cause a significant impact.

Chemical Milling Maskant Application and Chemical Milling. This operation uses etchant solutions to reduce the thickness of selected areas of metal parts in order to reduce weight. Chemical milling maskants are typically rubber- or polymeric-based coatings applied to an entire part or subassembly by brushing, dipping, spraying, or flow coating. After the chemical milling maskant is cured, it is removed from selected areas of the part where metal is to be removed during the chemical milling process.

Chemical milling maskants typically contain either a toluene/xylene mixture or perchloroethylene as solvent constituents. These chemical solvents vaporize when exposed to air, and if not stored in tightly sealed containers, become a source of hazardous air pollutants (HAPs). These organic HAP emissions also occur as the solvent evaporates as the chemical milling maskant is applied and cured.

Parts Cleaning. Aircraft components are cleaned frequently to remove contaminants such as dirt, grease, and oil. Cleaning is performed using a wide variety of cleaning materials, including aqueous, semi-aqueous, or, in some cases, solvent-based cleaners. Recently, many aircraft maintenance facilities have substituted solvent-based cleaners with water-based cleaning materials. Many components are cleaned with soap and water.

Parts cleaning operations can include immersion, flush, spray gun cleaning, or hand wiping of aircraft components. For most parts, cleaning is typically performed by a hand wiping process. However, parts that are either too large or too intricate to hand wipe are cleaned by immersion in large solvent baths or parts cleaning machines. Assemblies and parts with concealed or inaccessible areas may be cleaned by pouring the cleaning material over or into the part. The cleaning material is then drained from the part and the procedure is repeated as many times as necessary to ensure the required cleanliness.

The potential environmental impact of parts cleaning operations is dependent on the type of cleaning solution used. Halogenated, solvent-based cleaning materials potentially have the most significant impact. These solvents can generate organic HAP emissions from the evaporation of solvents during the cleaning process, including: (1) evaporation of solvent from open containers and solvent-soaked cloth and paper, and (2) emissions from storage tanks used to store cleaning solvents. In addition, solvent spills have the potential to contaminate soil, groundwater, or surface water. Contamination can be caused by hazardous constituents found in solvents themselves, as well as in metals, oils, and other potential contaminants found in the parts being cleaned. Spent hazardous solvents must be managed as hazardous wastes. Typically, they are reclaimed by a RCRA permitted hazardous waste recycler.

Facilities that use aqueous or semi-aqueous cleaning materials have a much less significant potential environmental impact because they do not generate hazardous air emissions. They do, however, generate metals, oil, and grease in the aqueous system that have the potential to contaminate water supplies. Wastewater from these cleaning processes is required to be treated onsite in accordance with the facility's wastewater discharge permit (known as a National Pollutant Discharge Elimination System or NPDES permit) or according to standards set by any local pretreatment programs.

Metal Finishing. Metal finishing processes are used to prepare the surface of a part for better adhesion, improved surface hardness, and improved corrosion resistance. Typical metal finishing operations include chemical conversion coating, anodizing, electroplating, and any operation that chemically affects the surface layer of a part. Each of these metal finishing operations has the potential to significantly impact the environment by discharging metals, cyanides, phosphates, acids, and other contaminants to waterways, soil, or groundwater.

HAP emissions and contaminated wastewater are the most significant environmental aspects of metal finishing operations. As the organic chemicals in the processing solutions evaporate, they generate hazardous vapors and emissions. Evaporation of solution also occurs from refurbished parts as they are removed from the processing tanks. Wastewater from these operations includes cyanide solutions, corrosive acid, and alkali solutions. This water is typically treated prior to discharge, in accordance with a facility's NPDES permit or applicable pretreatment requirements. For more details on metal finishing processes and the associated environmental aspects, see EPA's Sector notebook titled *Profile Of The Fabricated Metal Products Industry* (EPA 310-R-95-007).

Coating Application. A coating is a material that is applied to the surface of a part to form a decorative or functional solid film. The most common coatings are primers and topcoats. Coatings are applied to aircraft components using several methods of application. The methods most commonly used are spraying, brushing, rolling, flow coating, and dipping. Nearly all coatings contain a mixture of organic solvents. Spray guns and other components of coating units must be cleaned when switching from one coating to another. The cleaning of spray guns involves disassembling the gun and placing the parts in a vat containing an appropriate solvent. The residual coating is brushed or wiped off the parts.

Organic HAP emissions from coating application are generated from evaporation of solvents during mixing, application, and from overspray, which is exhausted from spray booths or hangars. Coating operations also produce waste paint and waste solvent thinner that are typically drummed and shipped offsite as RCRA hazardous waste.

Depainting. Depainting involves the removal of coatings from the outer surface of aircraft. Two methods are chemical stripping and blast depainting. During chemical stripping, stripping agents are applied to the aircraft, allowed to degrade the coating, and then scraped or washed off with the coating residue. Blast depainting methods use a media such as plastic, wheat starch, carbon dioxide, or high pressure water to remove coatings by physically abrading the coatings from the surface of the aircraft. Depainting operations can produce either a liquid or solid waste stream. depending on the type of process used.

Air pollution and soil or water contamination are potential impacts from depainting. Chemical depainting generates organic HAPs from evaporation of the solvents in the stripping solution, while particulate emissions occur from the blasting media. Depainting operations can produce either a liquid or solid waste stream, depending on the type of process. Chemical depainting processes produce a liquid sludge that consists of the stripper solution and paint residue. Blast depainting processes produce a solid waste stream that consists of paint chips and spent blasting media. These wastes are required to be characterized as hazardous or nonhazardous and disposed of appropriately.

Painting. Aircraft painting generally occurs in an enclosed area to minimize potential environmental and human health impacts. High pressure, low volume, and electrostatic painting systems can reduce the amount of paint needed for a job.

Aspects of painting with potential environmental impacts include management of unused paints, spray paint booth air filters, and spent paint thinner, and emissions of volatile organic compounds (VOCs) from thinners and solvents. Spent paint filters often must be handled as hazardous waste because of the presence of wet paint or paint containing lead or chromium. Through proper training of employees and the use of high efficiency equipment, painting operations have been able to reduce paint waste, minimize air emissions, and protect the health of employees.

III.A.2. Fueling

An essential part of any airport operation is the fueling of aircraft. Fueling is conducted either by tank trucks or a central underground fueling system. In both operations, fueling involves the transfer of a potentially hazardous liquid to the aircraft. Aviation fuels are broken down into two classes. The reciprocating engines use various grades of aviation gasoline, while the jet class, which includes gas turbines, utilizes jet fuels. There are grades of aviation gasoline that are readily identified by the color-coded dyes added to them. The color-coded system aids maintenance personnel in finding fuel leaks when they occur and prevents fueling mixups.

For jet fuel, there are two basic grades of jet fuel, Jet-A and Jet-B. Jet-A fuel, a narrow cut kerosene product, is the standard commercial and general aviation grade available in the United States. It usually contains no additives but may be additized with an anti-icing chemical. Jet-A1 is identical to Jet-A except that it has a lower freeze point. It is used outside the United States and is the fuel of choice for long haul flights where the fuel temperature may fall to near the freeze point. It often contains a static dissipator additive. Jet-B fuel is a wide cut kerosene with lighter gasoline-type naphtha components. It is not used by the commercial air transportation sector, however, it is used by the military.

Fuel tanks are generally located in the wings of light aircraft. However, depending on the make and model of the aircraft, it is also common to find fuel tanks in the main fuselage. Fuel lines range in diameter from 1/8 of an inch to as large as 4 inches on very large aircraft. Fuel lines of aircraft using wing tanks are located back from the leading edge of the wing. With fuselage tank model twin-engine aircraft, the fuel lines run from the fuselage tanks out through the wing structure along the wing spar into the engine compartment. On single-engine aircraft, the fuel lines are routed from the fuel tank to the firewall, and then to the engine.

Environmental Aspects and Potential Impacts of Fueling

The major environmental aspect of fueling operations is managing the fuel so that it is not released to the environment, either to the air, water, or soil. Leaking pipes or improper connections between fueling lines and the aircraft can allow fuel vapors to be released to the air, causing air contamination. Leaks, improper connections, and improperly monitored storage tanks also can lead to fuel spills. As a contingency measure, many airports and airlines employ vacuum sweeper trucks as well as hand operated sweeper units for spill response. Vacuum sweepers allow the spilled material to be removed quickly from the site while minimizing the spill's potential to impact the environment. If spills are not contained or diverted to an established treatment system, they may end up being discharged to soil and groundwater either directly through storm drains, or as sheet runoff during rain events.

Underground fueling systems that are not maintained properly can leak into the surrounding soils and eventually contaminate groundwater. EPA regulations for underground storage tanks require tanks to be upgraded and monitored to reduce the probability of leaks to groundwater.

By conducting activities to prevent releases such as maintaining fuel tanks, lines, and fueling systems, and by assuring proper training of employees, the possibility of leaking tanks, equipment leaks, or accidental spillage is reduced substantially.

III.A.3. Aircraft Cleaning

Exterior cleaning of aircraft typically consists of washing with detergent solutions and a water rinse. Small aircraft cleaning is carried out using hand held spray nozzles, hoses and brushes. For larger aircraft, wet cleaning usually is limited to wheel wells and landing gear and is conducted to facilitate inspections. In addition, wet cleaning sometimes is performed on wing structure and flap-sequencing carriage areas for overhaul and inspection processes and on the lower aircraft fuselage for removal of accumulations of oil and grease.

Because it can be more economical (e.g., lower water costs) to dry polish aircraft fuselages rather than wash them with water and cleaning solutions, aircraft are cleaned using dry methods whenever possible.

Environmental Aspects and Potential Impacts of Cleaning

The primary environmental aspect of aircraft cleaning is the generation and disposal of wastewater from cleaning aircraft exteriors. If high pressure steam cleaners are used, water use may range from 10-20 gallons for washing small aircraft, and between 100 and 200 gallons for large aircraft.[2] Wastewater from cleaning activities may contain diluted cleaning chemicals; low concentrations of metals, oil and grease, solvents, dirt and grit, or other materials that are used as detergents, or are found in the aircraft itself. If not treated, the washwater has the potential to pollute the soil, groundwater, and surface waters.

---

[2] A Boeing 727 is an example of a narrow-body aircraft, while MD-11's, Boeing 747's and 767's are examples of wide-body aircraft.

To prevent such contamination, wastewater from cleaning operations usually drains to catch basins where it is mixed with other airport wastewater and discharged at an onsite treatment facility prior to discharge in accordance with the facility's NPDES permit. Prior to discharge, the wastewater may also pass through a holding tank where metals, dirt, and grit settle to the bottom, oil and grease are skimmed off the water surface, and the remaining water is discharged. If the washwater is not treated onsite, it may be discharged to a publicly owned treatment works (POTW), where it is treated prior to discharge. Washwater discharged to the POTW may be subject to pretreatment requirements established by EPA and the POTW.

III.A.4. Aircraft Deicing and Anti-Icing

As noted earlier, FAA regulations govern every aspect of airline and airport operations, including procedures and standards for aircraft maintenance and airworthiness, including aircraft deicing. Aircraft deicing and anti-icing are key components in assuring cold weather aircraft safety. Deicing and anti-icing remove from and inhibit for a period of time the formation of ice and snow on wings, fuselages, and other parts of the airplane that provide lift during takeoff. Common practice is to deice (remove accumulation) then anti-ice (protect from further accumulation) aircraft before takeoff. These processes use glycol-based materials, including ethylene glycol, diethylene glycol, or propylene glycol.

Aircraft deicing is carried out either at the departure gate area or at a central or remote facility in the vicinity of the runway to minimize the amount of time between treatment and takeoff. Central and remote deicing areas facilitate collection of deicing fluids for recycling and treatment.

Deicing is almost performed exclusively using hand held nozzles and hoses. Automatic deicer spray machines, called "deicing gantries", have been developed in recent years. However, there are some limitations on the practicality of such equipment and the associated capital investment.

Environmental Aspects and Potential Impacts of Deicing

Deicing operations generate spent deicer fluids. These fluids drain from the aircraft surfaces or from the runway surfaces to drains that direct the fluids to onsite water treatment facilities, to storm drains, or simply to paved surfaces where they may be discharged to local waterways or groundwater as sheet runoff. In some cases, deicing fluids may be released directly to the environment through runoff to surface waters or infiltration to groundwater. Glycol-based fluids deplete oxygen from the waters in which they are disposed and have toxic effects on life forms in those waters (*Aviation Week and Space Technology*, January 1995).

In general, each airport has its own distinct characteristics and drainage systems and collecting deicing fluid for reuse or recycling may not be practical. However, some airports have constructed deicing fluid collection systems that prevent discharge to storm water sewers and segregate spent deicer from other wastewater for reclamation, recycling, onsite treatment, or disposal offsite. FAA allows the reuse of deicing fluids that are reformulated and re-certified to meet appropriate aircraft deicing fluid specifications. However, at this time, the aviation industry has not recycled glycols for reuse on aircraft or runways due to cost. Some reclaimed deicing fluids may be sold in secondary markets (e.g., windshield deicers for automobiles). In compliance with Clean Water Act requirements, spent deicing fluids are treated either in the facility wastewater treatment system, discharged to publicly owned wastewater treatment plants, or discharged directly to surface waters in accordance with permit conditions.

III.A.5. General Aircraft Operational Activities

As discussed earlier, the FAA has jurisdiction over all aircraft operations and prohibits states and local governments from regulating in the areas of aircraft operations and airspace management. In addition, the exclusive jurisdiction also extends to environmental statutes as they relate to the aviation industry. For example, Section 233 of the Clean Air Act specifically prohibits states from regulating air pollution from aircraft engines.

Aircraft Operation. The mode of operation of the aircraft can be broken down into five stages: idling at gate and runway; engine power up; taxiing; takeoff and climb out; and approach and landing. Depending on the type of engine and aircraft, these activities can consume varying amounts of resources and produce various pollutants. Because fuel is the airline industry's second largest expense, increasing fuel efficiency of aircraft engines has been a top priority of U.S. airlines. Over the past two decades, U.S. airlines have increased fuel efficiency nearly 50% by lowering cruising speeds, using computers to determine optimum fuel loads and to select altitudes and routes that minimize fuel burn; and keeping aircraft exteriors trimmed (i.e., stowed) to minimize aerodynamic drag.[3]

The environmental aspects of aircraft operation are related to the use and burning of fuel. Fuel has the potential to cause varying environmental impacts depending on the type of fuel, the efficiency of burning, and the manner in which excess fuel is discarded. During aircraft operations, engines emit hydrocarbons, carbon monoxide, and nitrogen oxides (NOx). Hydrocarbon and carbon monoxide emissions result from incomplete combustion at the lower power settings for descent, or when idling or taxiing

---

[3] *The Airline Handbook*, Chapter 9: Airlines and the Environment from the Air Transport Association, 1997.

on the ground. NOx, the result of combustion products mixing with nitrogen in the air, is produced when engines are at their hottest, such as during takeoffs and, to a lesser extent, during cruise when jet engines also produce carbon dioxide and water vapor.

Aircraft loading and off loading. Aircraft loading and off loading includes all activities associated with the movement of materials, items, and people in and out of airplanes. Regardless of the type of airport, aircraft loading and off loading occur an infinite number of times daily throughout the U.S. Aircraft cargo loads consist of several different items, including but not limited to passengers, baggage, mail, live animals, dangerous goods (including hazardous materials), and wet cargo (e.g., fresh fish, seafood, meat, casings, etc.).

The primary loading and off loading activity with a potentially significant impact on human health and the environmental is the loading and off loading of hazardous materials. Though a rare occurrence, these loading activities have the potential to contaminate soil, groundwater, or surface water in the event of a spill or release. Facilities minimize and control these impacts through development and implementation of spill prevention control and countermeasures plans, storm water pollution prevention plants, and other emergency response programs.

If hazardous materials are transported by aircraft, the materials are subject to U.S. Department of Transportation (DOT) requirements that regulate aircraft inspections, placement of materials, packaging, and shipping papers (e.g., waybills, manifests). If hazardous materials are loaded onto an airplane, containers should be inspected for proper labeling/placarding, any signs of leakage, and compatibility with other hazardous materials. If damage or spillage of a package containing hazardous materials is observed on board an aircraft or during loading/off loading, immediate action must be taken in accordance with company or airport procedures.

Transportation of Dangerous Goods. Once hazardous materials are loaded onto aircraft, they are transported to their destination. In preparation for transport, they are stored, segregated and secured to assure safety during the transportation process. If improperly stored and secured, dangerous goods have the potential to not only impact the health of workers and passengers, but also to impact the safety of the aircraft itself.

To assure that these goods are transported in a safe manner, regulations have been established by DOT and the International Civil Aviation Organization (ICAO) Dangerous Goods Panel. These standards regulate the types of materials that can be transported, and the types of aircraft in which they can be transported. The ICAO Dangerous Goods regulations include a detailed list of individual articles and substances specifying the United Nations classification of each article or substance, their acceptability for air transport, and the conditions for their transport.

According to the regulations, dangerous goods may be transported in one of the following ways: they may not be carried on any aircraft under any circumstances; they are forbidden under normal circumstances, but may be carried with specific approvals from the States concerned; they may be carried only on cargo aircraft; or they may be safely carried on passenger aircraft, provided certain requirements are met. It should be noted that most dangerous goods fall into the latter transport category.

The ICAO Dangerous Goods regulations also provide packing instructions for all dangerous goods acceptable for air transport with a wide range of options for inner, outer, and single packaging. In addition, all individuals involved in the preparation or transport of dangerous goods must be properly trained to carry out their responsibilities. Information on the goods must be conveyed by the pilot to air traffic services to aid in the response to any aircraft incident or accident. Finally, dangerous goods accidents or incidents must be reported, so that an investigation by the relevant authorities can establish the cause and take corrective action.

Aircraft Noise. Another type of pollution generated from the operation of aircraft is noise pollution. Noise from airports is a significant negative impact for many people in the airport vicinity. Federal noise regulations require all large aircraft to meet noise standards. FAR Part 150 regulations address the issue of aircraft noise and provide a comprehensive scheme for planning and mitigation measures funded by aviation trust funds intended to reduce noise impacts on the public (US EPA Office of Federal Activities, *Pollution Prevention/Environmental Impact Reduction Checklist for Airports*).

Air Pollutants from Transportation

The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many transportation sources. The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. Exhibit 12 summarizes annual releases (from the industries for which a Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM_{10}), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 12. Annual Air Pollutant Releases by Industry Sector (tons/year)

Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC	TOTALS
Power Generation	366,208	5,986,757	140,760	464,542	13,827,511	57,384	20,843,162
Petroleum Refining	734,630	355,852	27,497	36,141	619,775	313,982	2,087,877
Iron and Steel	1,386,461	153,607	83,938	87,939	232,347	83,882	2,028,174
Pulp and Paper	566,883	358,675	35,030	111,210	493,313	127,809	1,692,920
Stone, Clay, and Concrete	105,059	340,639	192,962	662,233	308,534	34,337	1,643,764
Transportation*	**128,625**	**550,551**	**2,569**	**5,489**	**8,417**	**104,824**	**800,475**
Organic Chemicals	112,410	187,400	14,596	16,053	176,115	180,350	686,924
Inorganic Chemicals	153,294	106,522	6,703	34,664	194,153	65,427	560,763
Nonferrous Metals	214,243	31,136	10,403	24,654	253,538	11,058	545,032
Lumber and Wood Production	122,061	38,042	20,456	64,650	9,401	55,983	310,593
Metal Mining	4,670	39,849	63,541	173,566	17,690	915	300,231
Nonmetal Mining	25,922	22,881	40,199	128,661	18,000	4,002	239,665
Plastic Resins and Synthetic Fibers	16,388	41,771	2,218	7,546	67,546	74,138	209,607
Metal Casting	116,538	11,911	10,995	20,973	6,513	19,031	185,961
Rubber and Misc. Plastics	2,200	9,955	2,618	5,182	21,720	132,945	174,620
Motor Vehicles, Bodies, Parts and Accessories	15,109	27,355	1,048	3,699	20,378	96,338	163,927
Textiles	8,177	34,523	2,028	9,479	43,050	27,768	125,025
Printing	8,755	3,542	405	1,198	1,684	103,018	118,602
Fabricated Metals	4,925	11,104	1,019	2,790	3,169	86,472	109,479
Pharmaceuticals	6,586	19,088	1,576	4,425	21,311	37,214	90,200
Furniture and Fixtures	2,754	1,872	2,502	4,827	1,538	67,604	81,097
Ship Building and Repair	105	862	638	943	3,051	3,967	9,566
Electronics and Computers	356	1,501	224	385	741	4,866	8,073
Dry Cleaning	102	184	3	27	155	7,441	7,912

* "Transportation" includes air, water, railroad, trucking, and pipeline categories and SIC codes, and as such, represents a very broad range of industries. This represents stationary source air emissions only, not mobile sources.

Source: U.S. EPA Office of Air and Radiation, AIRS Database, 1997.

III.B. Airport Operations

Airport operations include all activities related to operating and maintaining the airport. These activities include operation and maintenance of runways, control towers, maintenance facilities, aircraft gates, baggage handling facilities, and general airport operations. This section focuses on two of these activities: runway deicing and general operations.

III.B.1. Runway Deicing

Airport runways, taxiways, and gate areas are sprayed with deicer and anti-icer to remove and prevent the buildup of ice and snow that would inhibit taxing, takeoff, and landing. Pavement deicing/anti-icing breaks the bond holding ice and compacted snow to the surfaces of runways and taxiways, facilitating mechanical ice and snow removal, and allowing aircraft to maintain adequate friction between aircraft tires and the runway. Runway and ramp deicing is usually done with one or more substances (e.g., glycol, urea, sodium formate, and/or potassium acetate). Sand is usually reserved to prevent slippage at the gate area, but not on taxiways and runways due to potential engine ingestion hazards.

Environmental Aspects and Potential Impacts of Runway Deicing

Deicing mixtures have the potential to contaminate groundwater and surface water supplies as they flow from airport runways to storm drains or to waterways as sheet runoff. Sand has the potential to clog storm water drains and contaminate water bodies through increased erosion and sediment buildup. Deicing chemicals that mix with storm water discharges must be managed according to the facility's NPDES storm water permit. In an effort to control water contamination, many facilities direct storm water to an onsite treatment facility prior to discharge.

III.B.2. General Airport Operations

General airport operations encompass many activities including passenger and vehicle traffic, ticketing, baggage handling, passenger security, and concessions and food services. Airports, like other administrative offices, can generate large quantities of waste paper and consume large amounts of energy from lighting, heating and cooling systems, and computers. Concession shops and food service operations can generate significant quantities of solid waste, such as corrugated cardboard, paperboard, office paper, newspapers, magazines, wooden pallets, aluminum, plastic, and glass containers, as well as leftover food. Groundskeeping and landscaping activities can generate waste pesticides and herbicides. Airport traffic congestion can generate significant air emissions.

Environmental Aspects and Potential Impacts of General Operations

The operation of airports can have a variety of impacts on the environment. These impacts include erosion, sedimentation, soil compaction, noise pollution, chemical pollution resulting from aircraft maintenance and deicing, aircraft emissions, contaminated runway and grounds runoff, generation of waste construction materials, and litter and other debris from administrative and food service operations.

In regards to wildlife, there is typically no significant destruction of wildlife habitat. FAA is, however, aware of the problem that certain species (e.g., large waterfowl, birds that flock, deer) cause aviation. As a result, FAA encourages, and in some cases requires, airport sponsors to work with wildlife agencies to manage the habitat attracting these species. Such measures are needed to reduce the number of collisions between these species and aircraft to protect human and wildlife populations.

IV. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. Airlines and airports are reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some operations are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies. ***While implementing pollution prevention techniques, it is important that the facility assure that the techniques are conducted in accordance with FAA safety regulations and airworthiness requirements. FAA's Advisory Circular entitled, "Management of Airport Industrial Waste"(AC#150/5320-15), provides guidance on managing industrial wastes that airport operations generate.***

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be implemented feasibly. In the waste management hierarchy, if source reduction is not feasible, the next alternative is recycling of wastes, followed by energy recovery, and as a last alternative, waste treatment.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the air transportation industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be used effectively.

Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be considered carefully when pollution prevention options are evaluated, and the full impacts of each option must be evaluated for its effects on air, land, and water pollutant releases.

Waste minimization generally encompasses any source reduction or recycling that results in either the reduction of total volume or the toxicity of hazardous waste. Source reduction is a reduction of waste generation at the source, usually within a process. Source reduction can include process modifications, feedstock (raw material) substitution, housekeeping and management processes, and increases in efficiency of machinery and equipment. Source reduction includes any activity that reduces the amount of waste that exits a process. Recycling refers to the use or reuse of a waste as an effective substitute for a commercial product or as an ingredient or feedstock in an industrial process.

IV.A. Air Transportation Operations

Pollution prevention/waste minimization opportunities in the air transportation industry are available for many operations including aircraft and vehicle maintenance and repair, washing and cleaning, deicing, fueling, aircraft modification, and airport layout and operations. These areas are addressed in the following sections.

IV.A.1. Maintenance and Refurbishing Operations

Aircraft maintenance activities generate wastes that are of great environmental concern to the air transportation industry. The major wastestreams from aircraft maintenance and refurbishing are lubricants, batteries, scrap metal, parts cleaning wastes (e.g., solvents), depainting wastes (e.g., chemical paint stripping wastes, abrasive blast and surface preparation wastes), and painting/painting equipment cleaning wastes. Source reduction is the best pollution prevention approach for reducing the amount of wastes produced. Source reduction can be achieved through material substitution, process or equipment modification, recycling, or better operating practices. ***Note: Such modifications must be made in accordance with FAA requirements, as well as the extraordinarily specific maintenance practices recommended by airframe and engine manufacturers.*** The following material presents pollution prevention/waste minimization opportunities for each type of waste.

Used Oil and Lubricants. Most airline maintenance facilities recycle used oil. Recycling used oil requires equipment like a drip table with a used oil collection bucket to collect oil dripping off parts. Drip pans can be placed under aviation-support vehicles awaiting repairs in case they are leaking fluids. Some facilities use absorbent materials (e.g., "pigs" or "quick dry") to catch drips or spills during activities where oil drips may occur. While absorbents prevent oil from impacting the environment, they actually create more solid and potentially hazardous waste in the form of contaminated absorbent materials. Preventing small spills in the first place, using drip pans, or cleaning spills with rags, soap and water can prevent the generation of additional waste. Recycling used oil by sending it to a commercial recycling facility saves money and protects the environment.

R0074784

To encourage recycling, the publication *How To Set Up A Local Program To Recycle Used Oil* is available at no cost from the RCRA/Superfund Hotline at 1-800-424-9346 or (703) 412-9810.

Spent petroleum-based fluids and solids should be sent to a recycling center whenever possible. Solvents that are hazardous waste must not be mixed with used oil. If they are mixed, the entire mixture may be considered hazardous waste, and thus subject to more stringent regulation. Non-listed hazardous wastes will be mixed with waste oil, and as long as the resulting mixture is not hazardous, can be handled as waste oil. All used drip pans and containers should be labeled properly.

Fluids. Aircraft and aviation-support vehicles require regular changing of fluids, including oil, coolant, and others. To minimize releases to the environment, these fluids should be drained and replaced in areas where there are no connections to storm drains or municipal sewers. Minor spills should be cleaned prior to reaching drains. Used fluid should be collected and stored in separate containers. Fluids can often be recycled. For example, brake fluid, transmission gear, and gear oil are recyclable. Some liquids are able to be legally mixed with used motor oil which, in turn, can be reclaimed.

During the process of engine maintenance, spills of fluids are likely to occur. The "dry shop" principle encourages spills to be cleaned immediately, without waiting for the spilled fluids to evaporate into the air, to transmit to land, or to contaminate other surfaces. The following techniques help prevent spills:

✓ Collect leaking or dripping fluids in designated drip pans or containers. Keep all fluids separated so they may be properly recycled.

✓ Keep a designated drip pan under the vehicle while unclipping hoses, unscrewing filters, or removing other parts. The drip pan prevents splattering of fluids and keeps chemicals from penetrating the shop floor or outside area where the maintenance is occurring.

✓ Immediately transfer used fluids to proper containers. Never leave drip pans or other open containers unattended.

Radiator fluids from aviation-support vehicles are often acceptable to antifreeze recyclers. This includes fluids used to flush out radiators during cleaning. Reusing the flushing fluid minimizes waste discharges. If a licensed recycler does not accept the spent flushing fluids, consider changing to another brand of fluid that can be recycled. Many maintenance facilities have purchased antifreeze recycling systems that connect directly to a vehicle so that the antifreeze is taken from the vehicle, cleaned, and then put back into the same vehicle.

If the maintenance facility services air conditioners in aviation-support vehicles, special equipment must be used to collect the freon or other refrigerant because it is not permissible to vent the refrigerant to the atmosphere. Air conditioner maintenance activities require employee training, specifically for handling refrigerants. Reusing refrigerants onsite is less costly than the only other legal alternative, sending the refrigerant to an offsite recycler.

Batteries. Facilities have many battery disposal options: recycling onsite, recycling through a supplier, or direct disposal. Facilities should explore all options to find one that is right for the facility. Many waste batteries must be handled as hazardous waste. Lead acid batteries are not considered hazardous waste as long as they are recycled. In general, recycling batteries may reduce the amount of hazardous waste stored at a facility, and thus the facility's responsibilities under RCRA. The following best management practices are recommended when sorting used batteries:

✓ Place on pallets in a contained area, and label by battery type (e.g., lead-acid, nickel, and cadmium).

✓ Protect them from the weather with a tarp, roof, or other means.

✓ Store them on an open rack or in a watertight, secondary containment unit to prevent leaks.

✓ Inspect them for cracks and leaks as they are removed from the vehicle or aircraft. If a battery is dropped, treat it as if it is cracked. Acid residue from cracked or leaking batteries is likely to be hazardous waste under RCRA because it is likely to exhibit the characteristic of corrosivity, and may contain lead and other metals.

✓ Avoid skin contact with leaking or damaged batteries.

✓ Neutralize acid spills and dispose of the resulting waste as hazardous if it still exhibits a characteristic of a hazardous waste.

Machine Shop Wastes. The major hazardous wastes from metal machining are waste cutting oils, spent machine coolant, and degreasing solvents. However, scrap metal also can be a component of hazardous waste produced at a machine shop. Material substitution and recycling are the two best means to reduce the volume of these wastes.

The preferred method of reducing the amount of waste cutting oils and degreasing solvents is to substitute them with water-soluble cutting oils. Recycling of waste cutting oils also is possible if nonwater-soluble oils must be used. Machine coolant can be recycled, and a number of proprietary systems are available to recycle the coolant. Coolant recycling is implemented most easily when a standardized type of coolant is used throughout the shop. Reuse and recycling of solvents also are achieved easily, as mentioned above. Most shops collect scrap metals from machining operations and sell these to metal recyclers. Metal chips which have been removed from the coolant by filtration should be drained and included in the scrap metal collection. Wastes should be segregated carefully to facilitate reuse and recycling.

Small Parts Cleaning. Solvents are commonly used for small parts cleaning. Spent solvents are often toxic and/or hazardous and should be disposed of in an environmentally safe manner. Spent solvent, if hazardous, must be treated and disposed of as hazardous waste, unless recycled properly. There are several options for reducing the amount and/or toxicity of spent solvents:

- ***Switch to non-hazardous substances.*** Switch from hazardous, organic-based to non-hazardous, aqueous-based solvents. In addition, certain aqueous parts washers can use detergents instead of solvents. While water-based parts washers may be more expensive than solvent-based parts washers (costs range from $1,000 to $3,000 for water-based washers capable of washing small parts), the cost of the parts washer can be quickly recovered as the cost of disposing or recycling of hazardous solvent as well as the cost of any required training for workers handling the solvent are eliminated. This will reduce the amount of hazardous waste generated from cleaning operations.

- ***Keep lids closed when not in use.*** For solvents that contain volatile organic compounds, keeping containers closed except when parts actually are being cleaned reduces solvent emissions to the atmosphere, improves worker safety, and allows the solvent to be used longer, rather than simply to evaporate.

- ***Reuse.*** Solvents can be reused if quality requirements are met and until their effectiveness is compromised. and then they can be recovered and recycled.

- ***Recycle.*** Solvent recycling also can decrease hazardous waste production from small parts cleaning. Spent solvents can be cleaned and recycled with a solvent still. Processes for recycling solvents are well established and widely used in many industrial sectors. Solvents should not be poured down sewer drains, mixed with used oil, or stored in open containers to allow them to evaporate. Solvent stills (e.g., distillation units) may only be installed in appropriately fire rated areas.

- ***Use good housekeeping practices.*** To minimize solvent waste generation, facilities should use good housekeeping practices including labeling of all chemicals and wastes to avoid misuse and potential injury or contamination; keeping containers of hazardous solvents closed to prevent air emissions; providing storage area leak control and containment; and making improvements in drum location, product transfer leak collection, and drum transport procedures. If solvents are used, care should be taken to wear protective safety gear and follow good housekeeping practices.

Depainting

Chemical Stripping Wastes. Chemical stripping operations must be conducted according to the appropriate and relevant requirements associated with the original equipment manufacturers' specifications. Chemical stripping wastes consist primarily of stripping agent and paint sludges. Methylene chloride is the most commonly used paint stripping agent, although the industry increasingly is using less toxic agents such as dibasic esters, semi-aqueous, terpene-based products, aqueous solutions of caustic soda, and detergent-based strippers that currently are available on the market. In order to reduce compliance costs, many facilities are replacing methylene chloride with nonhalogenated strippers.

The Aerospace National Emission Standards for Hazardous Air Pollutants (NESHAP) (effective September 1998) places stringent limitations on the use of chemical strippers containing hazardous air pollutants. (See discussion in Section V.C Pending and Proposed Regulatory Requirements.)

Storing and reusing or recycling used strippers also are effective waste minimization techniques. Solvent strippers, particularly stripping baths, generally can be reused several times before their effectiveness is diminished. Both spent caustic and organic stripping solutions can be treated to remove contaminants. Segregating the spent stripping wastes from other waste streams will help facilitate cost-efficient reuse and recycling of contaminated strippers.

Abrasive Blasting and Surface Preparation Wastes. Abrasive blasting is being used as an alternative for chemical paint stripping. Although blasting does not require disposal of chemical strippers, it does create a large amount of water runoff and air pollution, and the presence of paint chips containing hazardous metals and organometallic biocides can make abrasive blasting wastes potentially hazardous. Research and testing are underway on a number of innovative alternative paint removal and surface preparation techniques including: plastic media blasting, steel shot slingers, water jet stripping, thermal stripping, dry ice pellets, laser paint stripping, and cryogenic stripping. However, an alternative as economically viable and easy as chemical paint stripping has not been found.

- Plastic media blasting has had mixed results. The same types and quantities of solid wastes are generated as with grit blasting, but the plastic media tend to be more easily recyclable through the use of pneumatic media classifiers that are part of the stripping equipment. The abrasion eventually turns the plastic media to dust, making the waste paint the main waste to be disposed. However, it will not work on epoxy or urethane paints. In addition, the blasting equipment is more expensive and requires more highly trained operators.

- Cavitating water jet stripping systems remove most paints, separate the paint chips from the water, and treat the water to eliminate dissolved toxic materials. Although relatively little hazardous waste is generated by this process, it is not as efficient as grit blasting, and the equipment has higher capital and operating costs.

- The thermal stripping process softens the paint so it can be peeled relatively easily. Although it generates only one waste stream (waste paint), it is more labor-intensive than other stripping methods and can only be used on non-heat-sensitive surfaces.

- Carbon dioxide pellets can be used as a blast medium leaving only paint chips that can be swept up and placed in containers for disposal (the dry ice evaporates). However, the cost of the dry ice, storage, and handling equipment can be substantial.

- A pulsed carbon dioxide laser controlled by an industrial robot to remove paint produces no residue. However, the method is complex, capital intensive, and requires highly skilled operators.

- Cryogenic stripping using liquid nitrogen baths followed by gentle abrasion or plastic shot blasting is useful for small parts or objects, but requires special equipment for handling the liquid nitrogen.

Blasting cannot be used as a paint stripping method on certain substrate because the abrasive media will cause damage, especially to composite materials.

Painting and Painting Equipment Cleanup Wastes. Methods for minimizing paint and painting equipment cleanup wastes include tight inventory control, material substitution, and minimization of fugitive oversprays. Tight inventory control techniques such as monitoring employee operations or limiting access to raw materials storage areas force employees to stretch the use of the raw materials. Use of less toxic types of paints can reduce the amount of hazardous paint waste as well as painting equipment cleanup waste (i.e., solvent wastes). Also, the use of powder coatings based on finely pulverized plastics that are baked on at 400°F has been tried as a substitute for paint for some industrial applications.

Minimizing overspray has benefits in terms of both inventory control and elimination of surface water runoff. For inventory control, overspray can be minimized by using air-assisted, airless, high volume, low pressure turbine, air-atomized electrostatic, and airless electrostatic application techniques. In addition, overspray can be minimized by maintaining a fixed distance from the surface while triggering the paint gun, and releasing the trigger when the gun is not aimed at the target. Overspray control for minimizing runoff can be achieved by using plastic sheeting under and around the aircraft being painted, or using a paint booth for smaller parts.

To reduce the amount of wastes created by painting operations, all paint should be used until containers are completely empty. Containers that are considered empty under the Resource Conservation and Recovery Act (RCRA) may be disposed of as solid waste (40 CFR 265). However, they may face requirements under DOT regulations depending on the amount of hazardous waste remaining in the container. Used containers of paint may need to be disposed of as hazardous wastes if they are not completely empty. Also, paint may be purchased in recyclable and/or returnable containers to reduce disposal costs.

IV.A.2. Fueling

Pollution prevention opportunities for aircraft and vehicle refueling operations primarily focus on the prevention of fuel spillage and the associated air, water, and hazardous waste pollution. Fuel tank monitoring and automatic shutoff devices are key spill prevention measures. Although not permitted for jet fuel, using color-coded dyes to identify fuel grades of aviation fuel is commonly used to prevent mixtures of fuel and to find fuel leaks. One technique to prevent fuel spills is to install catchment basins, including containment at hydrant pits. All leaking pipe joints, nozzle connections, and any damage to the fueling hose (e.g., kinks, crushing, breaks in the carcass, bulges, blistering, soft spots at the coupling, deep cracks or cuts, spots wet with fuel, or excessive wear) should be reported immediately to reduce their potential impact on the environment. Using dry cleanup methods for the fuel area reduces water runoff and associated contamination of groundwater and surface water supplies.

Pollution prevention techniques for aircraft fueling include:

✓ Inspect fueling equipment daily to ensure that all components are in satisfactory condition.

✓ Employ proper grounding and bonding techniques for a safe fueling operation.

✓ If fueling of an airplane occurs at night, assure it is carried out it in well lit areas.

✓ Where possible, avoid fueling an aircraft during aircraft maintenance activities that might provide a source of ignition to fuel vapors. Similarly, assure that all radio and radar equipment is off during the refueling process.

✓ While fueling, check for leaks and assuring that the fueling operator has a clear view of control panel.

✓ Never leave the nozzle unattended during overwing fueling, or wedge or tie the nozzle trigger in the open position.

✓ Discourage topping off of fuel tanks, except when required for compliance with FAA safety regulations.

✓ Sump of hydrant pits.

Vehicle fueling. Self-locking fueling nozzles minimize the risk of both fuel spillage and air pollution by ensuring a secure seal between the fuel source and tank.

Fuel in vehicle operations. Use of battery-operated or alternative fuel vehicles provides two ways to reduce emissions from aviation-support vehicles. Natural gas vehicles, for example, are a viable alternative to gasoline- and diesel-powered transportation. Almost any gasoline-powered vehicle can be converted to run on natural gas by installing a natural gas fuel system and storage tanks without removing any existing equipment. Diesel conversions are somewhat more complicated because they also involve reducing compression and adding a sparked-ignition system. Other fuels suitable for vehicles include methanol, ethanol, and propane.

In 1997, there were alternative fuel vehicle programs at virtually every major airport in the United States. The alternative vehicle usage at airports runs the gamut from taxis, shuttle buses, passenger busses, transport busses, minivans, trucks, cars, tugs, tractors, belt loaders, and ground power units, to catering vehicles. The use of natural gas vehicles is being driven by both cost effectiveness and regulation. Many states require companies with fleets of twenty or more vehicles to phase in alternative fuel vehicles. The 1990 Clean Air Act also contains incentives to encourage the use of alternative fuels. Federal (and in some areas, State) tax deductions for "alternative fuel vehicles" and related refueling equipment are available. The maximum tax deductions range from $2,000 to $50,000 for each alternative fuel vehicle and up to $100,000 on refueling stations.

IV.A.3. Aircraft and Vehicle Exterior Cleaning

Pollution prevention opportunities for aircraft and aviation-support vehicle cleaning focus on the reduction of wastewater discharges.

> Note: Air worthiness requirements may dictate the quantity of water used in certain cleaning operations.

- ***Aircraft Cleaning.*** For washing aircraft, it is best to utilize a designated cleaning area, recycle washwater (if possible), and use phosphate-free detergents. Washwater should be contained and an oil/water separator should be used. Washwater can be captured, filtered, and reused in aircraft washing and other activities. If the washwater is reused for washing aircraft, ***it must meet the manufacturer's specifications for washwater***. Washwaters containing contaminants can result in corrosion of potentially critical aircraft parts.
  Another water reduction tool, a flow restrictor, can be used to control the amount of water being used to wash aircraft. A reduction in water usage will translate into a reduction in the volume of generated wastewaters. (Note that technologies for water reduction are only suggestions and should be evaluated individually to address the circumstances appropriate to each site.)

- ***Vehicle Washing.*** Vehicle washing has become a major environmental compliance issue for most companies that operate a fleet of vehicles. While pollutants from vehicle washing are generally controlled by routing the water through an oil and water separator.

many techniques are available that prevent the water from being generated at all. The following pollution prevention activities will help ensure that a facility is addressing potential sources of pollution:

- ✓ Wastewater discharge can be prevented by dry washing vehicles using a chemical cleaning and waxing agent, rather than detergent and water. The dry washing chemical is sprayed on and wiped off with rags. No wastewater is generated. Dry washing is labor intensive and creates solid waste that must be disposed of properly.

- ✓ Wastewater can be contained by washing at a low point of the facility, blocking drains from the facility using a containment dike. or blanket, or washing on a built-in or portable containment pad.

- ✓ Wastewater can be disposed of by evaporation from a containment area, or by discharging the wastewater to a sanitary sewer system. Permission must be obtained from the POTW before washwater can be drained. pumped. or vacuumed to a sanitary sewer connection.

IV.A.4. Aircraft Deicing

As noted earlier, FAA regulations and advisory circulars govern in detail virtually every aspect of airline and airport operations, particularly with respect to procedures and standards for aircraft maintenance and airworthiness, including aircraft deicing. Potential pollution prevention opportunities for aircraft deicing operations include (1) providing the appropriate training on the use of glycol products to ensure they are efficiently applied to reduce polluting airport runoff and (2) collecting deicing fluid to prevent direct discharges to surrounding surface water and groundwater along with facility storm water. Appropriate liquid aircraft deicers include ethylene glycol, propylene glycol, and di-ethylene glycol.

Recycling deicing fluid. In general, the reuse of deicier fluid *on aircraft* is problematic and usually prohibited due to quality control and the cost issues associated with storage and treatment. However, recycling deicing fluid is a method employed by some airports and airlines as recycled deicing fluid can be used for *nonaircraft applications*. There are two main processes used to recycle deicing fluid. The first process involves filtering collected fluid, demineralizing it, removing salts, and then evaporating the water to leave a higher glycol concentration.

The second process uses reverse osmosis membrane technology to recover glycol by preconcentrating dilute runoff prior to distillation. In order to make recycling practical and economically feasible, it is necessary to collect concentrations that contain more than 10% glycol. Traditionally to allow recycling, only one type of chemical glycol (ethylene or propylene) could be used at an airport. However, newer methods are available to handle mixtures. The benefits of recycling fluids include recovery of the cost of glycol, recovery of the utility cost for water, and reduced disposal cost for spent glycol.

The most widespread collection method involves the collection of deicer through separate drainage areas around aircraft deicing operations, which minimizes the mixing of storm water and deicing fluid. The collection systems can be located either at the gate area or at a remote deicing area. Deicer fluid at gate area surfaces can be collected using vacuum sweeping machines, sponge rollers, and pumps.

Alternative deicing methods. Additional technology-based, alternative deicing methods currently are being developed by industry. While some of these have yet to be proven cost effective, they do present viable alternatives as technology is improved.

- FAA has approved site-specific procedures for infra-red equipment designed to de-ice aircraft.
- Deicing truck with a cab. This type of enclosure for the operator reduces overspray since the operator can get closer to the job. However, minimum safe distances must be maintained to avoid accidents and damage to aircraft or personnel. Customers of such a system have reported up to 30% reductions in consumption of glycol-based and other anti-deicing fluids.
- More advanced computerized ice detection protection systems. For example, a system that takes electronic measurements from a wing-mounted sensor disc to identify the type and thickness of ice contamination has been developed. The system also can tell when the deicing fluid is in a transition stage and about to fail as a protective coat. Such a mechanism would be useful in determining when and where the aircraft needs to be deiced.

Segregation of Wastestreams. Wastewater segregation can be an effective technique that often does not require significant process or equipment modifications. In some cases, wastewater streams can be treated more effectively and economically if they are segregated from other streams which do not require the same degree of treatment. Highly contaminated wastewater streams, oily wastewater streams, and wastewater streams containing contaminants requiring a specific treatment method (e.g., metals removal) can be segregated to reduce the volume of wastewater receiving certain treatment steps. Wastewater treatment can also be improved by adding stages to existing wastewater treatment systems. Additional stages, such as biological treatment, chemical precipitation, filtration, ion exchange, and sludge dewatering, improve system effectiveness and treatment costs through reduced sludge generation, recovery of metals for resale, and replacement of more costly treatment stages. By segregating wastestreams, facilities can provide the appropriate treatment to each wastewater stream. (Note: Wastestream segregation should be considered as a preferred alternative at a new or existing facility when it can be accomplished at a reasonable cost.)

IV.A.5. General Aircraft Operations

Modifications. Pollution prevention opportunities for aircraft modification primarily focus on improving the efficiency of the engine. Engine manufacturers are being encouraged or required to research and develop cleaner, quieter, and more fuel-efficient aircraft. Air pollution is a function of both the type of aircraft engine and the mode of operation of the aircraft, which can be broken down into the following stages: idling at gate and runway; engine power up; taxiing; takeoff and climb out; and approach and landing. With respect to the type of engine, one mechanism that can improve air quality in and around airports is for airlines and associated personnel to encourage and support aviation research that would reduce aircraft emissions. In the meantime, airlines have the option of buying and leasing aircraft that meet or exceed the strictest requirements while retiring, replacing, or retrofitting older equipment as rapidly as possible to reduce both the amount of air and noise pollution.

Operations. Pollution prevention opportunities for aircraft operations at the airport include the following:

✓ Utilize more efficient aircraft. By operating more efficient aircraft, airlines have been able to reduce fuel consumption and decrease the cost of operations. Since 1976, the introduction of more fuel efficient aircraft has reduced fuel consumption per passenger mile by approximately 50%.[4]

---

[4] *Airline Fuel Consumption*, The Boeing Company, 1997.

R0074795

✓ Retrofit gate facilities to centralized ground power in order to reduce aircraft engine running and prevent extraneous air emissions associated with engine and auxiliary power unit usage.

✓ Reduce holdover time from deicing to takeoff to eliminate the need for a plane to require deicing more than once.

✓ Checking cargo prior to loading for leaking or otherwise damaged shipments will prevent the leakage of wastes. This is of particular importance for loading dangerous goods, wet cargo, live animals, or other cargo prone to leakage. After unloading, it is useful to check the cargo compartments to ensure that all of the load for a given station has been removed. Inspecting any traces of leakage at once will enable the operator to establish the source of such leakage.

IV.B. Airport Operations

IV.B.1. Runway Deicing

In addition to collection and recycling of deicing fluids, pollution prevention opportunities include the use of alternative, less polluting deicers such as magnesium acetate and potassium acetate. These fluids have been approved by FAA on both safety and environmental grounds, and have no significant impact on water quality. It should be noted that although they have received FAA approval, magnesium acetate and potassium acetate have caused safety problems by damaging aircraft lighting systems. As in all cases where alternative technologies are used to minimize environmental impacts, aircraft safety is a major concern and must be addressed.

IV.B.2. General Airport Operations

Pollution prevention opportunities for airports focus primarily on alleviating air and noise pollution by implementing layout modifications and changes in airport operations. These improved practices can reduce the amount of air and noise pollution generated by aircraft and associated airport activities.

- For existing airports, engage in comprehensive noise mitigation planning and implement feasible measures to reduce noise impacts on densely populated regions. For new airports, if possible, choose an optimal site for the airport that is away from large communities.

- Use proper land use planning, which is a local government responsibility, for the areas affected by airport noise. For examples, airports may choose to purchase land surrounding the airport for airport use or acquire land as aviation easements. Airports may also work with local zoning boards and encourage them to zone land near airports for airport compatible uses. In particular. FAA is concerned about sanitary landfill locations near airports because landfills attract certain bird species that are hazards to aviation due to their size and/or flocking behavior.

Additional Airport Activities Impacting Air Quality. Air pollution resulting from airport operations is dependent on both mobile sources of pollution such as airplanes, ground-service vehicles, and automobiles accessing the airport as well as point sources of pollution such as power plants. fueling systems, fuel storage facilities, aircraft maintenance facilities, and deicing facilities.

Airport Traffic. Air quality in and around the airport vicinity is related not only to aircraft using the airport but to travelers and employees accessing the airport and maintenance vehicles that service the airport. Automobiles and busses used by motorists that enter and leave airports create a large source of air pollution through automobile exhaust. To reduce emissions from private vehicles, airports can link or improve public transport access. provide express bus services, and institute bus/high occupancy vehicle lanes on access roads.

Employee Programs. Initiating employee programs can reduce air pollution in and around the airport. For instance, modifying airport employee work weeks to a revised schedule that limits trips made by employees will decrease air emission (e.g., an airport may implement a 9 day/80 hour two-week schedule). Other options are voluntary employee Rideshare Programs or day care services to prevent employees from having to travel unnecessary miles, which in turn reduces the quantity of auto emissions associated with airport operations.

Recycling solid waste. Recycling all paper, cardboard, plastics. metal, and airport-specific items such as wood and film plastic will prevent pollution. In addition, distributing recycling literature and educational materials to employees and travelers will encourage more recycling of these materials.

Pest Management. Food waste from the large number of concessionaires at major airports create pest management problems at airports. Various pesticides, fumigants, and other pest management techniques are used at airports to control pests.

Landscaping. Airport erosion control projects should use environmentally and economically beneficial landscaping methods. Any plantings near runways should avoid attracting hazardous wildlife (e.g., geese, gulls, large mammals, or prey species that attract large mammals). However. careful planting can reduce the use of pesticides, herbicides insecticides, and rodenticides; control erosion; reduce water usage; reduce energy usage; reduce runoff and air emissions from mowers; and associated exposure to workers and the public.

V. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section V.A. contains a general overview of major statutes
- Section V.B. contains a list of regulations specific to this industry
- Section V.C. contains a list of pending and proposed regulations

The descriptions within Section V are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

V.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity, and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities must generally obtain a permit either from EPA or from a State agency which EPA has authorized to implement the permitting program if they store hazardous wastes for more than 90 days (or 180 or 270 days depending on the amount of waste generated and the distance the waste will be transported) before treatment or disposal. Facilities may treat hazardous wastes stored in less-than-ninety-day tanks or containers without a permit. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.101) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, and disposal facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 States and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261 and 262) provides definitions and lays out the procedure every generator must follow to determine whether the material in question is considered a hazardous waste or solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establish the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Providing they meet additional requirements described in 40 CFR 262.34, generators may accumulate hazardous waste for up to 90 days (or 180 or 270 days depending on the amount of waste generated and the distance the waste will be transported) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet LDR treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Virtually all hazardous wastes are subject to LDR requirements. Generators of waste subject to the LDRs must provide notification of such to the designated treatment, storage, and disposal facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities that store such waste, including large quantity generators accumulating waste prior to shipment off-site.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that must be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

***EPA's RCRA, Superfund and EPCRA Hotline** at 1-800-424-9346 responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding Federal holidays.*

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law known commonly as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs (including remediation costs) incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as removals. EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

***EPA's RCRA, Superfund and EPCRA Hotline** at 1-800-424-9346 answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding Federal holidays.*

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release equal to or exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, known commonly as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline *at 1-800-424-9346 answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding Federal holidays.*

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters.

Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The National Pollutant Discharge Elimination System (NPDES) program (CWA §502) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized 42 States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set the conditions and effluent limitations on the facility discharges.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated the NPDES storm water permit application regulations. These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category I: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTWs). The national pretreatment program (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if the State develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities that could reasonably be expected to discharge oil in harmful quantities prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR §112.20) and for polychlorinated biphenyl (PCB) transformers and PCB-containing items were revised and finalized in 1995.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Groundwater and Drinking Water Resource Center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable, health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at 1-800-426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and PCBs.

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms.

Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, and volatile organic compounds (VOCs). Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under Section 110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and may go into effect as early as late 1997.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source.

Under Title III, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title I, section 112(c) of the CAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV of the CAA establishes a sulfur dioxide and nitrogen oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs) and chloroform, were phased out (except for essential uses) in 1996.

EPA's Clean Air Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at 1-800-296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at 1-800-535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities (www.epa.gov/ttn then select Directory and then CATC).

V.B. Industry Specific Requirements

As noted earlier, several government entities regulate specific transportation sectors. The air transportation industry is regulated by several different Federal, State, and local agencies. The air transportation industry is regulated by DOT's largest agency—the Federal Aviation Administration (FAA). The DOT has traditionally established national standards that are not affected by local or State laws.

EPA has traditionally relied on delegation to States to meet environmental standards, in many cases without regard to the methods used to achieve certain performance standards. This has resulted in States with more stringent air, water, and hazardous waste requirements than the Federal minimum requirements. This document does not attempt to discuss State standards, but rather highlights relevant Federal laws and proposals that affect the air transportation industry.

Clean Water Act

NPDES Requirements. Wastewater from air transportation facilities discharging to surface waters is regulated under the Federal Water Pollution Control Act (FWPCA). National Pollutant Discharge Elimination System (NPDES) permits must be obtained to discharge wastewater into navigable waters. The airport is usually considered the "discharger" for regulatory control and permitting purposes, and the individual tenants may not hold specific discharge permits. However, in some cases, the airport is the permittee and the tenants are the co-permittees. In the event of a discharge problem, a tenant who is a co-permittee contributing wastewater to an airport's discharge may be subject to action on the part of the airport or regulators (EEA, 1996).

As mandated by Section 304(m) of CWA, EPA is developing effluent limitation guidelines for certain industrial wastewater discharges from operations. At this time, there are no effluent limitation guidelines established specifically for aviation operations, however. other wastewater discharge restrictions may apply. For example, existing categorical guidelines for metal finishing currently apply to certain discharges from this industry sector. In addition, EPA is in the process of establishing effluent limitation guidelines for the transportation equipment cleaning, which will include operations such as exterior cleaning. These guidelines are scheduled to be promulgated in 2000. (Contact: Gina Matthews or Jan Goodwin, Office of Water, (202) 260-6036 and (202) 260-7152, respectively).

Storm Water Requirements. As discussed under the general description of the Clean Water Act, EPA published storm water regulations on November 16, 1990, which require certain dischargers of storm water to waters of the U.S. to apply for NPDES permits. According to the final rule, facilities with a "storm water discharge associated with industrial activities" are required to apply for a storm water permit. The rule states that transportation facilities classified in SIC 40 through 45, and 5171 which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations are considered to have a storm water discharge associated with industrial activity. However, only those portions of the facility that are either involved in vehicle maintenance (including vehicle refurbishing, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or which are otherwise identified under paragraphs (b)(14)(I)-(xi) of Section 122.26 are considered to be associated with industrial activity. It is also important to that co-permittee permitting is available if appropriate to a specific tenant/airport relationship for covering storm water run off.

Facilities covered by this rule must submit one of the following permit applications:

- Individual permit application.
- Group permit application. A group permit application can be filed by facilities with like operations and discharges. In 1991, a group storm water permit application that covered airports was filed by the American Association of Airport Executives and the Airport Research and Development Foundation. On the application, airports were identified as the permittee and all tenants as co-permittees (EEA, 1996).
- Notice of Intent for general permit coverage.

SPCC. The CWA requires facilities to develop Spill Prevention Control and Countermeasure (SPCC) plans for petroleum products, such as oil or any substance, that cause a sheen on water, if they are stored in large quantities at a particular site. The SPCC program requires reporting spills to navigable waters and the development of contingency plans that must be kept onsite. SPCC plans document the location of storage vessels, types of containment, dangers associated with a major release of material from the tanks, types of emergency equipment available at each site, and procedures for notifying the appropriate regulatory and emergency agencies. No SPCC plan is considered complete until it has been reviewed and certified by a registered Professional Engineer.

Resource Conservation and Recovery Act

Air transportation facilities generate a variety of RCRA-regulated wastes in the course of normal operations and utilize underground storage tanks for fuel storage. However, underground airport hydrant fuel systems have been deferred from the bulk of federal UST requirements pursuant to an exclusion set forth in 40 CFR §280.10. Aircraft refurbishing and maintenance operations generate hazardous wastes such as certain spent solvents and caustics, and paints and paint sludges. Additional common materials from aviation maintenance facilities that may be hazardous include:

- Rechargeable nickel-cadmium batteries and lead-acid motor vehicle batteries
- Vehicle maintenance fluids
- Fluorescent light bulbs
- Scraps of metals (cadmium, chromium, lead, mercury, selenium, and silver) and materials containing these metals (e.g., high-grade stainless steel or paint waste) (exempt if recycled)
- Waste solvents
- Near-empty paint cans and spray cans
- Paint stripping residue.

Note that petroleum products and petroleum-containing wastes (e.g., waste oil, contaminated fuel, or fuel spill clean-up wastes) are specifically exempted from RCRA regulations, unless they exhibit any of the hazardous waste characteristics (EEA, 1996). Many air transportation facilities qualify as hazardous waste generators under RCRA law. Under RCRA, it is the facility's responsibility to determine whether a waste is hazardous. A list of EPA hazardous wastes can be found in 40 CFR §§261.31-261.33. Wastes are also hazardous if they exhibit a characteristic described in 40 CFR §§261.21-261.24. RCRA wastes are subject to the hazardous waste regulations of 40 CFR Parts 124, 261-266, 270-273, and 302. Used oil and USTs are subject to different rules.

Oil Pollution Act

The 1990 Oil Pollution Act (OPA) establishes strict, joint and several liability against facilities that discharge oil or which pose a substantial threat of discharging oil to navigable waterways. OPA imposes contingency planning and readiness requirements on certain facilities that may include vehicle maintenance shops. These requirements may affect some air transportation maintenance establishments. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and facility response plans to oil discharges (40 CFR Part 112) were revised and finalized in 1994.

Comprehensive Environmental Response, Compensation, and Liability Act

A number of wastes generated from the air transportation refurbishing and maintenance processes contain CERCLA hazardous substances. Therefore, past spills and on-site releases of such substances may require remedial clean-up actions under Superfund.

Emergency Planning and Community Right-to-Know Act

CERCLA/EPCRA Emergency Release Notification. Any person in charge of a facility is required to immediately notify the LEPCs and SERCs likely to be affected if there is a release into the environment f a hazardous substance that exceeds the reportable quantity for that substance. Substances subject to this requirement include those on the list of "extremely hazardous substances" (40 CFR Part 355) as well as more than 700 hazardous substances subject to the emergency notification requirements under CERCLA Section 103(a) (40 CFR Section 302.4).

Many materials commonly used in the aviation industry fall into this category of CERCLA hazardous substances, including many solvents, ethylene glycol, methanol, methylene chloride, and 1,1,1-trichloroethane. With regard to the obligation to report releases of ethylene glycol being used for aircraft deicing at airports, the "facility" may include the truck applying the deicer, the aircraft to which the deicer is applied, or the entire airport. The person in charge of the "facility" must report a release into the environment of 5,000 pounds or more of ethylene glycol in any 24-hour period (EPA, 1996).

Federally Permitted Release Exemption. CERCLA Section 103(a) exempts those persons in charge of facilities from reporting releases that are federally permitted. On February 4, 1992, EPA issued OSWER Directive 9360.4-12 regarding *CERCLA Reporting Requirements for Releases of Ethylene Glycol From Airplane Deicing Operations*. This Interpretative Memorandum and OSWER Directive allows the airline industry to classify releases of the ethylene glycol as nonreportable (or exempt) discharges if a facility (1) has an NPDES permit covering ethylene glycol, (2) has applied for an NPDES permit, or (3) discharges to a publicly-owned treatment works (POTW) meeting the applicable pretreatment standards. Since most if not all fluid discharges resulting from aircraft deicing operations usually fit into one of the permitted release exemptions found in CERCLA Section 101(10), most water discharges of ethylene glycol-based deicing fluids will not result in a reporting requirement. (EPA, 1992)

Emergency Planning. Under EPCRA, a facility must notify authorities if it has onsite at any time a listed hazardous substance in an amount over the substance's threshold planning quantity. Extremely hazardous substances that may be present in aviation-related facilities include nitric acid, sulfuric acid, phenol and ammonia (EEA, 1996).

Clean Air Act

Sections 231-234 of the Clean Air Act gives exclusive jurisdiction to the federal government and preempts any state or local regulation with respect to emissions of any air pollutant from any aircraft or engine.

Air Quality Standards - Ozone Non-Attainment Areas. The most important pollutant affected by air quality standards is ozone. In attainment areas, a major source emits or has the potential to emit more than 100 tons per year of any criteria pollutant or 10 tons per year of any hazardous air pollutant or 25 tons per year of any combination of hazardous air pollutants (emission thresholds differ for various categories of nonattainment areas). Large aircraft maintenance facilities performing aircraft painting or using large amounts of solvents may exceed these limits. Emission rates are dependent on the types of chemicals and methods used and the types of air emission control equipment used. Some regulations apply to substances (e.g., solvent degreasers) regardless of the size of the source. These regulations are designed to reduce emissions from solvent evaporation (EEA, 1996).

To assist State and local agencies in establishing regulations that reduce VOC emissions from the air transportation industry, EPA developed a control technique guideline. This guideline offers an incentive of reduced recordkeeping requirements for facilities that use only approved cleaning agents, and requires vapor pressure limits for non-listed cleaning agents. Additionally, the guideline requires unused cleaning agent and solvent-laden rags to be stored in containers to prevent evaporation. (EEA, 1996) Airports located in ozone non-attainment areas may be subject to restrictions applicable to motor vehicles. These restrictions may affect the type and use of both airside and landside vehicles.

NESHAPs/MACT Standard. National emission standards for hazardous air pollutants (NESHAP) attempt to control several hundred compounds, the most notable for airports being asbestos. Airports must comply with the NESHAP requirements for asbestos when demolishing, or significantly remodeling, a building containing asbestos. Asbestos is commonly found in ceiling tile, floor tile, boiler room insulation, and sprayed-on insulation installed more than 20 years ago.

As stated earlier, MACT is the control technology achieving the maximum reduction in the emission of the hazardous air pollutants, taking into account cost and other factors. A MACT standard for coating operations conducted by aerospace manufacturing and reworking facilities was finalized by EPA in 1996. The emission limit from primers is 2.9 pounds per gallon and the topcoat emission limit is 3.5 pounds per gallon. Generally, HAP emissions are not permitted during paint removal operations (except during spot stripping and decal removal) (EEA, 1996). However, a number of exceptions may apply which permit such emissions under circumstances addressed in the NESHAP. According to the aerospace NESHAP, the provisions restricting HAP emissions during paint removal do not apply to the removal of paint from parts or units normally removed from the plane.

New Source Performance Standards (NSPS). Some facilities subject to NSPS may be found at airports, including industrial and utility boilers, vehicle maintenance facilities, and fuel storage and delivery facilities.

State Implementation Plans (SIPs). SIPs regulate stationary sources, such as buildings and other permanent installations, and mobile sources, such as automobiles. Typical airport facilities and activities which may be subject to stationary source regulations include heating and refrigeration plants; fueling systems; fuel storage facilities; aircraft maintenance facilities; deicing; roadways, garages, and parking lots; landside development; building demolition; and building construction. SIPs may also control mobile sources such as fleet vehicles and other vehicles using the airport. Airports are large parking areas for automobiles, trucks, and aircraft. SIPs may have to limit motor vehicle emissions through "transportation control measures." These measures are designed to reduce congestion and the number of vehicle miles traveled in a region. Measures which affect airports include improved public transit, measures to encourage uses of buses and other high occupancy vehicles, mandatory trip reduction, and traffic flow improvements.

Where applicable, SIPs must address the requirements of general air conformity (40 CFR Part 93). In addition, FAA is required to ensure compliance with general air conformity requirements for federal airport actions planned for nonattainment or maintenance areas.

Ozone-Depleting Substances. The amended CAA is phasing out the production and restricting the use and distribution of ozone-depleting chemicals. One ozone-depleting chemical widely used in the air transportation industry for fire suppression is halon. Halon production has ceased and future purchases must be from recycled stock. For consistency with these regulations, FAA has revised its policy and no longer requires halon use during firefighting drills conducted under FAR 121.417 and FAR 135.331 (EEA, 1996).

Additionally, EPA has established requirements for servicing and disposal of air conditioning and refrigeration equipment containing regulated ozone-depleting refrigerants. Certified, self-contained recovery equipment must be available during refrigeration equipment servicing. Additional recordkeeping and reporting requirements apply for appliance owners/operators and technicians. Facilities with refrigeration equipment containing ozone-depleting chemicals must comply with 40 CFR Part 82 (EEA, 1996).

Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA regulations are applicable to air transportation facilities and operations where herbicides are used to control weeds and brush, or when pesticides and rodenticides are used for pest control in buildings. Air transportation operations should only apply herbicides, both general and restricted use, according to label instructions. Certification is required for use of restricted use herbicides.

V.C. Pending and Proposed Regulatory Requirements

Clean Water Act

Presently, there are no effluent limitations guidelines specific to the air transportation industry. Effluent guidelines are currently being developed for tank interior cleaning, including aircraft cleaning, by the Office of Water. These guidelines are to be proposed in January 1998 and issued in final by February 2000 (Contact: Gina Matthews or Jan Goodwin, Office of Water, (202) 260-6036 and (202) 260-7152, respectively).

On January 31, 1997, EPA proposed a package of negotiated amendments, including deadline extensions, to the effluent guidelines plan set forth in a 1992 Consent Decree. For metal products and machinery industry guidelines, which are applicable to certain maintenance and refurbishing activities, the proposed modifications would allow EPA to combine the current two-phase guideline development process into one streamlined effluent guideline procedure. The new combined rule is scheduled to be finalized by December 2002.

The modified consent decree also targets airport deicing operations. The consent decree allowed EPA to remove deicing discharges from the scope of the categorical rulemaking, and instead initiate a study of water pollution problems associated with airport deicing operations and storm water runoff. Recently issued FAA guidelines on aircraft deicing and the recent EPA storm water rules are likely to have a significant effect on airport deicing operations.

In addition, the EPA Office of Water will also work with the Department of Defense to study deicing operations at military installations. Depending on the results of this study, guidelines specific to deicing at military installations may be developed.

EPA's five-year-old baseline general permit for industrial storm water dischargers expired on September 30, 1997. EPA suggests that industries covered by the baseline permit should explore their permit options. Most State five-year industrial permits expired along with the EPA Baseline General Permit on September 30, 1997. Most permits contain a provision stating that the expired permit remains effective and enforceable until replaced. However, the permits also contain a provision requiring permittees to submit a new Notice of Intent (NOI) prior to permit expiration to remain covered. Once an airport is without a permit, it generally cannot reapply for coverage under the expired permit.

Emergency Planning and Community Right-to-Know Act

Under EPCRA 313, Toxic Release Inventory (TRI) reporting is required by manufacturing and certain other facilities. Air transportation facilities are currently not subject to TRI reporting requirements. EPA recently expanded the TRI program and did not include airports (62 FR 23834), however, they may be added in the future.

Clean Air Act

EPA has completed its final amendments to the Aerospace NESHAP under the CAA which will be implemented September 1, 1998. The Aerospace

NESHAP establishes work practice, equipment, and pollution control standards for maintenance procedures.

EPA will issue its final Control Techniques Guidelines document for the aerospace industry addressing reasonably available control technology (RACT) for volatile organic compounds (VOC) emissions, which will address the maintenance issues discussed in the document.

EPA's Clean Air Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. In addition, the Clean Air Technology Center's website includes recent CAA rules and EPA guidance documents (www.epa.gov/ttn then select Directory and then CATC).

VI. COMPLIANCE AND ENFORCEMENT HISTORY

Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (see Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (April 1, 1992 to March 31, 1997) and the other for the most recent twelve-month period (April 1, 1996 to March 31, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across EPA Regions for certain sectors.[5] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of

[5] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

records for that facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times, e.g., a facility with 3 enforcement actions counts as 3.

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/ EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); and Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance.
Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections" or the "Total Actions" column.

VI.A. Air Transportation Industry Compliance History

Exhibit 13 provides an overview of the reported compliance and enforcement data for the air transportation industry over the past five years (April 1992 to April 1997). These data are also broken out by EPA Regions thereby permitting geographical comparisons. A few points evident from the data are listed below.

As shown, there were 444 facilities identified through IDEA with air transportation SIC codes. Of these, 52 percent (231) were inspected in the last 5 years.

- Over the 5 years, 973 inspections were conducted at those 231 facilities. On average, each facility was inspected between 4 and 5 times, or about once a year.

- The 973 inspections resulted in 48 facilities having enforcement actions taken against them. At those 48 facilities, there were a total of 97 enforcement actions, meaning each facility averaged approximately 2 enforcement actions over the past 5 years.

- The average enforcement to inspection rate is 0.10. This average rate means that for every 10 inspections conducted, there is 1 resulting enforcement action taken. Across the regions, this rate ranged from 0.03 to 0.30.

Exhibit 13. Five-Year Enforcement and Compliance Summary for the Air Transportation Industry

A	B	C	D	E	F	G	H	I	J
Region	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
I	23	4	18	77	3	4	50%	50%	0.22
II	19	13	56	20	5	17	88%	12%	0.30
III	46	25	137	20	3	4	100%	0%	0.03
IV	132	95	402	20	16	37	100%	0%	0.09
V	23	15	89	16	4	8	50%	50%	0.09
VI	37	17	53	42	5	6	100%	0%	0.11
VII	31	13	58	32	1	2	0%	100%	0.03
VIII	21	9	14	90	2	4	100%	0%	0.29
IX	27	14	82	20	5	8	100%	0%	0.10
X	85	26	64	80	4	7	71%	29%	0.11
TOTAL	444	231	973	27	48	97	88%	12%	0.10

VI.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 14 and 15 allow the compliance history of the air transportation sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Exhibits 14 and 15 permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering the last five years (April 1992 to April 1997) to that of the past year (April 1996 to April 1997). Some points evident from the data are listed below.

- Overall, the air transportation sector enforcement numbers are mostly consistent, on a percentage basis, with the other sectors.

- As shown in Exhibit 14, the air transportation enforcement-to-inspection rate is 0.10 over the past 5 years. Over the last year, as shown in Exhibit 15, the air transportation enforcement-to-inspection rate is 0.08.

Exhibits 16 and 17 provide a more in-depth comparison between the air transportation industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous exhibits, the data cover the last five years (Exhibit 16) and the last year (Exhibit 17) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- As shown, over the past 5 years, nearly half of all inspections conducted and resulting in enforcement actions at air transportation facilities have been under RCRA.

- Over the past year, while RCRA accounted for more than half of all inspections, only 25 percent of the enforcement actions were under RCRA.

Exhibit 14: Five-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or more Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

R0074826

Exhibit 15: One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Madmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

R0074827

Exhibit 16: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

R0074828

Exhibit 17: One-Year Inspection and Enforcement Summary by Statute for Selected Industries											
Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

VI.C. Review of Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

VI.C.1. Review of Major Cases

As shown in the previous tables, there have been only 97 enforcement actions taken against air transportation industries over the past 5 years. Stemming from those 97 actions are at least 34 cases, some of which are discussed in more detail below. The 34 cases can be categorized as follows:

- 1 Clean Air Act case (new source performance standards)
- 2 Clean Water Act cases (pretreatment and NPDES permit violations)
- 21 RCRA (USTs, unpermitted storage units, etc.)
- 5 CERCLA
- 4 TSCA (PCBs)
- 1 EPCRA (release reporting).

Of these 34 cases, 16 were against federal facilities and 2 were criminal cases. Supplemental environmental projects were negotiated in 3 of the cases. (These are discussed in more detail in the following section.) The following cases are examples of EPA's enforcement against air transportation industries.

- Pacific Southwest Airmotive, Inc. (PSA) owned and operated a jet engine overhaul facility in San Diego, California. EPA brought an enforcement action against PSA (and ultimately its new owner U.S. Air) under the Clean Water Act for violations of the pretreatment standard for metal finishing operations. During operations, PSA discharged an average of 73,000 gallons per day of regulated industrial wastewater through the sewers to San Diego's Point Loma wastewater treatment plant. The court entered a civil consent decree in which U.S. Air agreed to pay $335,000 in civil penalties.

- Grumman St. Augustine Corporation strips, paints, and refurbishes aircraft at its St. Augustine, Florida, facility. EPA brought an enforcement action against Grumman in 1991 as part of the RCRA Land Disposal Restrictions Initiative. A consent decree in 1993 settled the enforcement action. The decree calls for a civil penalty of $2.5 million, of which Grumman will initially pay $1.5 million in cash. The penalty would be reduced by $1 million if Grumman completed several innovative pollution prevention projects.

The pollution prevention provisions would substantially reduce or eliminate several highly toxic waste streams, including a paint stripper, methylene chloride, and ozone-depleting chemicals (e.g., CFCs). EPA estimated that up to 240,000 pounds of hazardous emissions per year will be eliminated and toxic sludge will be reduced if Grumman complied with RCRA. Furthermore, if compliance with RCRA is achieved, approximately 2.4 million gallons of potable water will be conserved.

- As a result of an imminent and substantial endangerment situation, EPA issued Reese Air Force Base in Lubbock, Texas, an administrative order under RCRA Section 7003. In March 1993, EPA learned that Reese had detected trichloroethylene above safe drinking water standards in some privately-owned drinking water wells near the base. After confirming the data, EPA issued the administrative order. The order requires the base to conduct the following activities:

  (1) Collect samples from wells in a 36-square-mile area (within a 2-mile perimeter of the base) to determine the extent of the contamination
  (2) Notify the owners of any contamination
  (3) Supply an alternate source of drinking water to the residents with contaminated wells
  (4) Monitor the ground water in and adjacent to the plume.

  Reese has completed the initial sampling of about 950 wells, provided carbon filters for all the impacted water wells, and connected some of the users to the City of Lubbock's water system. The city is in the process of connecting its water lines to the residents that live within the city limits. The residents living outside the city limits may use the water from the wells after it has been carbon filtered.

- Region II conducted a major consolidated multimedia inspection of Kennedy International Airport in New York City, which is operated by the Port Authority of New York and New Jersey. A number of violations were documented, both at facilities operated by the Port Authority itself, as well as at some facilities operated by airline or service companies. In 1993 a complaint was issued to the Port Authority citing it for TSCA violations and proposing a penalty of $289,000. On June 28, 1994, Region II issued three additional administrative complaints to Ogden Aviation Services, Inc., citing that company for violations of the federal underground storage tank regulations, and proposing penalties totaling $109,125.

VI.C.2. Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the Internet at EPA's EnviroSen$e website: http://es.inel.gov/sep.

The following are examples of three SEPs negotiated with air transportation facilities.

- In response to violations of EPCRA Section 304 and CERCLA Section 103 at the Memphis/Shelby County Airport (Tennessee), the County Airport Authority agreed to implement a $475,000 pollution prevention SEP. The SEP involves the purchase of equipment that will assist in the deicing of runways. The use of this equipment will reduce the amount of deicing fluid required, which results in a substantial reduction in the use of ethylene glycol. In addition, the Authority agreed to pay a $9,000 penalty to resolve its past violations.

- EPA achieved a comprehensive settlement of a TSCA administrative complaint against the Port Authority of New York and New Jersey, which is a joint State agency that operates Kennedy and LaGuardia Airports in New York City. The Region had cited the Authority for multiple violations of PCB regulations at the airports. The settlement provides that the port authority will pay a civil penalty of $19,500 and conduct two SEPs. One SEP consists of a 3-year fluorescent bulb recycling program for all Port Authority facilities in the New York metropolitan area. The total cost to implement the SEP is $130,000. The second SEP is a storm water management training program that will be conducted at the airports over a 2-year period. This SEP will cost $90,000.

- American Airlines, Inc. was charged with violations of the RCRA land disposal restrictions for discharging degreasing solvents, which are hazardous waste, into their onsite injection wells. A consent order was filed against American Airlines, in which it agreed to pay a cash penalty of $20,000, take affirmative actions to prevent further injection of restricted wastes, and conduct a SEP in the amount of $385,235. The SEP reduces chrome wastes by subjecting them to a chrome waste recovery system. The system reduces the waste by 98 percent or, in this case, 6,969 pounds per year. In addition, this system results in the elimination of 26 million gallons of wastewater annually into injection wells.

VII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those initiated independently by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VII.A. Sector-Related Environmental Programs and Activities

VII.A.1. EPA Voluntary Programs

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative developed by EPA that focuses on improving environmental performance, encouraging voluntary compliance, and building working relationships with stakeholders. EPA initiated a one year pilot program in 1995 by selecting 12 projects at industrial facilities and federal installations that demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, pollution prevention, community involvement, and mentor programs. In return for participating, pilot participants received public recognition and were given a period of time to correct any violations discovered during these experimental projects.

EPA is making plans to launch its full-scale Environmental Leadership Program in 1998. The full-scale program will be facility-based with a 6-year participation cycle. Facilities that meet certain requirements will be eligible to participate, such as having a community outreach/employee involvement programs and an environmental management system (EMS) in place for 2 years. (Contact: http://es.inel.gov/elp or Debby Thomas, ELP Deputy Director, at (202) 564-5041)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information regarding XL projects, including application procedures and criteria, see the April 23, 1997 Federal Register Notice. (Contact: Fax-on-Demand Hotline (202) 260-8590, Web: http://www.epa.gov/ProjectXL, or Christopher Knopes at EPA's Office of Policy, Planning and Evaluation at (202) 260-9298.)

Climate Wise Program

EPA's ENERGY STAR Buildings Program is a voluntary, profit-based program designed to improve the energy-efficiency in commercial and industrial buildings. Expanding the successful Green Lights Program, ENERGY STAR Buildings was launched in 1995. This program relies on a 5-stage strategy designed to maximize energy savings thereby lowering energy bills, improving occupant comfort, and preventing pollution—all at the same time. If implemented in every commercial and industrial building in the United States, ENERGY STAR Buildings could cut the nation's energy bill by up to $25 billion and prevent up to 35% of carbon dioxide emissions. (This is equivalent to taking 60 million cars of the road). ENERGY STAR Buildings participants include corporations; small and medium sized businesses; local, federal and state governments; non-profit groups; schools; universities; and health care facilities. EPA provides technical and non-technical support including software, workshops, manuals, communication tools, and an information hotline. EPA's Office of Air and Radiation manages the operation of the ENERGY STAR Buildings Program. (Contact: Green Light/Energy Star Hotline at 1-888-STAR-YES or Maria Tikoff Vargas, EPA Program Director at (202) 233-9178 or visit the ENERGY STAR Buildings Program website at http://www.epa.gov/appdstar/buildings/)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program saves money for businesses and organizations and creates a cleaner environment by reducing pollutants released into the atmosphere. The program has over 2,345 participants which include major corporations, small and medium sized businesses, federal, state and local governments, non-profit groups, schools, universities, and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. As of March 1997, participants had lowered their electric bills by $289 million annually. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and an information hotline. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Green Light/Energy Star Hotline at 1-888-STAR-YES or Maria Tikoff Vargar, EPA Program Director, at (202) 233-9178.)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1997, the program had about 500 companies as members, one third of whom are Fortune 1000 corporations. Members agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports. To member companies, EPA, in turn, provides technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at 1-800-372-9473 or Joanne Oxley, EPA Program Manager, (703) 308-0199.)

NICE^3

The U.S. Department of Energy is administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 45 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, and demonstrate new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the forest products, chemicals, petroleum refining, steel, aluminum, metal casting and glass manufacturing sectors. (Contact: Chris Sifri, DOE at (303) 275-4723 or Eric Hass, DOE at (303) 275-4728 or http//www.oit.doe.gov/access/nice3.)

Design for the Environment (DfE)

DfE is working with several industries to identify cost-effective pollution prevention strategies that reduce risks to workers and the environment. DfE helps businesses compare and evaluate the performance, cost, pollution prevention benefits, and human health and environmental risks associated with existing and alternative technologies. The goal of these projects is to encourage businesses to consider and use cleaner products, processes, and technologies. For more information about the DfE Program, call (202) 260-1678. To obtain copies of DfE materials or for general information about DfE, contact EPA's Pollution Prevention Information Clearinghouse at (202) 260-1023 or visit the DfE Website at http://es.inel.gov/dfe.

VII.A.2. Trade Association/Industry Sponsored Activity

Industry Working Group on Deicing

A deicing working group was formed by the American Association of Airport Executives and the Airports Council International - North America to (1) study the use of deicing chemicals on aircraft; (2) study the feasibility of locating deicing facilities away from airport gates; and (3) provide information to both industry members and the federal government on ways in which deicing operations can be improved upon. As part of their investigation, the working group sent out surveys to the major airports to determine which deicing procedures and chemicals are being used by the industry. Some of the survey questions relate to environmental effects of deicing and recovery, reuse, and recycling of waste deicer. The results of the survey indicated that a number of air carriers are using alternative chemicals, and have constructed remote deicing facilities with deicer recovery systems. (Contact: Carter Morris, American Association of Airport Executives, (703) 824-0500.)

ISO 14000

ISO 14000 is a series of internationally-accepted standards for environmental management. The series includes standards for environmental management systems (EMS), guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of 110+ country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO.

VII.B. Summary of Trade Associations

American Association of Airport Executives
4212 King Street
Alexandria, VA 22302
Phone: (703) 824-0500
Fax: (703) 820-1395

The American Association of Airport Executives (AAAE) is comprised of airport management personnel and representatives of companies serving the civil airport industry. The AAAE sponsors educational seminars, conducts examinations, and maintains a speakers' bureau. AAAE has an Environmental Service/Environmental Affairs Committee that provides assistance on complying with environmental regulations (e.g., regulation interpretations, training seminars, and manuals). Environmental compliance assistance is focused on the storm water rules. Publications are the bimonthly *Airport Executive Magazine* and the *Airport Report Newsletter*. Separate yearly conferences are held on topics such as national airports, legislative issues (semiannual), international facilities, and general annual issues.

Airports Association Council International
1220 19th Street NW, Suite 200
Washington, D.C. 20036
Phone: (202) 293-8500
Fax: (202) 331-1362

The Airports Association Council International (AACI) is comprised of operators of public airport facilities. The group also includes government bodies that own and operate major airports. The association provides compliance assistance to members through seminars, meetings, conferences, regulation interpretations, and manuals. One day conferences are frequently held on environmental management and auditing techniques. Committees include planning and environmental, safety and security, and U.S. government affairs. Publications are the weekly *Airport Highlights*, the annual *Worldwide Airport Traffic Report*, and the *Airport Environmental Management Handbook.* The AACI holds an annual meeting in September or October.

National Air Transportation Association
4226 King Street
Alexandria, VA 22302
Phone: (703) 845-9000
Fax: (703) 845-8176

The National Air Transportation Association (NATA) represents the interests of aviation services companies such as fixed-based operators and on-demand air taxis. NATA provides compliance assistance to members in the form of guidelines, explanations of regulations, and seminars. Most of NATA's work relates to Federal Aviation Administration regulations; however, environmental services are also provided. Environmental aspects of deicing and aircraft cleaning are not a major focus, because the membership does not include the carrier companies, however, some fixed-based operators carry out deicing operations. Publications include an annual membership directory, an annual report, and the monthly *ATAnews*.

Airports Council International - North America
1775 K Street, NW Suite 500
Washington, D.C. 20006
Phone: (202) 293-8500
Fax: (202) 331-1362

Airports Council International - North America (ACI-NA) is the "voice of airports" representing local, regional, state, and national governing bodies that own and operate commercial airports in the U.S. ACI-NA member airports enplane more the 90 percent of the domestic and virtually all of the international airliner passenger and cargo traffic in North America.

Aerospace Industries Association
1250 Eye Street, NW
Washington, D.C. 20005
Phone: (202) 371-8400

Member companies of Aerospace Industries Association (AIA) represent the primary manufacturers of military and large commercial aircraft, engines, accessories, rockets, spacecraft, and related items.

General Aviation Manufacturers Association
1400 K Street, NW Suite 801
Washington, D.C. 20005
Phone: (202) 393-1500

The General Aviation Manufacturers Association (GAMA) is a national trade association, headquartered in Washington, D.C., representing 53 manufacturers of fixed-wing aircraft, engines, avionics, and components. In addition to building nearly all U.S. general aviation aircraft, GAMA member companies also operate aircraft fleets, airport fixed-based operations, pilot schools, and training facilities.

Air Transport Association of America
1709 New York Ave., NW
Washington, D.C. 20006
Phone: (202) 626-4000
Fax: (202) 626-4181

The Air Transport Association of America (ATA) represents 22 major scheduled airlines in the U.S. engaged in transporting persons, goods, or mail by aircraft. ATA serves its membership by providing aviation safety, advocating industry positions, conducting designated industry-wide programs and monitoring public understanding. ATA publishes annually *Air Transport* as well as fact sheets, press releases, studies, speeches, and references pertaining to air transport. The ATA holds quarterly meetings.

Air Line Pilots Association
535 Herndon Parkway
P.O. Box 1169
Herndon, VA 20170
Phone: (703) 689-2270
Fax: (703) 689-4370

The Air Line Pilots Association (ALPA) is a union representing 46,000 airline pilots at 45 U.S. airlines. ALPA provides lobbying of airline pilot views to Congress and government agencies, and devotes approximately 20 percent of its dues income to support aviation safety.

Regional Airline Association
1200 19th Street, N.W. Suite 300
Washington, D.C. 20036
Phone: (202) 857-1170
Fax: (202) 429-5113

The Regional Airline Association (RAA) represents regional air carriers and suppliers of products and services that support the industry before the Congress, Federal Aviation Administration, Department of Transportation and other federal and state agencies. RAA member airlines transport between 90-95 percent of all regional airline passengers. RAA developed an *Environmental Compliance Handbook* addressing compliance issues.

Aircraft Owners & Pilots Association
421 Aviation Way
Frederick, MD 21701
Phone: (301) 695-2000

With over 270,000 members, the Aircraft Owners & Pilots Association (AOPA) represents the interests of general aviation pilots. It provides insurance plans, flight planning, and other services, and sponsors large fly-in meetings.

Helicopter Association International
1619 Duke Street
Alexandria, VA 22314
Phone: (703) 683-4646
Fax: (703) 683-4745

The members of Helicopter Association International (HAI) represent rotocraft operators and manufacturers.

National Association of State Aviation Officials
8401 Colesville Road, Suite 505
Silver Spring, MD 20910
Phone: (301) 588-0587
Fax: (301) 585-1803

The National Association of State Aviation Officials (NASAO) represents departments of transportation and state aviation departments and commissions from 49 states, Puerto Rico, and Guam.

National Business Aircraft Association
1200 18th Street, NW, Room 200
Washington, D.C. 20036
Phone: (202) 783-9000

The National Business Aircraft Association (NBAA) represents 361 companies that own and operate aircraft flown for corporate purposes. NBAA is affiliated with the International Business Aircraft Council.

Flight Safety Foundation
2200 Wilson Boulevard
Arlington, VA 22201
Phone: (703) 739-6700
Fax: (703) 739-6708

The Flight Safety Foundation (FSF) promotes air transport safety. Its members include airport and airline executives and consultants.

Experimental Aircraft Association
EAA Aviation Center
Oshkosh, WI 54903
Phone: (414) 426-4800

The Experimental Aircraft Association (EAA), with over 700 local chapters, promotes the interests of home-built and sport aircraft owners.

Aviation Distributors & Manufacturers Association
1900 Arch Street
Philadelphia, PA 19103
Phone: (215) 564-3484
Fax: (215) 564-3484

The Aviation Distributors & Manufacturers Association (ADMA) represents the interests of a wide variety of aviation firms including FBOs and component parts manufacturers.

International Air Transport Association
2000 Peel Street
Montreal, PQ, Canada H3A2R4
Phone: (514) 844-6311
Fax: (514) 844-5286

The International Air Transport Association (IATA) is an association of 105 international air carriers whose main functions include coordination of fares and operations.

Cargo Airline Association
1220 19th Street, N.W. Suite 400
Washington, D.C. 20036
Phone: (202) 293-1030
Fax: (202) 293-4377

The Cargo Airline Association (CAA) is a nationwide trade organization with members made up of all segments of the air cargo community. The Association is responsible for promoting the use of air freight services; monitoring regulatory activity; representing the industry before Congress, various agencies, and courts; providing educational programs; and keeping members up-to-date on all issues affecting air cargo.

VIII. RESOURCE MATERIALS/BIBLIOGRAPHY

Section II: Introduction to the Air Transportation Industry

The Airline Handbook, http://www.air-transport.org/handbk. Air Transport Association.

Dun & Bradstreet Market Place Webpage, http://www.dnb.imarketinc.com

Federal Aviation Administration home page, http://www.faa.gov and http://www.faa.gov/publichinfo.htm

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

1992 Census of Transportation, Communications, and Utilities: U.S. Summary, U.S. Department of Commerce.

Encyclopedia of American Business History and Biography: The Airline Industry, A. Bruccoli Clark Layman, Inc., and Facts On File, Inc., 1992.

Air Environmental Management Handbook, M. Schneiderman and T. Devine, 1993.

Memorandum on ICAO, January 1994.

Transportation in America, Eno Transportation Foundation, Inc., 1994.

Air Transport Association Annual Report, 1997. Air Transport Association.

Airports and the Environment: A Study of Air Transport, Alan H. Stratford.

Section III: Operations Description

Hazardous Materials Shipments: Classification, Identification, and Procedures. Keller & Associates, 1977.

Planning & Design of Airports, 3rd Edition, Robert Horonjeff and Francis McKelvey. McGraw-Hill Book Co. 1983.

Airport Planning & Management, 2nd Edition, Alexander Wells, TAB Books, 1992.

Report of the American Association of Airport Executives - AD HOC Working Group on Deicing, American Association of Airport Executives, Alexandria, Virginia, 1993. (Contact: David Jeffrey, American Association of Airport Executives, (703) 824-0500 ext.136.)

Aviation Week and Space Technology, January 1995.

U.S. EPA Office of Air and Radiation, AIRS Database, 1997.

AHM 640-Aircraft Loading and Off-Loading Precautions. International Air Transport Association (IATA).

Pollution Prevention/Environmental Impact Reduction Checklist for Airports, U.S. EPA Office of Federal Activities.

Section IV: Pollution Prevention Opportunities

Fact Sheet - FCAD-1. California, Plus Fact Sheet - Minnesota and Michigan FM10-2-9. Office of Research and Development, 1990.

Guides to Pollution Prevention - The Mechanical Equipment Repair Industry, Office of Research and Development, EPA/625/R-92/008. September, 1992.

Guide to Cleaner Technologies - Cleaning and Degreasing Process Changes, Office of Research and Development, EPA/625/R-93/017, February 1994.

Guide to Cleaner Technologies - Alternatives to Chlorinated Solvents for Cleaning and Degreasing, Office of Research and Development, EPA/625/R-93/016, February 1994.

Project Summary - Onsite Solvent Recovery, Office of Research and Development, EPA/600/SR-94/026, March 1994.

Guide to Cleaner Technologies - Organic Coating Replacements, Office of Research and Development, EPA/600/R-94/006, September 1994.

Guide to Cleaner Technologies - Alternative Metal Finishes, Office of Research and Development, EPA/625/R-94/007, September 1994.

Project Summary - Pollution Prevention Opportunity Assessment, U.S. Coast Guard Aviation Training Center, Mobile, AL. Office of Research and Development, EPA/600/SR-94/156, September 1994.

Project Report - NASA Langley Research Center and Tidewater Interagency Pollution Prevention Project Program. Office of Research and Development, EPA/600//R-94/171, September 1994.

Project Summary - Pollution Prevention Opportunities Assessment, U.S. Naval Base, Norfolk Naval Air Station, Office of Research and Development, EPA-600/SR-95/135, September 1995.

Environmental Research Brief - Pollution Prevention Assessment of Manufacturing of Aircraft Landing Gear. Office of Research and Development, EPA 600-S-95/032, August 1995.

Program Summary - Parts Washing Alternatives Study, U.S. Coast Guard, Office of Research and Development. EPA-600-SR-95/006, February 1995.

Demonstration of Alternative Cleaning Systems. Office of Research and Development, EPA/600/R-95-120, August 1995.

Airline Fuel Consumption, The Boeing Company, 1997.

Section V: Summary of Applicable Federal Statutes and Regulations

Environmental Regulatory Compliance Handbook. Prepared for Regional Airline Association, Prepared by Energy and Environmental Analyses, Inc., 1996.

Overview of the Storm Water Program, Office of Water, U.S. Environmental Protection Agency, June 1996. EPA 833-R-96-008.

New Technology Plays Key Role in Deicing Gear, Aviation Week & Space Technology, January 9, 1995, pp. 40-41.

Airports and the Environment: A Study of Air Transport. Stratford, A.H.

Flying Off Course: Environmental Impacts of America's Airports, Natural Resources Defense Council, October 1996.

Section VII: Compliance Activities and Initiatives

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Enforcement Accomplishments Report, FY 1994, U.S. EPA, Office of Enforcement (EPA/300-R95-004), May 1995.

Enforcement Accomplishments Report, FY 1995, U.S. EPA, Office of Enforcement (EPA/300-R96-006), July 1996.

Enforcement Accomplishments Report, FY 1996, U.S. EPA, Office of Enforcement (EPA/300-R97-003), May 1997.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviro$enSe Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the EnviroSenSe World Wide Web, set your World Wide Web Browser to the following address:

http://es.epa.gov/sector/index.html

or use

www.epa.gov/oeca - then select the button labeled Industry and Gov't Sectors and then select EPA Sector Notebooks . The Notebooks will be listed.

Direct technical questions to the Feedback function at the bottom of the web page or call Shhonn Taylor at (202) 564-2502

*U.S. GOVERNMENT PRINTING OFFICE:1998-618-895/90655

EPA

United States
Environmental Protection Agency
(2223A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2221A)

EPA 310-R-95-001
September 1995

EPA

Profile Of The Dry Cleaning Industry

SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-001

EPA Office of Compliance Sector Notebook Project

Profile of the Dry Cleaning Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048268-2

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates Inc. (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., ET, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via the Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, EPA

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

Industry Sector Notebook Contents: Dry Cleaning

EXHIBITS INDEX

LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA-	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation

NO_X -	Nitrogen Oxides
NPDES -	National Pollution Discharge Elimination System (CWA)
NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SO_X -	Sulfur Oxides
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

R0074856

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line EnviroSen$e Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE DRY CLEANING INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the dry cleaning industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

This notebook covers the entire dry cleaning industry which includes three distinct types of operations: commercial, industrial and coin-operated. The dry cleaning industry is covered by three Standard Industrial Classification (SIC) codes, the codes the Department of Commerce uses to track the flow of goods and services. The commercial sector is included in SIC 7216 (dry cleaning plants except rug cleaning). Commercial plants typically receive small quantities of clothes from individuals and usually do not clean furs or leathers although they offer non-dry cleaning services, such as refreshing garments. The industrial dry cleaning sector is included in SIC code 7218 (industrial launderers). According to the 1987 Census of Service Industries, there are 1,379 industrial laundry facilities. Of these, the Agency estimates that 325 have dry cleaning capacity (USEPA, 1993a) while the remainder are exclusively wet laundries. Industrial dry cleaners primarily clean uniforms and may also rent uniforms and other industrial clothing such as gloves. Coin-operated dry cleaning is included in SIC 7215 (coin-operated laundries and dry cleaning). The Census of Service Industries indicates that there are 27,180 coin-operated laundries (with and without payroll) in 1987. Of these, the Agency estimated that about 3,000 offer dry cleaning services of some kind (USEPA, 1993a) although some estimate that there are fewer than 100 of such cleaners in operation. Coin-operated dry cleaners may be self-service units located in laundromats or may be run by an attendant but located in a self-service laundromat.

II.B. Characterization of the Dry Cleaning Industry

The dry cleaning industry provides garment cleaning services and in most cases will provide related services such as clothes pressing and finishing. The dry cleaning process is physically very similar to the home laundry process, except that clothes are washed in dry cleaning solvent instead of water. Fabric or garment cleaning consists of three basic functions: cleaning, drying and finishing. Garments are pre-treated for stains, and then machine washed in a solution of a solvent, soaps and detergents. The solvent is extracted by first draining, and then spinning the clothes. Finally, the garments are dried through a combination of aeration, heat and tumbling, and then they are pressed.

These functions are the core of any fabric cleaning process, although the details vary and steps may be minimized or even omitted. All three functions are readily recognizable in the full-service dry cleaning process. Dry cleaners will also "refresh" a garment, concentrating mainly on finishing.

II.B.1. Industry size and geographic distribution

The number and size of dry cleaning firms varies within the three basic categories of dry cleaning operations. The commercial facilities are by far the most prevalent and include full service, retail operations located in shopping centers and near densely populated areas. The industrial dry cleaners operate the largest facilities which are often part of a business that rents uniforms, towels or other garments. The coin-operated sector of the market is typically associated with a laundromat that may provide either full-service retail dry cleaning similar to the commercial sector, or customer operated dry cleaning equipment. All sectors, however, provide a single basic service, clothes cleaning.

Commercial dry cleaning accounts for the majority of the firms with 30,494 facilities, as well as the majority of dry cleaning volume, 630,520 tons of clothes per year as shown in the exhibit below. The average commercial facility cleans approximately 19.7 tons of clothes per year. Industrial facilities while fewer in number, 325, have a larger average cleaning output of 578 tons of clothes per facility per year. Total dry cleaning volume of the industry sector is 187,991 tons per year. The coin-operated sector accounts for the smallest portion of the industry with 3,044 facilities processing 4,914 tons of clothes per year for an average 1.6 tons per facility.

R0074860

Exhibit 1: Commercial Dry Cleaners Dominate Industry

	Commercial	Industrial	Coin- Operated	Total
# of Facilities[a]	30,494	325	3,044[b]	33,863
Volume of Clothes Cleaned[c] (Tons/Year)	630,520	187,991	4,914	825,425
Mean Output per Facility[d] (Tons/year)	19.7	578	1.6	not applicable
Sales[e]	$4.8 billion	$385 million	$29 million	$5.2 billion

[a] USEPA, 1991b
[b] The number of coin-operated dry cleaning facilities estimated in USEPA, 1991b is high compared to a more recent estimate of <100 (Torp, 1994).
[c] Estimated values based on USEPA, 1991a and USEPA, 1991b.
[d] Volume/Number of facilities.
[e] USEPA, 1991b, some values were rounded (1993 dollars). Values indexed from 1989 dollars using the CPI for Apparel and Upkeep.

The size of dry cleaners varies by industrial sector. Most commercial dry cleaners are single facility "mom and pop" operations, although there is considerable variation in the size of these businesses. Classic family-owned-and-operated commercial cleaners typically have two or three full-time employees (including the owner) and perhaps some additional part-time employees. A typical firm might consist of a single small store front operation, with customer pickup and delivery in the front, and cleaning and finishing in the back. The store usually has one or two dry cleaning units (either a separate washer and dryer, or a combined "dry-to-dry" machine), and perhaps a water-based laundry machine for shirts and other washables.

Commercial dry cleaning is not a high profit business, and many dry cleaners are barely able to stay in business. Typical start-up costs in 1993 were $113,000, and over 60 percent of dry cleaners had annual revenues below $113,000; however, there is wide variation in the receipts. Official Census figures indicate one-quarter of the firms had annual revenues which were less than $28,000, and six percent had receipts over $564,000 in 1993 dollars (USEPA, 1991). The exhibit below shows the revenue distribution for commercial dry cleaners. The receipts must cover labor costs (by far the largest cost category), rent, capital depreciation, solvent and other supplies. Wages are typically low; the industry average operator wage is less than $7.00

R0074861

per hour. Many dry cleaners have difficulty paying competitive wages and earning any profit.

Exhibit 2: Very Small and Very Large Establishments Dominate Commercial Dry Cleaning (1993 dollars)

Annual Receipts ($/year) per Establishments	Number of Establishments	Percent	Total Annual Receipts ($1,000/year)	Percent
0-28,000	8,026	26%	160,474	53%
28,000-56,000	5,024	17%	229,611	5%
56,000-85,000	3,096	10%	233,950	5%
85,000-113,000-	3,096	10%	327,530	7%
>113,000	11,251	37%	3,857,651	80%
Total	30,494	100%	4,809,217	100%

Source: USEPA, 1993a

Coin-operated dry cleaners are gradually being phased out of the dry cleaning market. New coin-operated equipment is reported to be no longer available on the market (SRRP, 1990). The coin-operated segment of the dry cleaning industry resides in laundromats. There are two basic types of operations, including: commercial dry cleaners operating a laundromat and self-service dry cleaning operations. Commercial dry cleaners operating at a laundromat are classified as coin-operated because the dominant business at the location is the coin-operated laundromat. The dry cleaning side of the business can be fully staffed and provide the full services of a commercial dry cleaner. Alternatively, it can provide more limited service, with an operator receiving, cleaning, and returning batches of clothes to the customer, but not providing pressing, spotting or other services. The second type of coin-operated dry cleaning facility is the self-serve dry cleaning machine. These are truly coin-operated, with the customer operating the dry cleaning equipment. The exhibit below shows the total dry cleaning output and the average output per establishment as categorized by the coin-operated sector income. Comparing the total coin-operated dry cleaning sales from the first exhibit to total coin-operated sales below, shows that dry cleaning makes up only about 10 percent of the receipts in this sector, a much smaller fraction than for commercial or industrial laundries (USEPA, 1993a).

R0074862

Exhibit 3: Medium-Sized Establishments Dominate Coin-operated Dry Cleaning and Laundries
(1993 dollars)[a]

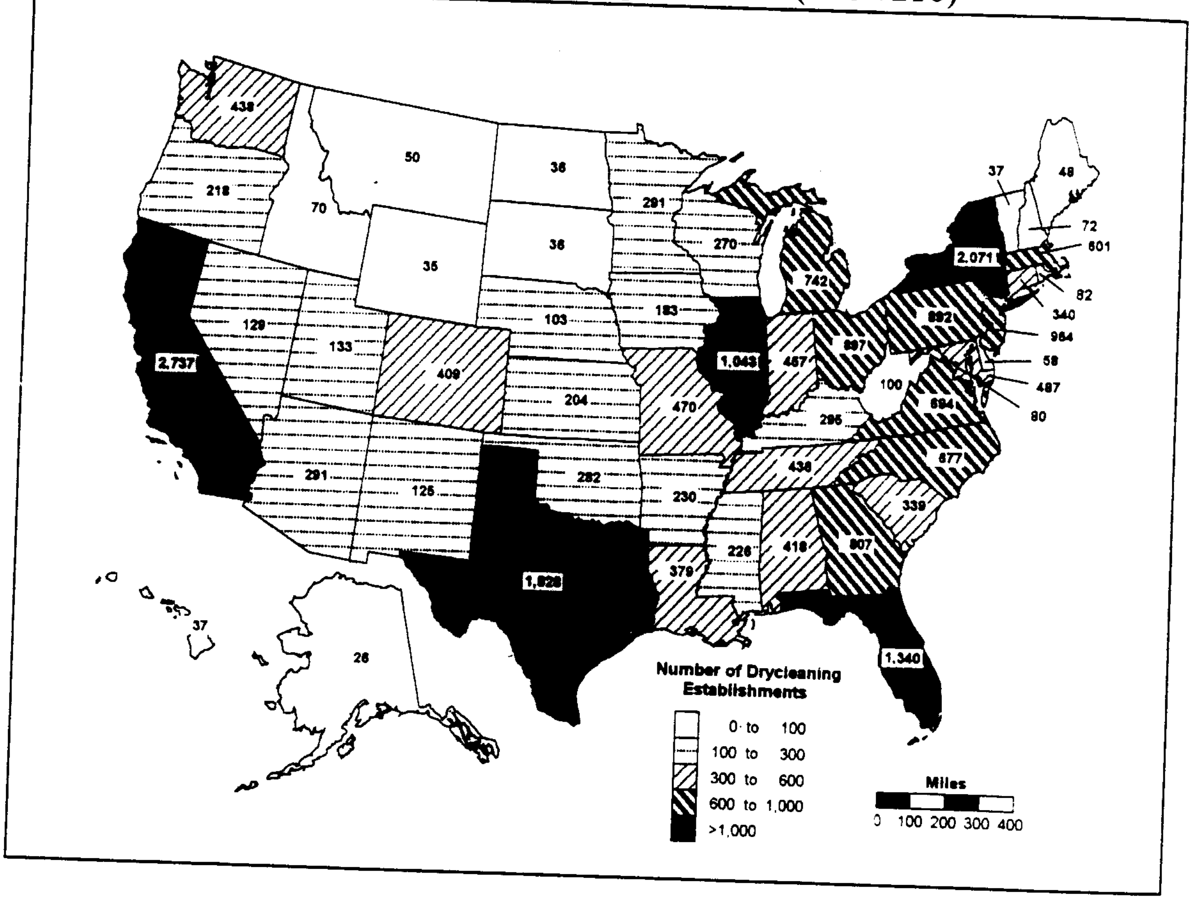
Annual Receipts ($/year) per Establishment	Number of Establishments[b]	Percent	Total Annual Receipts ($1,000/yr)	Percent
0-28,000	523	17%	10,425	4%
28,000-56,000	1,451	48%	66,180	23%
56,000-85,000	475	16%	35,888	12%
85,000-113,000	169	5%	17,664	6%
>113,000	426	14%	158,468	55%
Total	3,044	100%	288,627	100%

[a] Based on payroll converted to 1993 dollars using the CPI for Apparel and Upkeep.
[b] The distribution of establishments is based on the distribution of all coin-operated laundries with payroll (including those without dry cleaning capacity) reported in the 1987 Census of Service Industries.
Source: U.S. Environmental Protection Agency. 1993a. Economic Analysis of Regulatory Controls in the Dry Cleaning Industry. Final. EPA 450/3-91-021b. September.

Industrial dry cleaners tend to be larger than commercial establishments. They service institutional, professional and industrial customers by providing cleaning services for uniforms, restaurant linens, wiping towels, floor mats and work gloves. In many cases industrial dry cleaning firms offer rental as well as cleaning services. According to Census data, 1,379 industrial laundry facilities were operating in 1987 of which 325 were estimated to have dry cleaning operations. While sales for all operations at these facilities totaled $1.1 billion, only about 35 percent ($385 million) of the receipts were related to dry cleaning. The balance of receipts were from water washing or other activities (USEPA, 1993a).

Dry cleaners are spread throughout the United States although their location depends on both the type of operation and the solvent used. Commercial dry cleaners are distributed in a six to one ratio of urban to rural as a result of the greater demand for dry cleaning in urban settings. Their distribution roughly follows the population as shown in the exhibit below. Industrial laundries, however, tend to be located in medium to small cities to take advantage of the lower capital and labor costs. Industrial laundries are also less reliant upon being in their customer's immediate neighborhood. Coin-operated laundries tend to be in rural areas where commercial dry cleaning is not available. The type of solvent used for dry cleaning also varies by geographic region. Petroleum dry cleaners are concentrated in the Gulf states, particularly Texas and Louisiana, partly due to the availability of petroleum in these locations and partly because local fire regulations prohibit petroleum cleaners in many other regions.

Exhibit 4: Dry Cleaning Facilities (SIC 7216)



Source: 1992 Census of Service Industries, Geographic Area Series

R0074864

Exhibit 5: Geographic Distribution of Dry Cleaning Facilities Corresponds to Population in U.S.

State	Percent of Facilities[a]	Receipts ($1,000)	Facilities Rank	Population Rank	1990 Pop. (1,000)[b]
California	11.8	629,747	1	1	29,760
New York	8.9	346,412	2	2	17,990
Texas	7.9	448,292	3	3	16,987
Florida	5.8	273,109	4	4	12,938
Illinois	4.5	231,475	5	6	11,431
New Jersey	4.1	186,588	6	9	7,730
Ohio	3.9	208,832	7	7	10,847
Pennsylvania	3.8	196,682	8	5	11,881
Georgia	3.5	161,054	9	11	6,478
Michigan	3.2	161,270	10	8	9,295
Virginia	3.0	165,446	11	12	6,187
North Carolina	2.9	172,653	12	10	6,628
Massachusetts	2.6	136,666	13	13	6,016
Maryland	2.1	107,265	14	19	4,781
Missouri	2.0	98,485	15	15	5,117
Indiana	2.0	102,078	16	14	5,544
Washington	1.9	79,471	17	18	4,867
Tennessee	1.9	110,116	18	17	4,877
Alabama	1.8	93,949	19	22	4,041
Colorado	1.8	77,212	20	26	3,294
Louisiana	1.6	80,484	21	21	4,345
Connecticut	1.5	90,111	22	27	3,287
South Carolina	1.5	78,297	23	25	3,487
Kentucky	1.3	61,293	24	23	3,685
Minnesota	1.3	72,772	25	20	4,375
Arizona	1.2	73,290	26	24	3,665
Oklahoma	1.2	70,665	27	28	3,146
Wisconsin	1.2	63,964	28	16	4,891
Arkansas	1.0	45,053	29	33	2,351
Mississippi	1.0	46,756	30	31	2,573
Oregon	0.9	40,728	31	29	2,842

State	Percent of Facilities[a]	Receipts ($1,000)	Facilities Rank	Population Rank	1990 Pop. (1,000)[b]
Kansas	0.9	41,941	32	32	2,478
Iowa	0.8	36,487	33	30	2,777
Utah	0.6	26,191	34	35	1,723
Nevada	0.5	34,118	35	39	1,202
New Mexico	0.5	22,225	36	37	1,515
Nebraska	0.4	22,339	37	36	1,578
West Virginia	0.4	19,301	38	34	1,793
Rhode Island	0.3	17,081	39	43	1,003
D.C.	0.3	13,898	40	48	607
New Hampshire	0.3	17,519	41	40	1,109
Idaho	0.3	12,558	42	42	1,007
Delaware	0.2	13,530	43	46	666
Montana	0.2	6,576	44	44	799
Maine	0.2	9,623	45	38	1,228
Hawaii	0.2	21,141	46	41	1,108
Vermont	0.2	7,680	47	49	563
South Dakota	0.2	4,481	48	45	696
North Dakota	0.2	8,280	49	47	639
Wyoming	0.1	4,168	50	51	454
Alaska	0.1	17,679	51	52	550
Total	100	5,069,031			248,710

[a] Number of facilities comes from the 1992 Census of Service Industries. Drycleaning plants, except rug cleaning (SIC 7216).
[b] Populations are from 1990 Census, Summary Population and Housing Characteristics, Table I: US Summary. Total may vary due to rounding.

Ward's Business Directory of U.S. Private and Public Companies, produced by Gale Research Inc., compiles financial data on U.S. companies including those operating within the dry cleaning industry. Ward's ranks U.S. companies, whether they are a parent company, subsidiary or division, by sales volume within the 4-digit SIC codes that they have been assigned as their primary activity. Readers should note that: 1) companies are assigned a 4-digit SIC that most closely resembles their principal industry; and 2) sales figures include total company sales, including subsidiaries and operations not related to dry cleaning. Additional sources of company specific financial information include Standard & Poor's *Stock Report Services*, Dun & Bradstreet's *Million Dollar Directory*, Moody's Manuals, and annual reports.

Exhibit 6: Top U.S. Companies with Dry Cleaning Operations

Rank[a]	Company[b]	1993 Sales (millions of dollars)
1	Initial USA, Inc. - Atlanta, GA	170
2	Concord Custom Cleaners - Richmond, KY	25
3	Dryclean USA, Inc. - Miami, FL	25
4	Pride Cleaners, Inc. - Leawood, KS	16
5	Fashion Care, Inc. - Atlanta, GA	10
6	Spic and Span, Inc. - Milwaukee, WI	10
7	Al Phillips the Cleaner, Inc. - Las Vegas, NV	8
8	Admiral, Inc. - Annapolis, MD	7
9	Walker, Inc. - Omaha, NE	3
10	WH Christian and Sons, Inc. - Brooklyn, NY	3

Note: [a] When Ward's Business Directory lists both a parent and subsidiary in the top ten, only the parent company is presented above to avoid double counting. Not all sales can be attributed to the companies dry cleaning operations.
[b] Companies shown listed SIC 7216 as primary activity.

Source: Ward's Business Directory of U.S. Private and Public Companies - 1993.

II.B.2. Product characterization

The dry cleaner's product is the service of cleaning clothes conveniently. The products may also include services such as pressing and finishing. The market is divided into two parts, those customers who shop for price and will accept adequate quality and those who are buying quality cleaning with price being less of a concern. The latter are more steady dry cleaning customers while the former will forego dry cleaning during financial downturns.

II.B.3. Economic trends

In 1992, the total dry cleaning market generated $5.2 billion in revenues, with $4.8 billion generated by the commercial sector and $385 million and $29 million generated by the industrial and coin-operated sectors respectively. Current industry estimates indicate a zero growth rate for the commercial sector through 1996 while both the industrial and coin-operated sectors are anticipated to continue their decline during this period. More clothes are being made of launderable fabrics which reduces the demand for commercial dry cleaning. Self-service coin-operated dry cleaning machines are no longer manufactured and those currently in use are being phased out as they age. The trend toward launderable fabrics will inevitably reduce the need for industrial dry cleaning as well.

Convenience is the driving force in commercial dry cleaning. Location near the consumer and fast turnaround on their clothes as well as the cleanliness of the item are important to dry cleaning success. Consumers care little about what solvent is used to clean their clothes as long as the cleaning service is convenient, fast and effective. While the switch to launderable fabrics reduces the need for dry cleaning, the other services such as laundering, pressing and finishing may still be in demand.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the dry cleaning industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Dry Cleaning Industry

Dry cleaning processes garments in a way that avoids saturating fabrics with water. If thoroughly saturated with water, agitated and heated, certain fabrics (especially wool, silk and rayon) may shrink or the dye may run. Other garments that are constructed from several materials can be damaged if the various layers react differently to the cleaning process. Because dry cleaning solvents do not saturate the fibers of the fabric, the swelling and shrinking from water saturation is avoided, allowing nearly all types of fabrics and garments to be safely dry cleaned.

Four solvents dominate the dry cleaning market: perchloroethylene (PCE), petroleum solvents, chlorofluorocarbons (CFC-113) and trichloroethane (TCA). The manufacture of the latter two will be banned in 1995 under the Clean Air Act Amendments. The exhibit below shows that PCE dominates the commercial sector while petroleum solvent is used in the majority of industrial machines.

One important characteristic of the dry cleaning industry is that the machinery used with these solvents has evolved over time. The development encompasses four "generations" of machines, all of which are still in use. The first generation of equipment has separate washers and dryers, thus the operator must transfer the clothes between the two. The second generation machine design eliminates the stand-alone dryer and combines both washing and drying into a single machine. The third generation of equipment includes added control technology to reduce the vapor emissions. The fourth generation of machine design modifies the third generation by recycling the air in the machine to further reduce emissions. Each generation is described further below.

Exhibit 7: Number of Dry Cleaning Facilities by Process and Industrial Sector[a]

Process Solvent	Industrial Sector			
	Commercial	Industrial	Coin-operated	Total
PCE	24,947	130	3,044	28,121
Petroleum	4,548[b]	195	0	4,743
CFC-113	949[b]	0	0	949
Trichloroethane	50[c]	0	0	50
Total	30,494	325	3,044	33,863

[a] USEPA, 1991b, unless otherwise indicated.
[b] Estimate based on USEPA, 1991a.
[c] Wolf, 1992.

First Generation Machines

The first generation of dry cleaning machines had separate washers and dryers. These transfer machines (so-called because the wet clothes were transferred from the washer to the dryer) were the predominant type of machine used until the late-1960s, when dry-to-dry machines were developed that reduced solvent loss and improved dry cleaning economics. In a typical transfer process, the clothes are loaded into the washer, where the solvent is combined with a water and detergent charge, and the clothes and solvent are agitated by rotation of the washer's drum. After washing, the drum is rotated at high speeds to extract the residual solvent. The clothes are then manually transferred to a dryer where recirculating warm air causes most of the remaining solvent to vaporize. To reduce wrinkling, the drying cycle is followed by a brief cool-down cycle during which unheated air is circulated through the clothes (USEPA, 1991). A flow diagram for a typical PCE transfer machine is shown below. The advantages of using transfer equipment are: (a) more production since a new load is being washed while the previous one is being dried; (b) less complicated construction with less automation and thus greater ease of repair; and (c) reduction of fabric damage since the cylinder remains cool after the prior load is removed. The disadvantages are:

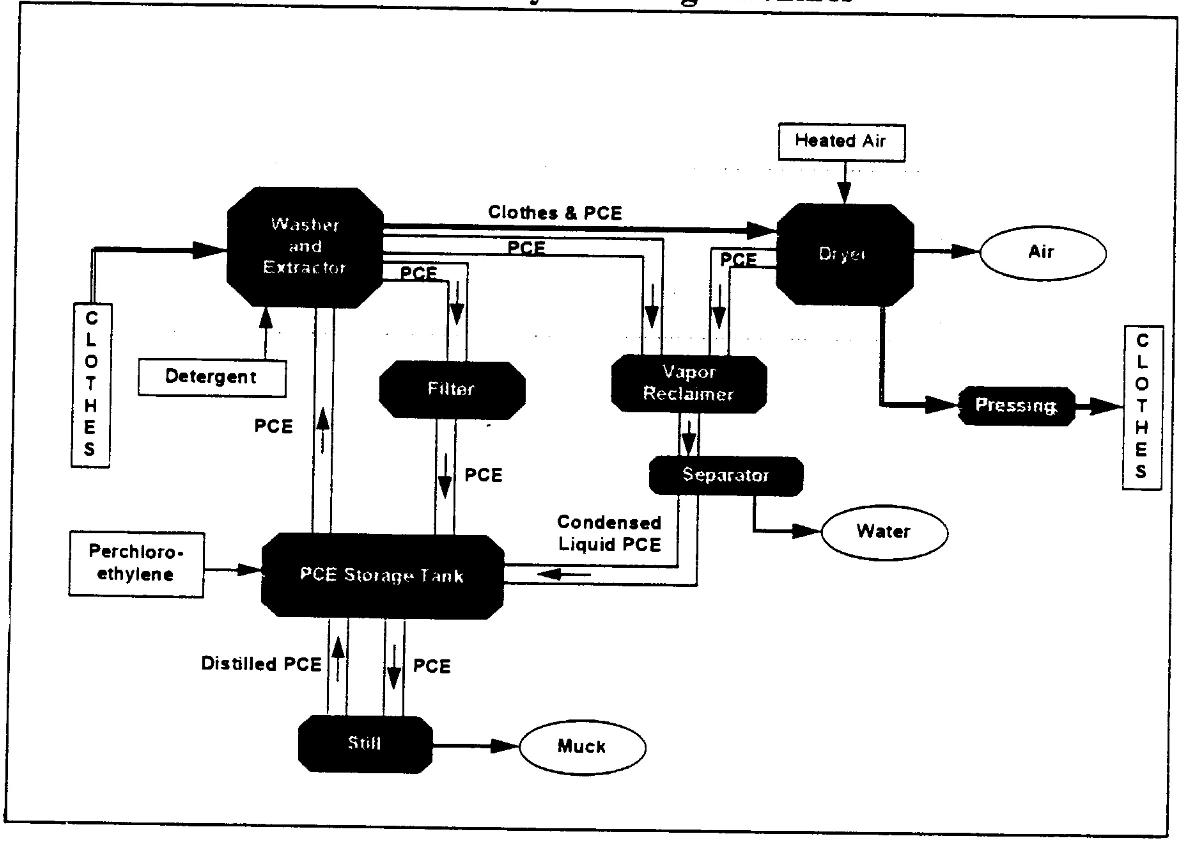
(a) the additional labor required to handle the heavy volume; (b) the solvent vapors that escape to the atmosphere during transfer; (c) exposure of the worker to the solvent; and (d) the garments that can fall on the floor during transfer. Currently, about 34 percent of dry cleaning machines in the U.S. are transfer units (Brown, 1993). However, the National Emissions Standards for Hazardous Air Pollutants (NESHAP) for PCE dry cleaning facilities will not allow new transfer machines that use PCE (USEPA, 1993b). Transfer machines cannot be converted to dry-to-dry machines, but they can be retrofitted with vapor control devices and with impermeable enclosures to capture fugitive emissions. Two technologies that can capture the solvent that escapes during clothing transfer are hamper enclosure and room enclosures.

Hamper enclosures consist of a hood or canopy usually made of polyethylene -- impervious plastic that encloses the clothing hamper and the open door of the washer when clothing is removed from the washer of a transfer machine and placed in the dryer. The same canopy is used when transferring the clothes from the hamper to the dryer (Environmental Reporter, 1992).

Room enclosures usually consist of a metal frame covered with clear impervious plastic that encloses both the washer and dryer of a transfer machine. During clothing transfer, a fan is turned on to draw air from outside the room enclosure through louvered door openings in the enclosure and then to a vapor emission control device.

R0074871

Exhibit 8: Process Flow Diagram for Perchloroethylene Solvent Transfer Dry Cleaning Machines



Source: Adapted from USEPA, 1991b

Second Generation Machines

Transfer units were used exclusively until the late 1960s, when a second generation of equipment was introduced to reduce the amount of space the machines occupied and to decrease solvent consumption. Called "dry-to-dry" machines, these units integrate the washing and drying into the same unit. This saves space, requires less labor (because the operator does not have to transfer garments), reduces the amount of solvent vapor that escapes, lowers worker exposure to solvent vapor, and generates a higher solvent mileage (the quantity of solvent needed to clean a quantity of clothes). The disadvantages are lower production and less flexibility, since each machine is committed to a single load during its entire wash-dry cycle. Dry-to-dry machines currently comprise 66 percent of the units used in the U.S. (Brown, 1993). Of these, 32 percent are the vented units (2nd generation machines) that are designed

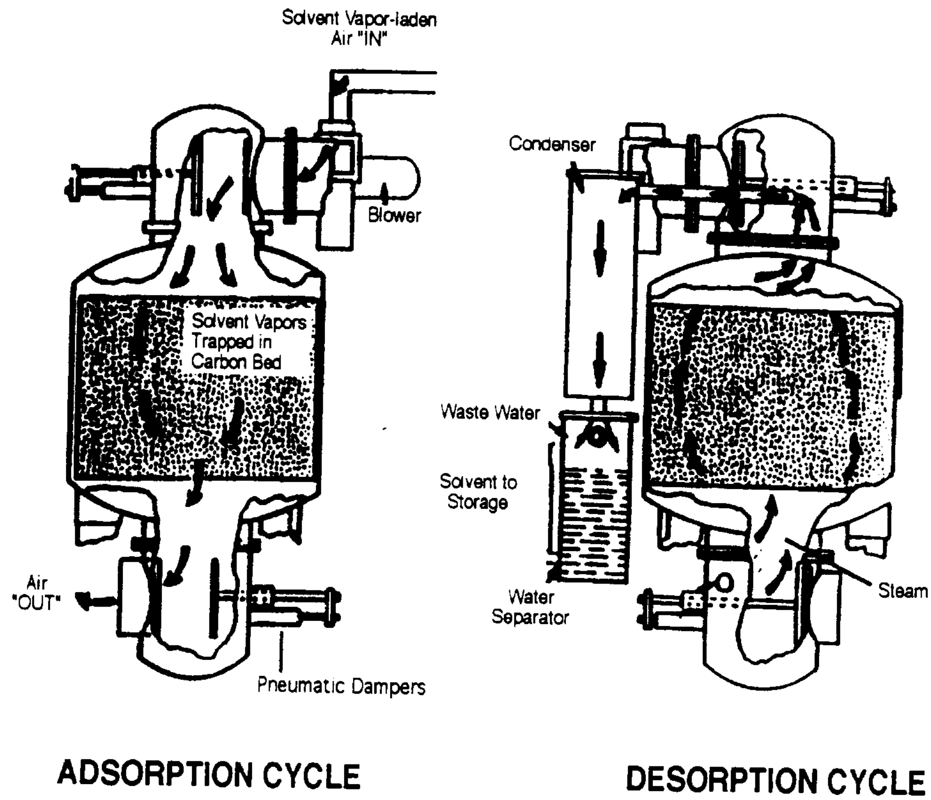
R0074872

to send residual vapors to the atmosphere or an external control device (Brown, 1993). The remainder are third or fourth generation machines as described below. Second generation machines can be retrofitted with control devices such as carbon adsorbers (not allowed under current regulations) and refrigerated condensers.

Carbon adsorbers recover solvent by sending contaminated air through a bed of activated carbon that then adsorbs[a] the solvent vapors as shown below. The adsorbed solvent is recovered by passing low-pressure steam (new designs use hot air) through the carbon bed. The mixed steam and solvent vapors are then passed through a water-cooled condenser and are collected in a phase separator.[b] The carbon is dried and reused while the recovered solvent is returned to the dry cleaning system (SRRP, 1990). Carbon adsorbers can be retrofitted to both dry-to-dry and transfer machines. In tests of carbon adsorbers, the removal efficiencies were above 95 percent (USEPA, 1991). However,.subsequent data from the California Air Resources Board led the Agency to believe that in actual practice the removal efficiencies are much lower. As a result, the NESHAP does not allow them as an option for primary control except in certain large facilities where carbon adsorbers were installed prior to the promulgation of the regulation, September 22, 1993.

[a] The system will hold molecules on its surface (adsorb) and then release them (desorb) when steam is passed through the bed.

[b] PCE and water are reasonably insoluble in the liquid phase. The cooled PCE/water mixture will enter the phase separator where two layers will form. The PCE will then be drawn off for recycling.



Source: USEPA 1991a

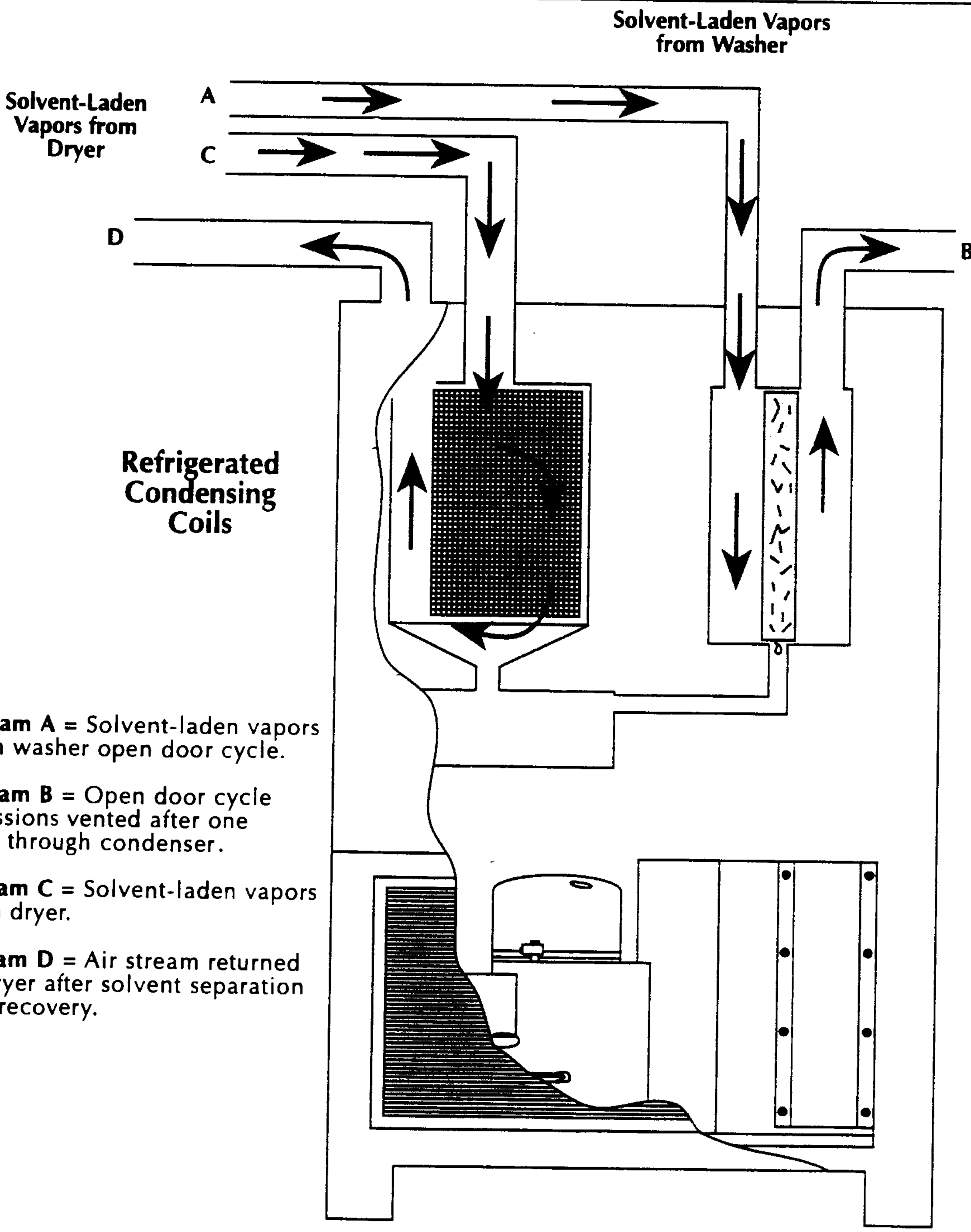
Exhibit 9: Flow Diagram of a Carbon Adsorber

Refrigerated condensers have both an advantage and a disadvantage when compared to carbon adsorbers. They require less maintenance because the refrigerant only needs to be replaced yearly while carbon adsorbers must be desorbed daily.[c] The disadvantage of refrigerated condensers compared to carbon adsorbers is that they cannot be used to control low concentration emission streams (USEPA, 1991a).

[c] The desorption of solvent is accomplished by passing steam (or hot air) through the carbon bed.

Refrigerated condensers remove vapors from the exhaust stream by cooling them to below their dew points. Most new machines have built-in refrigerated condensers, but the condensers can be retrofitted to both transfer and dry-to-dry machines (USEPA, 1991a). Refrigerated condensers achieve about 95 percent control of HAPs when compared to uncontrolled machines (Smith, 1995). The figure below shows a typical refrigerated condenser that can accommodate two HAP (hazardous air pollutant such as PCE)-laden streams. In transfer machines, a stream (Stream A) from the exhaust fan used when the washer door is opened will feed through the condenser and be vented (Stream B) and a stream from the dryer (Stream C) passes through the condenser, and after separation and recovery of the solvent returns the air stream to the dryer (Stream D). Dry-to-dry machines only have the second stream. In transfer machines, the exhaust vapors from the washer are vented (in one pass) through the condenser to the atmosphere, and thus the system can achieve only about 85 percent control of HAPs compared to an uncontrolled machine (USEPA, 1991a).

Exhibit 10: Flow Diagram of a Refrigerated Condenser



Stream A = Solvent-laden vapors from washer open door cycle.

Stream B = Open door cycle emissions vented after one pass through condenser.

Stream C = Solvent-laden vapors from dryer.

Stream D = Air stream returned to dryer after solvent separation and recovery.

A refrigerated condenser as applied to a transfer dry cleaning machine.

Source: USEPA 1991a

R0074876

Third Generation Machines

The third generation of machines that were designed in the late 1970s and early 1980s are dry-to-dry with built-in refrigerated condensers. These are closed loop machines. A closed-loop machine does not vent air to the atmosphere but recycles it continuously throughout the dry cleaning cycle. The only air exchange with the atmosphere occurs during loading and unloading. Thirty-four percent of the machines currently in use in the U.S. are of this design (Brown, 1993). The advantage is a single unit that will release smaller amounts of vapor. The disadvantage is the greater complexity of machine design which could lead to higher maintenance costs and more frequent breakdowns. The principles of operation are the same as for the second generation machines that use refrigerated condensers.

Fourth Generation Machines

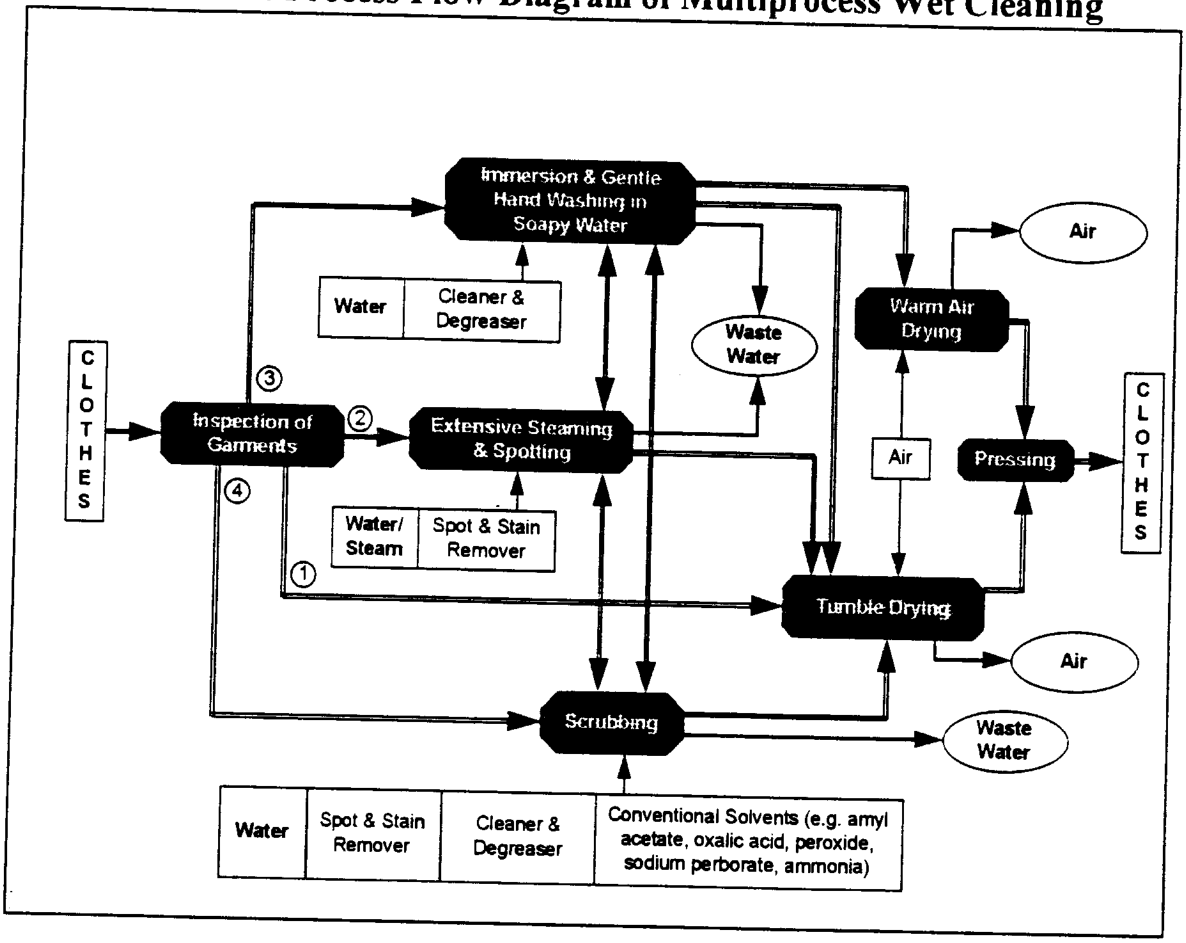
The fourth generation machine is a non-vented, closed loop process with an additional internal vapor recovery device. The control technologies used in these machines are refrigerated condensers and carbon adsorbers. In non-vented, closed loop machines, refrigerated condensers can match carbon adsorber's 95 percent control efficiency (USEPA, 1991a).

Technological Trends

The recent technological trends have been to increase mileage and to reduce emissions. The increased mileage decreases solvent costs for the facility while the reduced emissions are driven by both environmental and worker protection laws. In September, 1993 the Agency promulgated a National Emission Standard for Hazardous Air Pollutants (NESHAP) for Perchloroethylene Dry Cleaners. These regulations require both existing and new facilities that meet certain size requirements to use designated vapor control technologies and undertake leak detection and equipment repair to prevent fugitive emissions. Occupational Safety and Health Act regulations have imposed limits on worker exposure to perchloroethylene which has led to machine designs that reduce emissions from opening the door after operation. For petroleum solvents the trend has been towards development of solvents with higher flash points to reduce the explosion potential and to solvents with lower volatile organic compound content to reduce VOC emissions.

One of the most important current developments in the industry is the commercialization of aqueous alternatives for a portion of the clothes currently dry cleaned. Multi-process wet cleaning is a method of hand cleaning clothes using a controlled application of water. It is called "multiprocess" because a number of different steps can be included in the process depending upon the fabric type and the soil and stains on the garment. A cleaning technician inspects incoming garments for the degree of soiling and based on that and the fiber type a cleaning process is chosen. The process could be spotting, localized steaming, hand washing or machine washing. A flow diagram of multi-process wet cleaning is shown below. The second aqueous alternative is machine wet cleaning. This process uses a specially designed washing machine that reduces the agitation the clothes are subject to in a traditional laundering process and adds proprietary chemicals (that satisfy the German environmental regulations) to reduce fiber swelling. These machines have been used profitably in Europe (primarily Germany) and are now being introduced into the U.S. market by several manufacturers. The process is diagramed below. The critical test for market acceptance will be the percent of the current U.S. dry cleaning clothes stream that these processes can clean effectively without damaging the garments. Two firms in New York City currently are using a combination of the two aqueous processes and report eighty percent repeat business.

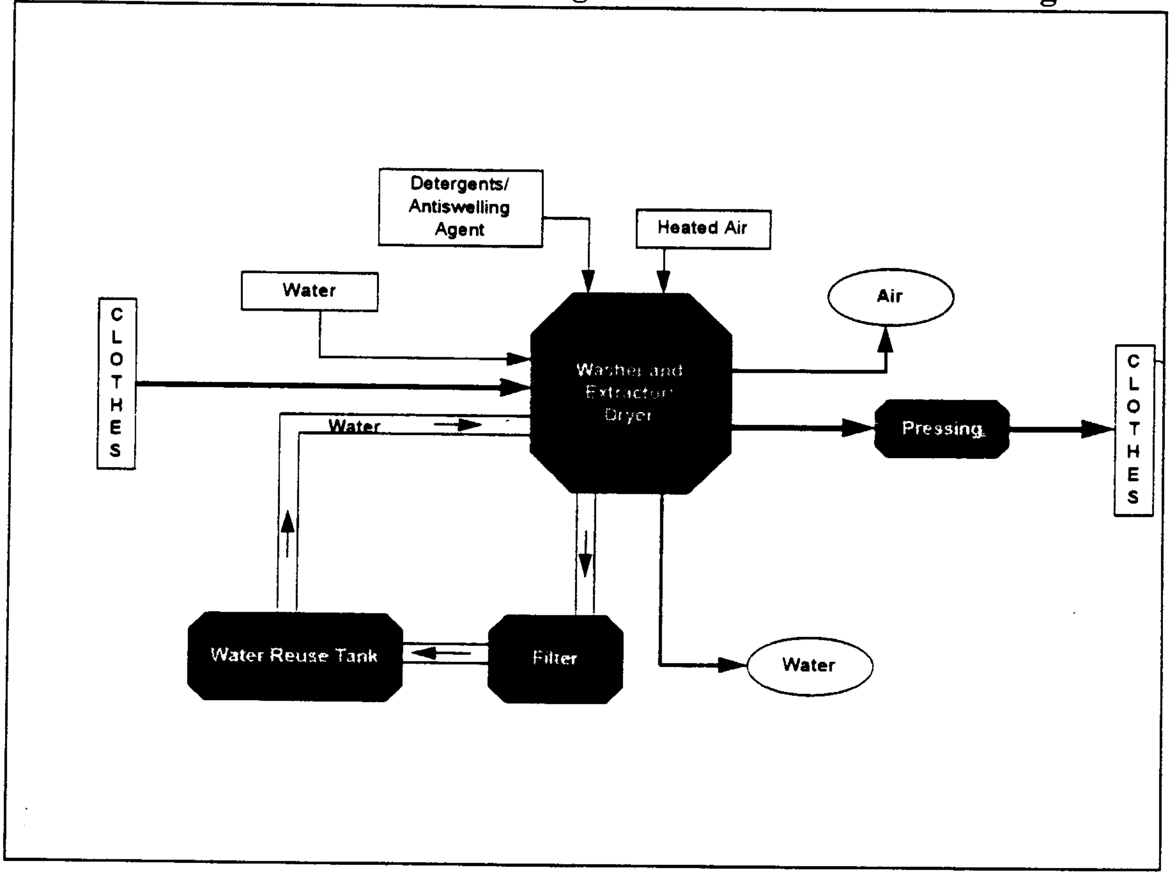
Exhibit 11: Process Flow Diagram of Multiprocess Wet Cleaning



Source: Developed for USEPA Office of Pollution Prevention and Toxics' Design for the Environment Program.

R0074879

Exhibit 12: Process Flow Diagram of Machine Wet Cleaning



Source: Developed for the USEPA Office of Pollution Prevention and Toxics' Design for the Environment Program.

III.B. Raw Material Inputs and Pollution Outputs

The primary dry cleaning releases are to air (through both fugitive emissions and direct release at the end of the cycle), water (from water that was contained in the clothes and from regenerating carbon adsorbers) and solid waste (such as the muck from stills used to evaporate solvent-contaminated water, the residue remaining after contaminated solvent is filtered, and the carbon from an adsorber). There is an active recycling market for solvent recovered from dry cleaning facilities, although the overall percentage of solvent recovered is not known.

R0074880

Exhibit 13: Pollution Releases from Dry Cleaning Operations

Release Medium	Emissions
Air	Solvent spills Fugitive leaks from piping Vapor released with transferring or removing clothes from machines Vapor release from clothes dryers Residual vapor release from clothes after they are removed from the dryer
Water	Water from separator
Hazardous/Solid Waste	Residue from solvent still Filters

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 800-535-0202), or directly from the Toxic Release Inventory System database. (For user support call 202-260-1531)

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weights to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20 through 39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emission occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

R0074883

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks. or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Dry Cleaning Industry

The Toxics Release Inventory (TRI) covers only manufacturers categorized in two-digit SIC codes 20 through 39. Therefore dry cleaning facilities which are categorized as service industry establishments (SIC 72) are not required to report to TRI. However, solvent releases from dry cleaners were estimated by the Agency for two regulatory actions, the 1993 NESHAP for HAPs (excluding petroleum solvents) and the 1984 Petroleum Dry Cleaners New Source Performance Standard. The information is explained below.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time are available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), and the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health.[d] HSDB contains chemical-specific information on manufacturing and use.

[d] Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Release Inventory).

chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 800-231-3766.

Perchloroethylene (tetrachloroethylene) (CAS: 127-18-4)

Toxicity. Chronic exposure to perchloroethylene (PCE) has been linked to damage to the central nervous system and to a lesser extent, the lungs, liver, and kidneys. Exposure to PCE is irritating to the eyes, skin, and respiratory system.

Ecologically, experimental application of PCE to a freshwater pond led to the local extinction of several phytoplankton and zooplankton species.

Carcinogenicity. PCE is a possible human carcinogen via oral exposure.

Environmental Fate. PCE released to surface water or the soil rapidly evaporates. PCE is not expected to significantly biodegrade, bioconcentrate in aquatic organisms, hydrolyze, or significantly adsorb to sediments or soil particles. PCE released to the atmosphere degrades rapidly in the presence of sunlight. It may be subject to washout in rain.

IV.C. Other Data Sources

The primary releases from the dry cleaning industry are associated with the many solvents used. As mentioned in Section III.A., four solvents dominate: perchloroethylene, petroleum solvents, chlorofluorocarbons and trichloroethane. Estimates of national releases of hazardous air pollutants (HAPs) (excludes petroleum solvents) from the baseline estimate prior to the 1993 NESHAP are 90,200 tons/year from the commercial sector, 4,800 tons/year from the industrial sector and 990 tons/year from the coin-operated sector for a total of 95,900 tons/year. The total quantity of HAPs disposed of off-site is 47,500 tons per year and is primarily from filtration residue. The recent NESHAP will reduce the air emissions by prohibiting the sale of new transfer equipment, requiring control devices on existing equipment, and requiring new equipment to be fitted with controls. The most recent petroleum solvent emission data available for the dry cleaning industry are from 1982 in support of the 1984 New Source Performance Standards. Applying the release factor

R0074886

of 23 pounds of solvent per 100 pounds of clothes cleaned to the total petroleum-based facility throughput yields total petroleum solvent releases of 51,000 tons per year. These releases are distributed approximately equally between commercial and industrial plants (there are no coin-operated petroleum plants). Over 75 percent of the releases are from dryers with the remainder from a combination of evaporation from filters, still releases and fugitive emissions. These values may slightly overestimate current releases because vapor control technologies such as carbon adsorbers or condensers may have been added to existing machines.

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. Exhibit 14 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM_{10}), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 14: Pollutant Releases (short tons/year)						
Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Production	123,756	42,658	14,135	63,761	9,419	41,423
Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	541,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	103,575	4,107	39,062	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,155	369,058
Rubber and Misc. Plastics	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	**101**	**179**	**3**	**28**	**152**	**7,310**

Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

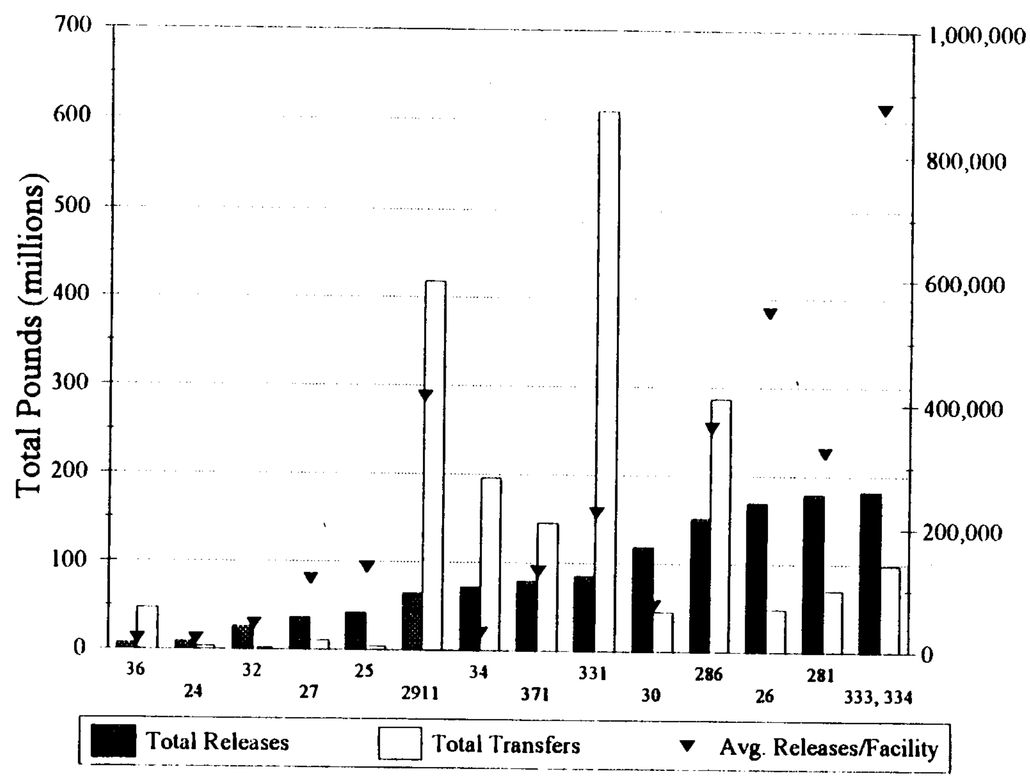
R0074888

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. In addition, the dry cleaning industry sector is not subject to TRI reporting and therefore is not presented in Exhibits 14 and 15. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 15 is a graphical representation of a summary of the 1993 TRI data for the dry cleaning industry and the other sectors profiled in these notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 16 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors.

Exhibit 15: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

Exhibit 16: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	1993 TRI Releases: Total Releases (million lbs.)	1993 TRI Releases: Average Releases per Facility (pounds)	1993 TRI Transfers: Total Transfers (million lbs.)	1993 TRI Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	42,000	2.2	4,000	28.8	46,000
Lumber and Wood Products	24	491	8.4	17,000	3.5	7,000	11.9	24,000
Furniture and Fixtures	25	313	42.2	135,000	4.2	13,000	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	32,000	46.7	147,000
Electronic Equip. and Components	36	406	6.7	17,000	47.1	116,000	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	75,000	45	29,000	163.4	104,000
Motor Vehicles, Bodies, Parts, and Accessories	371	609	79.3	130,000	145.5	239,000	224.8	369,000
Pulp and Paper	2611-2631	309	169.7	549,000	48.4	157,000	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72	30,000	195.7	83,000	267.7	123,000
Iron and Steel	331	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,000	98.2	472,000	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting.						
Nonmetal Mining	14	Industry sector not subject to TRI reporting.						
Dry Cleaning	**7216**	**Industry sector not subject to TRI reporting.**						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the dry cleaning industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

V.A. Pollution Prevention Opportunities for the Dry Cleaning Industry

A number of major changes within the dry cleaning industry are pushing dry cleaners toward pollution prevention. Projects such as the Design for the Environment, the import of European technologies, and increased attention on the part of state and federal regulators to dry cleaning have caused trade associations, technical assistance offices, and individual establishments to investigate possible techniques for reducing the environmental releases associated with dry cleaning. Pollution prevention approaches over the short term for existing facilities and equipment include: improved operating practices or "good housekeeping" and process and equipment retrofits. Over the long-term, there are several new fabric cleaning processes under development, some of which are commercially available while others are still in the research stage. Market forces might take longer than command and control regulations to influence cleaning technologies, as new technologies will only be adopted as existing equipment is retired and replaced.

R0074892

As pointed out in Section IV.C, air releases of perchloroethylene and petroleum solvents used to clean the fabric are the primary environmental release from dry cleaning. Spills, inadequate storage and drain disposal of solvents have led to groundwater contamination. In addition, (improper) disposal of solvent laden material, such as filters, as nonhazardous solid waste is of concern.

Because chemicals constitute a large cost for dry cleaners, particularly if drying exhaust is vented directly to the atmosphere, there are significant opportunities to reduce chemical use and possibly reduce operating costs. Reduced chemical use can, in turn, reduce the waste management costs associated with regulatory requirements as well as reduce potential financial liability. Some pollution prevention strategies may reduce risk but involve a higher energy consumption.

Several operating practices can reduce potential solvent exposure if they are used regularly. The practices of importance will vary based on the type of machine. For example, the major release in a transfer machine occurs when clothes are transferred. Because dry-to-dry machines wash and dry in a single container there are no such releases. Listed below are several specific practices that may reduce releases.

Improved Operating Practices- Specific to Transfer Machines

Conduct transfer of solvent saturated clothes from washer to dryer as quickly as possible.

Close dryer door immediately upon completion of transfer.

Improved Operating Practices - All Machines

Clean the filters that precede the carbon filters weekly.

Clean lint screens to avoid clogging fans and condensers.

Open button traps and lint baskets only long enough to clean.

Check baffle assembly in cleaning machine bi-weekly.

Use closed containers for collection and storage of recovered or new solvent.

Equipment Maintenance

Clean drying sensors weekly.

Replace seals regularly on dryer deodorizer and aeration valves.

Replace door gasket on button trap.

Replace gaskets around cleaning machine door or tighten enclosure.

Repair holes in air and exhaust duct.

Secure hose connection and couplings.

Clean lint buildup on cooling condenser coils weekly.

Equipment Modification

Use a hamper enclosure or a room enclosure of impermeable construction to reduce solvent release during transfer. The enclosure should be a complete vapor barrier, especially if the dry cleaner is located in a mixed use residential setting.

Use local exhaust ventilation through washer and dryer doors or exhaust hoods between washer and dryer. The exhaust velocity should be 100 feet per minute. In addition, a supplemental door fan local exhaust system should be included on third generation equipment. This should vent through a small carbon adsorber designed to control PCE emission levels between 5-20 ppmv.

Install general ventilation that changes the air every five minutes.

Place dry cleaning equipment in separate room at negative pressure and operate a separate exhaust system to control the vapors.

Place washer and dryer close together to minimize solvent losses during transfer.

Replace the cartridge filters with spin disk filters that can be cleaned without opening. This would produce fewer fugitive emissions and less hazardous waste.

Install distillation equipment where the still bottoms can be removed without opening the still. This reduces fugitive emissions.

Use carbon adsorber that is regenerated with hot air stripping rather than steam stripping. This reduces the waste stream.

Use double carbon waste water treatment devices to clean up PCE contaminated waste waters. Recycle the treated waste water to the process boiler.

Chemical Substitutions

Alternative petroleum solvents are being developed with higher flash points to reduce the fire hazard.

Alternative petroleum solvents are being developed with lower VOC content (the drawback, however, is the longer drying time).

Use wet cleaning processes.

Major Equipment Upgrades

Add a refrigerated condenser to the machine for primary control, followed perhaps by a carbon adsorber for secondary control.

Replace a transfer machine with a dry-to-dry machine.

Upgrade a dry-to-dry machine with additional control equipment such as a spill container that will catch and recycle solvent spills from the machine.

Replace current machine with a dry-to-dry closed-loop-non-vented machine that contains an integral refrigerated condenser and an integral carbon adsorber.

Technological Innovation

The majority of the hazardous solid waste is generated by the carbon adsorbers. Several technologies are being developed that use a polymer surface for adsorbing the solvent vapor. The surface can be regenerated by heating and, unlike carbon, does not need to be replaced, thus reducing the hazardous waste.

New aqueous processes that do not use organic solvents as the primary solvent were mentioned in Section III.B. Multiprocess wet cleaning and machine wet cleaning have both been introduced in several sites in the U.S.

New processes that use other cleaning methods are also under development. Both ultrasonic cleaning and a clothes cleaning method that uses liquid carbon dioxide are under development.

Both pollution prevention and end-of-pipe controls have the potential to substantially reduce the risk from toxic chemical release. The primary difference is the size of the initial investment. For example, to retrofit a dry-to-dry perchloroethylene machine with a refrigerated condenser costs about $7,500 while replacing the existing unit with a fourth generation machine that is closed-loop with a built-in refrigerated condenser and secondary controls is about $47,000 (35 pound machine). However, the total cost per pound of clothes cleaned over a fifteen year lifetime is nearly identical ($0.48 to $0.50) when the solvent savings are considered. The fourth generation machine also produces lower solvent releases to air and water and creates less hazardous waste. However, with 25 percent of commercial dry cleaners taking in annual receipts of less than $28,000, the initial investment required for a new machine may be prohibitive. (Information developed for OPPT's Design for the Environment Program.)

The aqueous processes have recently been introduced to the U.S. market. They reduce pollution considerably by not introducing toxic chemicals as the primary solvent. The multiprocess wet cleaning method is cost competitive with conventional dry cleaning although in preliminary short term testing it is more labor intensive. The performance of these cleaning methods has yet to be determined on a broad scale although the Agency's Design for the Environment (DfE) test site should provide this data within two years.

Liquid carbon dioxide and the ultrasonic cleaning are currently in the development stage. While neither of these technologies uses toxic chemicals, the technical and economic feasibility must be demonstrated before they are true market options.

Most commercial dry cleaners are small shops. Over twenty-five percent of dry cleaners have owners of Korean descent. Commercial dry cleaners may not be in compliance with current regulations because of lack of familiarity with the law or communication barriers. Dry cleaners get much of their technical information from their trade associations and their equipment suppliers who may only have information on their products. This could limit the dissemination of information on innovative alternatives such as machine wet cleaning which tends to be manufactured by washing machine makers rather than dry cleaning machine makers.

The Agency's Design for the Environment program has already participated in a number of outreach activities. These include attending trade shows to discuss alternatives, conducting a demonstration of multiprocess wet cleaning and arranging for a demonstration of several alternative technologies over the next two years. A full description of the program is provided in Section VIII.A.

Showing the commercial viability of alternatives is likely to produce the largest leverage for pollution prevention since dry cleaners are skeptical that new technologies will clean as well as the current process. However, current fashion trends, the introduction of new washable fabrics and the increased use of casual (washable) clothes in the work place have created opportunities for new processes and the increased use of traditional laundry.

Pollution prevention will reduce the releases of solvents to air and water and reduce the quantity of solid waste produced. Controlling releases will reduce worker exposure, customer exposure and the exposure of residents in multi use buildings that contain dry cleaners. Some pollution prevention efforts may also be cost effective for the dry cleaner if the solvent savings are significant. Finally, the fact that a dry cleaner is environmentally sound could be used in marketing. If customers prefer such "green cleaning," the fact that a cleaner is practicing pollution prevention could increase sales.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting

R0074898

program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil** storage and disposal regulations (40 CFR Part 279) do not define **Used Oil Management Standards** impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

R0074901

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compiie the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES

permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.
A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw material storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards.

R0074905

The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control** (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide

R0074906

available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Regulatory Requirements

The dry cleaning industry is becoming increasingly regulated at the Federal, State and local levels. Some of the regulations are directed specifically at dry cleaners such as the new National Emission Standard for Hazardous Air Pollutants (NESHAP) for Perchloroethylene Dry Cleaning. Other regulations are more general but are also likely to affect a significant part of the industry such as standards on underground tank storage. The major Federal laws that affect dry cleaners are identified below, as well as a few state regulations that may be indicators of national trends.

Occupational Safety and Health Act

The Occupational Safety and Health Administration proposed a 25 part per million permissible exposure level (PEL) for perchloroethylene that was to take effect on January 19, 1989. Before December 31, 1993, the PEL could be met by using personal protective equipment; however, after that date the PEL needed to be met by controls. Development of new dry cleaning machines (fourth generation) with recycling air and additional controls was underway to meet the requirement when the proposed limit was remanded in March 23, 1993, because of legal and administrative technicalities. The PEL reverted to 100 ppm; however, some states have already included the 25 ppm level in their regulations.

Clean Air Act Amendments of 1990

A number of provisions of the Clean Air Act Amendments (CAAA) of 1990 affect the dry cleaning industry. The most recent is the September 1993 promulgation of the National Emission Standards for Hazardous Air Pollutants (NESHAP) for the Perchloroethylene Dry Cleaning Industry covering the 80 percent of the industry that uses perchloroethylene solvent. These standards prohibit the sale of new transfer machines (although existing, those machines installed prior to December 1993, transfer machines are allowed), require retrofitting of existing (defined as installed prior to December 1993) dry cleaning equipment with control devices (if they fall under the large area and major source classifications) and require new machines to be sold with such technology (40 CFR §63.320). Title VI of the Clean Air Act Amendments of 1990 calls for a ban on chlorofluorocarbons in the year 2000 and on trichloroethane in 2002 because of their ozone depleting potential. In February of 1992, President Bush announced that the ban on CFCs and TCA would be effective in the United States on December 31, 1995. The Agency also issued New Source Performance Standards (NSPS) for petroleum-based dry cleaners in 1984 (petroleum-based dry cleaners represent less than 15 percent of the market) (49 FR 37328). These are applicable in CAA non-attainment areas and may also have been adopted by individual states. They set limits on solvent loss from drying, set standards on the use of filters, and require leaks to be repaired in a timely fashion. Dry cleaners must add control devices to reduce solvent loss from the washer and dryer as well as the filters. In addition, they must monitor their machines more closely for leaks.

Comprehensive Environmental Response, Compensation and Liability Act (1980) and Superfund Amendments and Reauthorization Act (1986)

Dry cleaners or their landlords may be held joint and severally liable for perchloroethylene contamination of the site under the Comprehensive Environmental Response, Compensation and Liability Act (Superfund) (40 CFR §305). The contamination may occur by having PCE containing waste water leak through sewer pipes or by leaks of PCE during normal operation.

Resource Conservation and Recovery Act

Under the Resource Conservation and Recovery Act (RCRA) dry cleaners who generate 100 kilograms (220 pounds) or more of perchloroethylene solid wastes (hazardous waste code D039) such as still bottoms, cartridge filters and filter muck each month are regulated under RCRA and must dispose of their wastes at a licensed hazardous waste facility (40 CFR. §260-270). Small quantity generators are defined as those who generate less than 100 kilograms and are exempt from this regulation (40 CFR §261.5). The slightly contaminated waste water generated by dry cleaners from various sources is considered hazardous waste under RCRA because it was derived from an F002 waste. The toxicity characteristic leaching procedure (TC) cutoff for perchloroethylene is 0.7 ppm. Typical separator water contains about 150 ppm and is therefore considered hazardous because it exceeds the TC level.

Underground Storage Tanks

Dry cleaning facilities that store either petroleum or perchloroethylene in an underground storage tank are subject to the Agency's underground storage tank regulations which require that the tank must be protected from corrosion, be equipped with devices that prevent spills and overfills and must have a leak detection method that provides monitoring for leaks at least every 30 days (40 CFR §265.190-196).

Clean Water Act

Discharges to a POTW - Facilities discharging wastewater to a sewer are often subject to restrictions required under the Clean Water Act (CWA). These restrictions are established by the local sewerage authority to prevent significant interference with the treatment facility or pass-through of pollutants not removed by treatment (40 CFR §125). The specific requirements include: notifying the POTW of discharges that could cause problems at the POTW, monitoring and record keeping as established by the POTW and a one-time notice of the discharge of hazardous waste, specifically if more than 33 pounds/month.

State Regulations

Several states have developed additional dry cleaning regulations. New York and California serve as examples.

New York

A negotiating committee of organizations representing dry cleaners, equipment manufacturers, consumer interests and regulatory agencies reached conceptual agreement in March 1994 on revised regulations to control emissions from dry cleaning facilities in New York State. The regulations include requirements for operator training and certification, equipment certification, inspection and monitoring, and stringent new equipment standards which include the retrofitting of existing equipment. A finalized draft will be released before the end of the year for public comment.

The agreement calls for the phased replacement of older dry cleaning equipment with state-of-the-art closed-loop machines that use a refrigerated condenser and an integrated carbon adsorber. The regulations call for the complete phase out of older transfer machines by 1996, the addition of vapor barriers or room enclosures by late 1995 for dry cleaners using older machines, and room ventilation systems providing a complete air exchange every five minutes.

The agreement specifies that manufacturers and/or vendors of new dry cleaning equipment must have their equipment tested and certified that it meets certain standards before it can be installed. The committee is developing new standards covering the operation and maintenance of dry cleaning facilities that will go into effect in 1996. (Contacts: Lenore Kuwik 518-457-2224 and Michael Barylski 607-753-3095 at the NY State Department of Environmental Conservation)

California

The California regulations are contained in the Airborne Toxic Control Measure (CATCM) for Emissions of Perchloroethylene from Dry Cleaning Operations (17 and 25 CCR §93109). The requirements for existing and new facilities regarding dry cleaning equipment include initial notification of installation, annual reporting to the state, maintenance of good operating practices to reduce emissions, and fugitive emissions control when applying water repellent using PCE as the solvent. Existing facilities must use either a converted closed-loop machine with a primary control system or a closed-loop machine with a primary control system. New facilities are required to use a closed-loop machine with both primary and secondary control systems once their district's have approved the ATCM.

Districts within California are allowed to supersede the ATCM if district regulations are more stringent than State regulations. At this time, only the Bay Area and the South Coast Air Quality Management Districts have proposals to supersede the ATCM; other districts are assumed to be following the ATCM. (Contact: Todd Wong, California Air Resources Board, 916 322-8285)

The **Bay Area Air Quality Management District** (BAAQMD) has proposed stricter controls than the ATCM including secondary controls and vapor barrier rooms in residential facilities and ventilation systems in non-residential facilities. They also allow evaporators to be used with certain minor criteria attached. (Contact: Scott Lutz, Bay Area Air Quality Management District, 415-749-4676)

The **South Coast Air Quality Management District** (SQAQMD) Proposal 1421 includes the control requirements in California's ATCM while keeping the NESHAP requirements for record keeping, inspection, and repair. Reporting requirements are derived from a combination of both the NESHAP and the ATCM. Specifically, Proposal 1421 requires that relocating facilities obtain a permit as if they were new facilities, waste water elimination systems be used, and facilities keep records of their solvent use for five years.

The SCAQMD is also creating the requirements for establishing a list of approved equipment. The basic structure is that the manufacturers/distributors will demonstrate the 1421 compliance of their equipment. Once the equipment has been approved, it will be added to the list of equipment considered in compliance with the regulations. The SCAQMD hopes this will facilitate dry cleaner adherence to the regulations. (Contact: Pierre Sycip, South Coast Air Quality Management District, 909-396-3095)

VI.C. Pending and Proposed Regulatory Requirements

Petroleum solvents are currently regulated under the new source performance standards for VOCs and will be listed as a source category for toxic substances in the year 2000. (Contact: Steve Shedd, U.S. EPA, 919-541-5397)

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within

R0074913

the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[e] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

This section provides summary information about major cases that have affected this sector, and a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

The final part of this section provides highlights from interviews with several knowledgeable EPA inspectors. These interviews provide the inspector's viewpoint on where compliance problems occur, why they occur, and possible solutions to eliminate these problems. The reader should not reach any definitive conclusions about an industry sector's ability or willingness to

[e] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

comply based on these interviews. These interviews provide only anecdotal information about the interactions occurring between inspectors and the facilities they inspect.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with three enforcement actions counts as one). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with three enforcement actions counts as three).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Reported inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and TSCA.

Facilities with One or More Violations Identified -- indicates the number percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column may exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Dry Cleaning Industry Compliance History

Exhibit 17 provides an overview of the reported compliance and enforcement data for the dry cleaning industry over the past five years (August 1990 to August 1995). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Within the limited universe of dry cleaning facilities retrieved from the database search, the number of dry cleaning facilities inspected was only 26 percent of those identified. In the past five years, the facilities identified were inspected on average every seven to eight years.

- A significantly larger proportion of facilities identified in the database search had been inspected than had enforcement actions brought against them.

- State lead enforcement actions accounted for almost all of the enforcement actions brought against dry cleaning facilities over the five year period.

Exhibit 17: Five-Year Enforcement and Compliance Summary for Dry Cleaning

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	146	8	14	625	0	0	--	--	--
II	12	3	4	180	0	0	--	--	--
III	22	17	36	37	1	1	100%	0%	0.03
IV	485	170	460	63	24	95	100%	0%	0.21
V	45	22	72	38	2	4	100%	0%	0.06
VI	188	9	11	1,025	1	1	100%	0%	0.09
VII	8	6	20	24	0	0	--	--	--
VIII	14	6	8	105	0	0	--	--	--
IX	2	1	5	24	1	2	44%	56%	0.45
X	11	3	3	220	0	0	--	--	--
TOTAL	933	245	633	88	29	103	99%	1%	0.16

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 18 and 19 allow the compliance history of the dry cleaning industry to be compared to the other industries covered by the industry sector notebooks. Comparisons between Exhibits 18 and 19 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past year. Some points evident from the data are listed below.

- Of those sectors listed, the dry cleaning industry has been the least frequently inspected industry over the past five years. The average time between inspections for the facilities identified is 88 months.
- The industry has a relatively small percentage of facilities with violations and enforcement actions, in comparison to the other sectors.
- The rate of enforcement actions per inspection over the past five years is relatively high for the industry, but has decreased over the past year.

Exhibits 20 and 21 provide a more in-depth comparison between the dry cleaning industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Exhibits (Exhibits 18 and 19), the data cover the last five years (Exhibit 20) and the last one year (Exhibit 21) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- The number of inspections carried out under each environmental statute as a percent of the total number of inspections has changed only slightly between the average of the past five years and that of the past year.
- The number of enforcement actions taken under RCRA dominate both the percentage of inspections as well as the percentage of enforcement actions.
- In the past year there has been a significant drop in the proportions of enforcement actions taken under RCRA from the average of the past five years, primarily resulting from an increase in enforcement actions taken under CWA.

Exhibit 18: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	**933**	**245**	**633**	**88**	**29**	**103**	**99%**	**1%**	**0.16**
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-Metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Nonferrous Metal	844	474	3,097	16	145	470	76%	24%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11

Exhibit 19: One-Year Inspection and Enforcement Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	**933**	**80**	**111**	**21**	**26%**	**5**	**6%**	**11**	**0.10**
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10

* Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

R0074921

Exhibit 20: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	298	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	**245**	**633**	**103**	**15%**	**1%**	**3%**	**4%**	**83%**	**93%**	**0%**	**1%**
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	0%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay, and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%

R0074922

Exhibit 21: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	0%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	0%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	0%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	437	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	0%	6%
Dry Cleaning	**80**	**111**	**11**	**21%**	**4%**	**1%**	**22%**	**78%**	**67%**	**0%**	**7%**
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	0%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	0%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	0%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	0%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	0%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	0%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	0%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%

VII.C. Review of Major Legal Actions

This section provides summary information about major cases that have affected this sector, and a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

VII.C.1. Review of major cases

Historically, OECA's Office of Regulatory Enforcement does not regularly compile information related to major cases and pending litigation within an industry sector. The staff are willing to pass along such information to Agency staff as requests are made. In addition, summaries of completed enforcement actions are published each fiscal year in the Enforcement Accomplishments Report. To date, these summaries are not organized by industry sector. (Contact: Office of Enforcement Capacity and Outreach, 202-260-4140)

VII.C.2. Supplementary Environmental Projects (SEPs)

Each Region's summary of Supplemental Environmental Projects (SEPs) undertaken in federal fiscal years 1993 and 1994 were reviewed. None was identified as being applied to a dry cleaning operation or establishment. Many process changes have been demonstrated which may be suitable for use as SEPs (see Pollution Prevention Opportunities - Section V.). However, because federal enforcement actions within the dry cleaning industry are few (one during the period from 1989-1994), the chances that SEPs are recommended or adopted for dry cleaners is reduced.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

Design for the Environment

The Environmental Protection Agency's Design for the Environment (DfE) program uses a non-regulatory, voluntary, and pro-active approach in working with industry and environmental and human health groups to reduce risk. The Design for the Environment (DfE) program was created by the Office of Pollution Prevention and Toxics of the U.S. Environmental Protection Agency in 1992 to promote the incorporation of pollution prevention principles in the design of products and processes through voluntary partnerships with industry, professional organizations, state and local governments, other federal agencies, and the public. The DfE provides businesses with the information needed to design for the environment and to help businesses use this information to make environmentally informed choices. The DfE program also works to make sure that the information reaches the people who make the choices - from buyers to industrial design engineers.

The Dry Cleaning (DfE) program has identified control technologies and alternative solvents and processes that might be used to reduce solvent releases from the industry. The Agency is evaluating the risks, costs and benefits of each alternative (including setting up an alternative process demonstration) and will publicize the results so that individual dry cleaners can understand the pros and cons of each alternative. Examples of the DfE's work in the dry cleaning industry include the following:

The DfE convened the International Roundtable of Pollution Prevention and Control in the Dry Cleaning Industry. Researchers, industry representatives, and government officials met to exchange information on issues related to the dry cleaning industry, including exposure reduction, regulation, and information dissemination.

The DfE program is producing a Cleaner Technologies Substitute Assessment (CTSA) for the dry cleaning industry to examine both existing and emerging technologies. The Agency expects to release a draft CTSA on existing technologies and another on emerging technologies sometime in 1995. The first phase of the CTSA will examine traditional, solvent-based technologies.

The new or alternative technologies, such as multiprocess wet cleaning, machine wet cleaning, liquid carbon dioxide technology, and microwave drying will be addressed in the second phase of the CTSA.

In November and December of 1992, the DfE program, in collaboration with the dry cleaning industry, conducted a short term, high volume demonstration to compare the costs and performance of an aqueous alternative process (multiprocess wet cleaning) to the traditional dry cleaning method that uses perchloroethylene.

As part of the Agency's outreach program, the DfE partnership produced a wet cleaning brochure entitled *Summary of a Report on Multiprocess Wet Cleaning*, to assist dry cleaners and consumers in learning more about how their choices and actions can affect the environment. The Agency also has distributed brochures and fact sheets on alternative cleaning processes, compiled case studies and success stories, and produced exhibits at trade shows to keep the public and the dry cleaning industry informed of the DfE project's activities.

To further test the viability of the wet cleaning process, the Agency has launched a two-year demonstration project in three demonstration sites around the United States that will establish the performance of wet cleaning methods under "real world" conditions. Two demonstration sites will test the full range of garments typically handled by professional clothes cleaners using only various wet cleaning technologies/techniques; while the one site will offer both wet and dry cleaning services. Technologies to be tested include: multiprocess wet cleaning; machine-based wet cleaning; and microwave drying to be used in combination with both cleaning methods.

The DfE project is developing a certification program centered around solvent use reduction, worker safety, and consumer awareness.

The Agency currently is working with the Federal Trade Commission on the labeling of "Dry Clean Only" garments. Public comments are being reviewed regarding proposed changes that attempt to allow for other forms of cleaning without increasing the liability of the dry cleaner. Currently, if a "Dry Clean Only" garment is damaged when cleaned using an alternative method, the dry cleaner is held liable. If the same garment is damaged during the dry cleaning process, the manufacturer is held liable. Proposed changes will make the garment label less restrictive and allow other forms of cleaning to be used without penalty. (Contact: Pollution Prevention Clearinghouse, PPIC, 202-260-1023)

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases of eighteen chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases by 33 percent as of 1992 and by 50 percent as of 1995. Certificates of Appreciation have been given out to participants meeting their 1992 goals. The list of chemicals includes seventeen high-use chemicals reported (including perchloroethylene) in the Toxics Release Inventory and dioxin. Because dry cleaning is a service, dry cleaners are not eligible for the 33/50 program even though perchloroethylene is covered by the program. (Contact: Mike Burns 202-260-6394 or 33/50 Program 202-260-6907)

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and state agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentor programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. At this time, no dry cleaning operations are ELP participants. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, U.S. EPA, 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995, Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis 202-260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Maria Tikoff at 202-233-9178 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA, in turn, provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn 202-260-0700 or the WasteWi$e Hotline at 800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman 202-260-4407)

Office of Enforcement Compliance Assurance

The Office of Compliance is compiling a list of resource materials on pollution prevention and contacts in the dry cleaning industry. This is the first of several projects planned to help reduce risk from dry cleaners. (Contact: Joyce Chandler 202-564-7073)

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Environmental programs

Several trade associations including the Neighborhood Cleaner's Association, the International Fabricare Institute (IFI) and the state and regional affiliates of IFI have instituted environmental programs. Theses include: introducing an environmental certificate program that provides members information on good environmental practices and then tests them on this knowledge, training sessions in alternative technologies, and information pamphlets on environmental laws and compliance. The additional trade association activities are listed below.

VIII.C.2. Summary of trade associations

Neighborhood Cleaners Association (NCA)
252 West 29th Street
New York, NY 10001-5201
Tel: (212) 967-3002 Contact: Bill Seitz

The NCA is a worldwide trade organization with over 4,000 members. NCA provides outreach to its members through monthly bulletins, through the NCA's Consumer Education Program, and educational courses on dry cleaning issues. NCA also offers representation for its members at all levels of government including the Federal Trade Commission.

R0074929

Federation of Korean Drycleaners Association (FKDA)
25606 Alicia Pkwy
Lagona Hills, CA 92653
Tel: (714) 770-8613 Contact: Hank Kim

The FKDA was founded in 1986 and is an umbrella organization representing 30 regional Korean dry cleaning associations throughout the U.S. It represents approximately 12,000 members, and educates its members by providing FKDA newsletters as well as organizing educational seminars on subjects such as pollution prevention and other critical issues.

International Fabricare Institute (IFI)
12251 Tech Road
Silver Spring, Maryland 20904
Tel: (301) 622-1900 Contact: Joe Meijer

The association is a worldwide organization of dry cleaners and launderers as well as organizations and individuals concerned with professional garment cleaning, care and serviceability. There are currently over 12,000 members. The association provides publications to aid members technically and in business, represents cleaners' interest in legislative activities, as well as provides testing services for products and training for employees.

State Fabricare Institutes

Many states or regions have trade associations that are affiliated with the International Fabricare Institute. For more information call the IFI.

Textile Care Allied Trade Association, Inc. (TCATA)
200 Broadacres Drive
Bloomfield, NJ 07003
Tel: (201) 338-7700 Contact: David Cotter

TCATA has existed since 1920 and represents manufacturers and distributors of commercial laundry and dry cleaning equipment and supplies. There are currently 275 members. Its primary concern is addressing issues that affect the industry's allied trades exclusively. The association provides newsletters to its members; coordinates an annual convention; co-sponsors a biennial trade show; and provides information on machinery requirements and certain market information.

Fabricare Legislative And Regulatory Education (FLARE)
P.O. Box 5157
Naperville, IL 60567-5157
Tel: (708) 416-6221 Contact: Manfred Wentz

FLARE is a volunteer organization led by members of International Fabricare Institute, Neighborhood Cleaners Association, R.R. Streets and Co.(a dry cleaning supply company), and the Textile Care Allied Trade Association. FLARE is committed to ensuring favorable treatment by local media and providing representation at all levels of government. The majority of their attention currently is given to environmental legislation and regulation affecting the fabric care industry; however, the FLARE organization is designed to address a much broader spectrum of legislation and regulation as well as public relations issues affecting the industry.

Center for Emission Control (CEC)
2001 L Street, N.W.
Suite 506A
Washington, DC 20036
Tel: (202) 785-4374 Contact: Steve Risotto

The CEC is an independent not-for-profit organization established in October 1990 to act as a clearinghouse for information about, and to encourage the development and use of, safe and effective work practices, process modifications, control technologies, and other methods to reduce emissions of chlorinated solvent. The CEC has developed a control option document on solvent applications in the dry cleaning industry. The organizations also may undertake and support research and development projects for the creation or application of new technologies or products that will reduce emissions of chlorinated solvents.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the Dry Cleaning Industry a list of publications and contacts are provided below:

Contacts[f]

Name	Organization	Telephone	Subject
Joyce Chandler	EPA/OECA	(202)564-7073	Regulatory requirements and compliance assistance
Ohad Jehassi	EPA/OPPT	(202)260-6911	Design for the Environment
George Smith	EPA/OAQPS	(919)541-1549	Regulatory requirements (air)

OECA: Office of Enforcement and Compliance Assurance
OAQPS: Office of Air Quality Planning and Standards
OPPT: Office of Pollution Prevention and Toxics

General Profile

Brown, Richard R. 1993. TVS Emission Reduction Technology for Dry cleaning. Presented at the Air and Waste Management Association, 86th Annual Meeting and Exhibition, Denver Colorado. 1993.

Proceedings of the International Roundtable on Pollution Prevention and Control in the Dry Cleaning Industry, United States Environmental Protection Agency, EPA/774/R-92/002.

Environmental Reporter, 1992. EPA solicitation of comment, notice of information availability on unregulated perchloroethylene emissions from dry cleaning industry. Bureau of National Affairs, Inc., Washington, D.C. October 9.

International Fabricare Institute. 1988. (IFI, 1988). Fundamentals of Dry cleaning.

International Fabricare Institute. 1989. (IFI, 1989). Equipment and Plant Operations Survey. Focus on Dry cleaning. Vol 13(1). March.

Meijer. 1995. Personal communication between Jon Meijer, IFI and Alice Tome, Abt Associates. April.

SRRP. 1990. Source Reduction and Recycling of Halogenated Solvents in the Dry Cleaning Industry-Technical Support Document.

[f] Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Smith. 1995. Memorandum from George Smith, Office of Air Quality Planning and Standards, USEPA to Joyce Chandler, Office of Enforcement and Compliance Assurance, USEPA, May 30.

Torp, Richard. 1994. Personal communication between Richard Torp of the Coin Laundry Association and Alice Tome of Abt Associates, Inc. February.

U.S. Environmental Protection Agency. 1982. (USEPA, 1982). Petroleum Dry Cleaners Background Information for Proposed Standards. Draft EIS. EPA 450/3-82-012a. Office of Air Quality Planning and Standards, USEPA, November.

U.S. Environmental Protection Agency. 1990. (USEPA, 1990). Drycleaning and Laundry Plants, RCRA information sheet, EPA/530-SW-90-027b.

U.S. Environmental Protection Agency. 1991a. (USEPA, 1991a). Dry Cleaning Facilities - Background Information for Proposed Facilities. Draft EIS. EPA-450/3-91-020a. Office of Air Quality, Planning and Standards, U. S. Environmental Protection Agency. November.

U.S. Environmental Protection Agency. 1991b. (USEPA, 1991b). Economic impact analysis of regulatory controls in the dry cleaning industry. Final. EPA-450/3-91-021. Office of Air Quality, Planning and Standards, U. S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 1993a. Economic Analysis of Regulatory Controls in the Dry Cleaning Industry. Final. EPA 450/3-91-021b. September.

U.S. Environmental Protection Agency. 1993b. (USEPA, 1993b). National Emission Standards for Hazardous Air Pollutants for Source Categories - PCE Dry Cleaning Facilities, Final Rule (58 FR 49354).

Trade Journals

American Drycleaner published monthly by American Trade Magazines, Chicago, Illinois.

The National Clothesline published monthly by BPS Communications, Philadelphia, Pennsylvania.

Drycleaners News published by Zackin Publications, Inc. Waterbury, Connecticut.

Process Descriptions and Chemical Use Profiles

Kirk-Othmer Encyclopedia of Chemical Technology. 1984. Drycleaning and Laundering.

Regulatory Profile

Department of Environmental Conservation New York State. (Undated) Draft Part 232 Dry Cleaning Inspection Report. Form listing the information required for a complete facility audit.

R0074933

U.S. Environmental Protection Agency. 1993c. (USEPA, 1993c). Multiprocess Wet Cleaning: Cost Performance Comparison of Conventional Dry Cleaning and an Alternative Process, Office of Pollution Prevention and Toxics, EPA 744-R-93-004, September.

Wolf, Katy, 1992. Case Study: Pollution Prevention in the Dry Cleaning Industry: A Small Business Challenge for the 1990s. Pollution Prevention Review, Summer.

Health Effects

U.S. Department of Health, Education and Welfare, National Institute of Occupational Safety and Health. 1976. Criteria for a recommended standard. Occupation Exposure to Tetrachloroethylene (Perchloroethylene). HEW Publication No. (NIOSH) 76-185.

U.S. Environmental Protection Agency. 1992. Proceedings of the International Roundtable on Pollution Prevention and Control in the Drycleaning Industry. Fact sheet: Air Contamination Above Dry Cleaners. EPA/774/R-92/002.

Pollution Prevention

U.S. Environmental Protection Agency. USEPA 1989. Solvent Waste Reduction Alternatives. EPA/625/4-89/021.

U.S. Environmental Protection Agency. USEPA 1991c. Preventing Pollution in the Dry Cleaning Business. USEPA Region I Groundwater Management Section and USEPA Headquarters, Office of Groundwater and Drinking Water. (Contains list of contacts for Region I)

Tennessee Department of Environment and Conservation et al. (Undated.) Clearing the Air on Clean Air: Strategies for Perc Dry Cleaners Compliance, Risk Reduction and Pollution Prevention. (Contains a state by state listing of contacts for help on air regulation compliance.)

[Note that several publications by OPPT's Design for the Environment Program on alternative dry cleaning technologies are expected in 1995. Contact: Ohad Jehassi, 202-260-6911, for publication dates.]

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy! VISA MasterCard DISCOVER NOVUS

Order Processing Code
* 3212

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Qty.	Stock Number	**Published in 1995** Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	**Published in 1997** Title	Price Each	Total Price
	055–000–00570–2	Air Transportation Industry, 90 pages	$ 7.50	
	055–000–00571–1	Ground Transportation Industry, 130 pages	10.00	
	055–000–00572–9	Water Transportation Industry, 90 pages	7.50	
	055–000–00573–7	Metal Casting Industry, 150 pages	13.00	
	055–000–00574–5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055–000–00575–3	Plastic Resin & Man–made Fiber Industry, 180 pages	15.00	
	055–000–00576–1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055–000–00577–0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055–000–00578–8	Textile Industry, 130 pages	10.00	
	055–000–00579–6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account ________ –

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

________ (expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0074936

EPA

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2221A)

EPA 310-R-95-002
September 1995

EPA

Profile Of The Electronics And Computer Industry

SECTOR EPA NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-002

EPA Office of Compliance Sector Notebook Project

PROFILE OF THE ELECTRONICS AND COMPUTER INDUSTRY

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048269-0

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviro$ense Bulletin Board and via Internet on the Enviro$ense World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, EPA. Photographs courtesy of Automata Company, Sterling, VA. Special thanks to Emad Youssef.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh.1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

ELECTRONICS AND COMPUTER INDUSTRY
(SIC 36)
TABLE OF CONTENTS

Page

ELECTRONICS AND COMPUTER INDUSTRY
(SIC 36)
TABLE OF CONTENTS (CONT'D)

ELECTRONICS AND COMPUTER INDUSTRY
(SIC 36)
TABLE OF CONTENTS (CONT'D)

ELECTRONICS AND COMPUTER INDUSTRY (SIC 36) EXHIBITS INDEX

ELECTRONICS AND COMPUTER INDUSTRY (SIC 36) EXHIBITS INDEX (CONT'D)

ELECTRONICS AND COMPUTER INDUSTRY (SIC 36) EXHIBITS INDEX (CONT'D)

Page

R0074948

ELECTRONICS AND COMPUTER INDUSTRY
(SIC 36)
LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation

ELECTRONICS AND COMPUTER INDUSTRY
(SIC 36)
LIST OF ACRONYMS (CONT'D)

NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)
NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

ELECTRONICS AND COMPUTER INDUSTRY (SIC 36)

I. Introduction to the Sector Notebook Project

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE ELECTRONICS/COMPUTER INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Electronics/Computer industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The electronics/computer industry is classified by the U.S. Bureau of Census as SIC code 36. SIC 36 includes manufacturers of electrical distribution equipment, household appliances, communication equipment, electrical industrial apparatus, radio and television receiving equipment, electronic components and accessories, electrical wiring and lighting equipment, and other electrical equipment and supplies. The electronics/computer industry is comprised of five major sectors: telecommunications, computers, industrial electronics, consumer electronics, and semiconductors. Many segments of the electronics/computer industry are interdependent and share common manufacturing processes.

The Department of Commerce provides the following three-digit breakout for industries in SIC 36:

- SIC 361 - Transformers
- SIC 362 - Motors/Generators
- SIC 363 - Household Appliances
- SIC 364 - Electrical Wiring and Lighting Equipment
- SIC 365 - Household Audio and Video Equipment and Audio Recordings
- SIC 366 - Communication Equipment
- SIC 367 - Printed Wiring Boards (also commonly called Printed Circuit Boards), Semiconductors, Integrated Circuits, and Cathode Ray Tubes
- SIC 369 - Storage Batteries, Primary Batteries (wet and dry).

In 1988, the U.S. Bureau of Census reclassified some of the manufacturing of computer parts, such as semiconductors, printed wiring boards, and integrated microcircuits, and included them with the component industries in SIC code 36. For the purpose of this profile, computer equipment (SIC 35) and the electronics/computer industry (SIC 36) have been combined because of the overlapping industry segments. Currently there is no SIC code for electronic assemblies manufactured by the electronic manufacturing services industry (EMSI), otherwise known as contract assemblies. Electronic assemblies are sometimes classified under SIC 3679 as indicated by the Institute for Interconnecting and Packaging Electronic Circuits (IPC).

Due to the vast size of the electronics and computer industries, this profile will focus on the distinct equipment and products that raise environmental concerns.

II.B. Characterization of the Electronics/Computer Industry

The electronics/computer industry produces a variety of products such as batteries, televisions, computer chips/components, and household appliances. During the manufacture of many of these products, chemicals are released into the environment. This profile will focus on three products:

SIC 3674 - Semiconductors and Related Devices
SIC 3672 - Printed Wiring Boards (PWBs)
SIC 3671 - Cathode Ray Tubes (CRTs).

The profile focuses on semiconductors and not integrated circuits because integrated circuits are used to produce semiconductors and most electronic devices manufactured today are multiple devices/circuit chips. Semiconductors, although accounting for only a small portion of total industry sales, are crucial to all electronic products and to the U.S. economy and pose numerous environmental concerns. PWBs and CRTs also raise environmental concerns from their manufacturing processes.

The following sections describe the size and geographic distribution, product characterization, and economic trends of the electronics/computer industry and specifically semiconductors, PWBs, and CRTs. The information provided in the following sections was compiled from a variety of sources including the Bureau of Census, documents developed by The World Bank, U.S. International Trade Commission, and the U.S. Department of Commerce.

II.B.1. Industry Size and Geographic Distribution

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Size Distribution

The U.S. has the largest electronics (including computer) workforce in the world, although Japan, the Republic of Korea, and other Asian nations are experiencing rapid growth in their electronics workforces. The size of the U.S. domestic electronics workforce for SIC 36 was estimated to be 2.39 million in 1991, while the number of worldwide employees was estimated to be four million. In addition, the electronics/computer industry is estimated to provide four million additional jobs to people who support and service U.S. electronics firms. The electronics/computer industry provides more jobs than any other manufacturing sector in the U.S., three times as many jobs as automotive manufacturing, and nine times more than the steel industry. The electronics/computer industry has not, however, experienced growth in domestic employment for the past two and one-half years. In fact, since 1989, the industry has lost 210,000 jobs.

IPC states that this stagnation in job growth is caused primarily by two factors: increased productivity and increased competition by foreign manufacturers that may have fewer government regulations. IPC also notes that the U.S. electronic manufacturing services industry or contract assembly industry is one of the fastest growing industries in the country, employing over 150,000 people.

The following exhibit lists the segments of the industry highlighted in this profile, as well as the number of facilities with fewer than and greater than 20 employees. Just under 50 percent of semiconductor and PWB manufacturing facilities have greater than 20 employees.

Exhibit 1
Facility Size Distribution of Electronics/Computer Industry

SIC Code	Number of Facilities with <20 Employees	Number of Facilities with > 20 Employees	Percentage of Facilities with > 20 Employees
3674 Semiconductors and Related Devices	484	439	48%
3672 Printed Wiring Boards	734	591	45%
3671 Cathode Ray Tubes	120	69	37%

Source: Based on 1992 Bureau of the Census data, Preliminary Report Industry Series.

Exhibit 2 lists the top ten electronics/computer industry companies worldwide according to a 1992 addition of *Electronic News*. The companies are listed in descending order of electronic sales during the latest available four quarters in 1992. Many of these top ten companies are not from the United States. However, a representative from the Electronic Industries Association (EIA) noted that many of these international companies have manufacturing facilities in the United States. Corporations that are among the top 25 in terms of electronic sales include AT&T, General Motors, Xerox, Apple Computer, Hewlett Packard, Motorola, and General Electric.

Exhibit 2
Top 10 Worldwide Electronics/Computer Industry Companies

Company Name	1992 Electronic Sales in Millions of Dollars
IBM	$53,600
Matsushita Electric	$48,668
Toshiba	$29,232
NEC	$28,375
Fujitsu	$25,879
Philips	$25,747
Hitachi	$25,107
Siemens	$24,550
Sony	$22,959
Alcatel Alsthom	$20,892

Source: Based on 1992 Electronic News.

Geographic Distribution

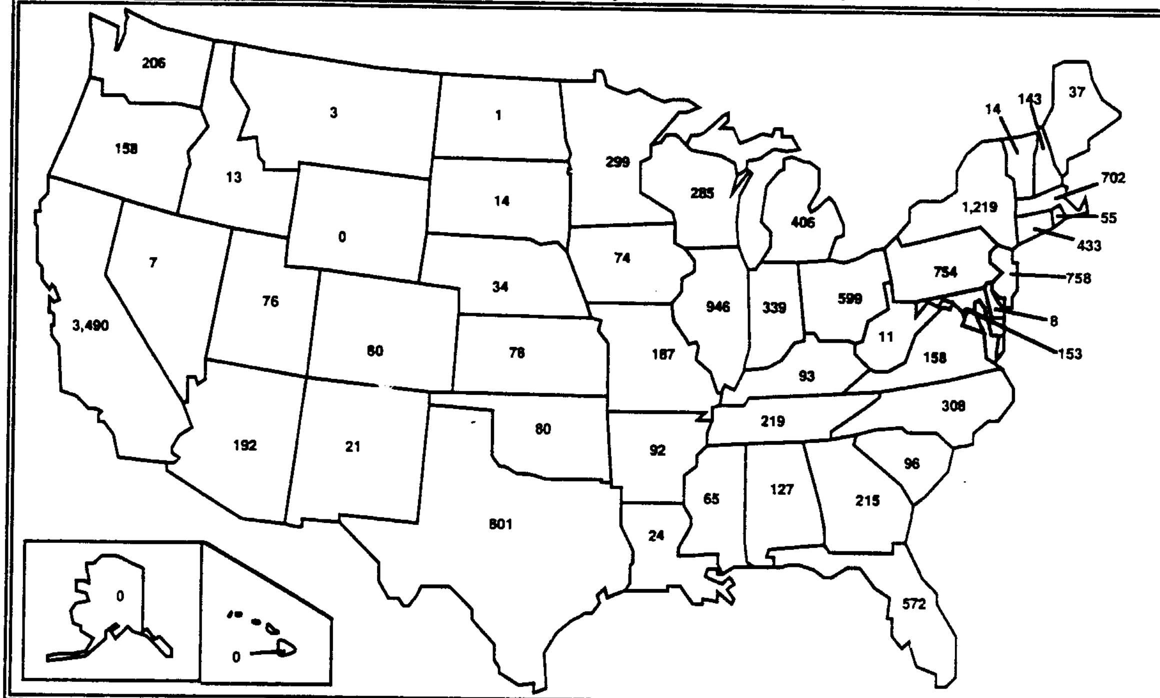
Exhibit 3 displays the number of electronics/computer industry facilities in each State for SIC 3671, 3672, and 3674. As seen in Exhibit 4, approximately 38 percent (3,689) of the facilities in the electronics/computer industry are located in EPA Region IX[1]. Region V has approximately 13 percent of the electronics/computer industry facilities. Across the U.S., approximately 60 percent of the facilities in the electronics/computer industry are located in six States: California (34 percent), Texas (6.5 percent), Massachusetts (6.4 percent), New York (4.5 percent), Illinois (4.4 percent), and Pennsylvania (4 percent).

The U.S. semiconductor industry is concentrated in California, New York, and Texas, specifically to be near primary users, transportation routes, utility and telecommunication infrastructures, and engineering experts. Texas, Oregon, and Colorado also received a large portion of capital investments by semiconductors producers during 1986-1992. Manufacturers have selected these States because of low tax rates, land values, and energy prices.

California has the largest concentration of industry workers, accounting for almost one-third of the semiconductor industry's employment. Texas, Arizona, New York, and Massachusetts also have high employment in the semiconductor industry. The majority of PWB manufacturers are located in Texas, California, Illinois, New York, Minnesota, and Massachusetts. According to Dun & Bradstreet, approximately 51 manufacturers produce cathode ray tubes (CRTs) in the U.S.; most of them are located in Illinois, Indiana, Ohio, Kentucky, Pennsylvania, and California (1994).

[1]EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

Exhibit 3
Geographic Distribution of and Number of Companies in the Electronics/Computer Industry (SIC 3671, 3672, and 3674)



Source: Based on 1992 Bureau of the Census data.

Exhibit 4
Percentage of Companies in the Electronics/Computer Industry (SIC 3671, 3672, and 3674) by Region

Region I:	10.8%	Region VI:	7.2%
Region II:	8.0%	Region VII:	1.4%
Region III:	6.0%	Region VIII:	3.4%
Region IV:	7.6%	Region IX:	37.6%
Region V:	13.1%	Region X:	4.8%

II.B.2. Product Characterization

Semiconductors

Although semiconductors account for only a small portion of electronics/computer industry sales, this product is crucial to all electronic products and to the U.S. economy. Semiconductors can serve one of two purposes: they act as a conductor, by guiding or

R0074959

moving an electrical current; or as an insulator, by preventing the passage of heat or electricity. Semiconductors are used in computers, consumer electronic products, telecommunication equipment, industrial machinery, transportation equipment, and military hardware. Typical functions of semiconductors in these products include information processing, display purposes, power handling, data storage, signal conditioning, and conversion between light and electrical energy sources. According to EPA's Design for the Environment (DfE) initiative, computers are the principal end use of semiconductors, constituting 40 percent of the market in 1992.

Printed Wiring Boards

Computers are also the major U.S. market for PWBs, with communications being the second largest application market. The Institute for Interconnecting and Packaging Electronic Circuits (IPC) indicates that nearly 39 percent of printed wiring boards produced in 1993 were used by the computer market, while 22 percent were used by the communication industry. PWBs and assemblies are used in many electronic products such as electronic toys, radios, television sets, electrical wiring in cars, guided-missile and airborne electronic equipment, computers, biotechnology, medical devices, digital imaging technology, and industrial control equipment.

Cathode Ray Tubes

According to EPA's Common Sense Initiative (CSI) subcommittee, the CRT industry produces tube glass, color picture tubes and single phosphor tubes, television sets, and computer displays. Currently, nearly all projection television tube and computer display manufacturers and the majority of CRT glass manufacturers are located outside the United States. Therefore, this CRT industry profile focuses on the production of color picture tubes, single phosphor tubes, and rebuilt tubes (collectively called CRTs and categorized under SIC 3671). These products are the video display component of televisions, computer displays, military and commercial radar, and other display devices.

II.B.3. Economic Trends

For the past two decades, worldwide production of electronics (including computers) has grown faster than any other industrial sector. The American Electronics Association (AEA) estimates that domestic sales of U.S. electronics companies increased from $127 billion to $306 billion during the period from 1980 to 1990. According to the U.S. Department of Commerce, the value of shipments (sale of computer products and services) in the computer industry declined during the 1990-1991 recession, but has experienced growth since then. The value of shipments increased two percent in 1993 to $8.3 billion and is expected to increase another two percent in 1994, to $8.48 billion. U.S. exports of the electronics/computer industry have increased at an average rate of 18 percent since 1977.

EIA indicates that the U.S. electronics/computer industry has experienced a 13 percent growth in production in 1994. Japan now holds the largest share of global consumer electronics production; 49 percent in 1990. Although the U.S. produced a little over 10 percent of global consumer electronics equipment, it is one of the two largest consumers of such products, with purchases totaling $33 billion in 1990.

Semiconductors

The U.S. semiconductor industry has experienced growth since 1992. The U.S. global market share of semiconductors, semiconductor processing equipment, and computer systems fell between 1980 to 1991. Japanese firms gained most of the market share lost by U.S. firms. Although the U.S. continues to be the world's largest consumer of electronics products, as a result of Japan's growth in consumer electronics production, Japan is now the world's largest consumer of semiconductors. The U.S. is the second largest market in the world for semiconductors, with consumption at $17.4 billion in 1990. The five largest U.S. producers are Motorola, Intel, Texas Instruments, National Semiconductor, and Advanced Micro Devices. According to the Department of Commerce, the value of shipments of U.S. semiconductors is estimated to be $37.6 billion in 1993 and is expected to grow 12 percent in 1994 to over $42.1 billion.

Printed Wiring Boards/Electronic Assemblies

Japan and the U.S. now have equal market shares, 27 percent each. IPC notes that the U.S. was the largest PWB market in the world with a value of approximately $5.5 billion in 1993. According to the Department of Commerce, the value of printed wiring board shipments produced in the U.S. was $6.75 billion in 1993 and is expected to grow by three percent, to $6.95 billion, in 1994. According to IPC, the U.S. electronic manufacturing services industry or contract assemblies industry generates over $9 billion in revenue.

Cathode Ray Tubes

According to 1994 U.S. Industrial Outlook data, the total value of CRT shipments was $3 billion in 1993 and is expected to increase six percent to $3.2 billion in 1994. The total value of CRT shipments is expected to increase more than 3.5 percent per year due to a projected rising demand for television sets and computer displays.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the electronics/computer industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the processes. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Electronics/Computer Industry

The products discussed in this section, semiconductors, printed wiring boards (PWBs), and cathode ray tubes (CRTs), pose significant environmental concerns during the manufacturing processes and/or comprise a large portion of the electronics/computer industry. This section will describe and distinguish these products as well as the steps followed to manufacture them. This discussion also includes an explanation of the wastes generated during the manufacturing processes.

III.A.1. Semiconductor Manufacturing

Semiconductors are made of a solid crystalline material, usually silicone, formed into a simple diode or many integrated circuits. A simple diode is an individual circuit that performs a single function affecting the flow of electrical current. Integrated circuits combine two or more diodes. Up to several thousand integrated circuits can be formed on the wafer, although 200-300 integrated circuits are usually formed. The area on the wafer occupied by integrated circuits is called a chip or die.

Information in this section is from a variety of sources including the following: U.S. EPA's DfE initiative, U.S. EPA Common Sense Initiative (CSI), California Department of Toxic Substances Control, McGraw Hill Encyclopedia of Science and Technology, *Integrated Circuits, Making the Miracle Chip, Microchip Fabrication: A Practical Guide to Semiconductor Processing*, and Microelectronics and Computer Technology Corporation (MCC). The semiconductor manufacturing process is complex and may require that several of the steps be repeated to complete the process. To simplify this discussion, the process has been broken down into five steps:

- Design
- Crystal processing
- Wafer fabrication
- Final layering and cleaning
- Assembly.

The primary reason that semiconductors fail is contamination, particularly the presence of any microscopic residue (including chemicals or dust) on the surface of the base material or circuit path. Therefore, a clean environment is essential to the manufacture of semiconductors. Cleaning operations precede and follow many of the manufacturing process steps. Wet processing, during which semiconductor devices are repeatedly dipped, immersed, or sprayed with solutions, is commonly used to minimize the risk of contamination.

Step One: Design

As with any manufacturing process, the need for a particular type of product must be identified and process specifications must be developed to address that need. In the case of semiconductors, the circuit is designed using computer modeling techniques. Computer simulation is used to develop and test layouts of the circuit path. Then, patterning "masks," which are like stencils, are fabricated, manufacturing equipment is selected, and operating conditions are set. All of these steps occur prior to actually producing a semiconductor.

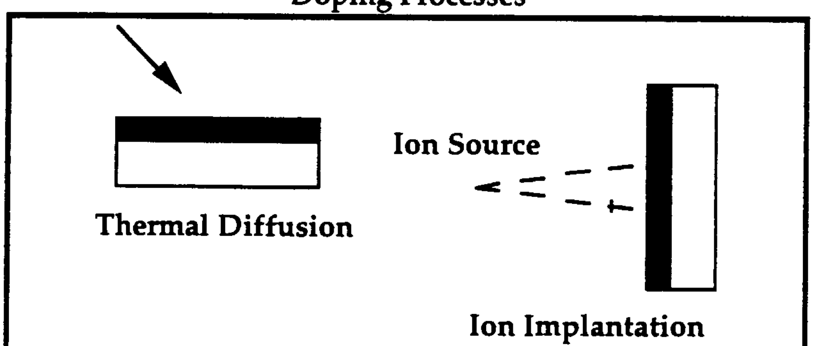
Step Two: Crystal Processing

Wafers, which consist of thin sheets of crystalline material, are the starting point of semiconductor production. Silicon, in the form of ingots, is the primary crystalline material used in the production of 99 percent of all semiconductors. Silicon crystals are actually "grown" using controlled techniques to ensure a uniform crystalline structure. Because crystals of pure silicon are poor electrical conductors, controlled amounts of chemical impurities or **dopants** are added during the development of silicon ingots to enhance their semiconducting properties. Dopants are typically applied using **diffusion** or **ion implantation** processes (See Exhibit 5). Dopants eventually form the circuits that carry the flow of current.

- Diffusion is a chemical process which exposes the regions of the silicon surface to vapors of the metal additive (dopant) while maintaining high temperatures. The process ends when the additives (represented by the arrow in Exhibit 5) migrate to the proper depth and reach the appropriate concentration in the silicon wafer.

- Ion implantation is a process that allows for greater control of the location and concentration of dopants added to the wafer. Metal dopants are ionized and accelerated to a high speed. As shown in Exhibit 5, the ions penetrate the silicon surface and leave a distribution of the dopant.

Exhibit 5
Doping Processes



Source: Based on 1990 Microchip Fabrication: A Practical Guide to Semiconductor Processing.

Either doping process can be used in semiconductor manufacturing. Antimony, arsenic, phosphorus, and boron compounds are the dopant materials most commonly used for silicon-based semiconductors. Other dopants include aluminum, gallium, gold, beryllium, germanium, magnesium, silicon, tin, and tellurium. Wastes including antimony, arsenic, phosphorus, and boron may be generated in the wastewater as a result of ion implantation or diffusion. Excess dopant gases, contaminated carrier gases, and outgassed dopant gases from semiconductor materials may also be generated.

Most semiconductor manufacturers obtain single crystal silicon ingots from other firms. Ingots are sliced into round wafers approximately 0.76 mm (0.03 inches) thick and then **rinsed**. The wafers are further prepared by mechanical or chemical means. A wafer's surface may be **mechanically ground**, **smoothed**, and **polished**, as well as **chemically etched** so that the surface is smooth and free of oxides and contaminants. Chemical etching removes organic contaminants using cleaning solvents and removes damaged surfaces using acid solutions. Chemical etching is usually followed by a **deionized water rinse** and **drying** with compressed air or nitrogen. In some cases, bare silicon wafers are cleaned using ultrasound techniques, which involve potassium chromate or other mildly alkaline solutions.

Etching is a method of cutting into, or imprinting on, the surface of a material. Several etching processes can be used on semiconductors, as well as integrated circuits and printed wiring boards. Wet etching uses acid solutions to cut patterns into the metal. Dry etching involves reactive gases and is rapidly becoming the method of choice for high resolution. Dry etching processes use various halogenated or nonhalogenated gaseous compounds.

In the semiconductor industry, dry plasma etching, reactive ion etching, and ion milling processes are being developed to overcome the limitations of wet chemical etching. Dry plasma etching, the most advanced technique, allows for etching of fine lines and features without the loss of definition. This process forms a plasma above the surface to be etched by combining large amounts of energy with low pressure gases. The gases usually contain halogens.

Materials used during the wet etching process may include acids (sulfuric, phosphoric, hydrogen peroxide, nitric, hydrofluoric, and hydrochloric), ethylene glycol, hydroxide solutions, and solutions of ammonium, ferric, or potassium compounds. Materials used during the dry etching process may include chlorine, hydrogen bromide, carbon tetrafluoride, sulfur hexafluoride, trifluoromethane, fluorine, fluorocarbons, carbon tetrachloride, boron trichloride, hydrogen, oxygen, helium, and argon. Typical solvents and cleaning agents include acetone, deionized water, xylene, glycol ethers, and isopropyl alcohol. The most commonly used cleaning solution in semiconductor manufacturing includes a combination of hydrogen peroxide and sulfuric acid.

Acid fumes and organic solvent vapors may be released during cleaning, etching, resist drying, developing, and resist stripping operations. Hydrogen chloride vapors may also be released during the etching process.

Step Three: Wafer Fabrication

Wafers are usually fabricated in batches of 25 to 40. Wafer preparation begins with an **oxidation** step.

- Oxidation is a process in which a film of silicon dioxide is formed on the exterior surface of the silicon wafer. Thermal oxidation takes place in a tube furnace with controlled, high temperatures and a controlled atmosphere. Oxidation is a reaction between the silicon wafer surface and an oxidant gas such as oxygen or steam. This process may be needed as a preliminary step before diffusion or ion implantation (doping). This layer protects the wafer during further processing. Following oxidation, the wafer surface is thoroughly cleaned and dried.

Materials used during oxidation, include silicon dioxide, acids (hydrofluoric), and solvents. Materials such as oxygen, hydrogen chloride, nitrogen, trichloroethane, and trichloroethylene may also be used. Wastes that may be generated from this process include: organic solvent vapors from cleaning gases; rinsewaters with organic solvents from cleaning operations; spent solvents (including F003); and spent acids and solvents in the wastewater.

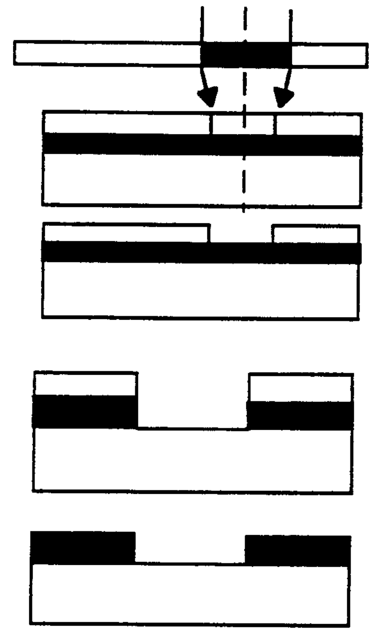
Next, patterns are imprinted onto the substrate using **photolithography** (also referred to as lithography) and **etching** processes. Photolithography is the most crucial step in semiconductor manufacturing because it sets a device's dimensions; incorrect patterns affect the electrical functions of the semiconductor.

- Photolithography is a process similar to photoprocessing techniques and other etching processes in that a pattern is imprinted. The silicon wafer is coated uniformly with a thin film of resist. A glass plate or mask is created with the circuit pattern, and the pattern is imprinted in one of several ways. One type of optical photolithography is the projection of x-rays through a special mask close to the silicon slice. Another type of optical photolithography, one that does not need a mask, is electron-beam direct patterning, which uses a controllable electron beam and an electron sensitive resist. Once the pattern is developed, some areas of the wafer are clear and the rest are covered with resist (See Exhibit 6).

Exhibit 6
Photolithography Process

Process Step	Purpose
1. Alignment and exposure	Precise alignment of mask to wafer and exposure to U.V. light. Negative resist is polymerized.
2. Development	Removal of unpolymerized resist.
3. Etch	Selective removal of top surface layer.
4. Photoresist Removal	Cleaning of photoresist from the wafer's surface.
5. Final Inspection	Inspection of wafer for correctness of image transfer from photoresist to top layer.

Cross Section



Source: Based on 1990 Microchip Fabrication: A Practical Guide to Semiconductor Processing.

Two types of photoresists can be used during semiconductor production:

- Positive photoresists are chemicals that are made more soluble, with regard to a solvent (i.e., developer), after exposure to radiation. During development, the developer removes the resist that was exposed to radiation.

- Negative photoresists are chemicals that polymerize and stabilize upon exposure to radiation. During development, the developer removes the resist that was protected from radiation.

After photolithography, chemical **developers** are used to remove unnecessary coatings or resist material that remains on the substrate. Development can be conducted by liquid methods (dip, manual immersion, or spray coating) or dry methods (plasma). The wafer is then **etched** in an acid solution to remove selected portions of the oxide layer to create depressions or patterns. The patterns are areas in which dopants will be applied. The wafer is **rinsed**, typically by immersing in a stripping solution to remove unwanted photoresist, and then dried. See Exhibit 7 for a list of materials used during the photolithography process.

Exhibit 7
Chemicals Used in Photolithography for Semiconductors

Photoresists	Developer	Solvents and Cleaning Agents
Positive:	**Positive:**	Deionized water
Ortho-diazoketone	Sodium hydroxide	Detergent
Polymethacrylate	Potassium hydroxide	Isopropyl alcohol
Polyfluoroalkylmethacrylate	Silicates	Acetone
Polyalkylaldehyde	Ethylene glycol	Ethanol
Polycyanoethylacrylate	Ethanolamine	Hydrofluoric acid
Polymethylmethacrylate	Isopropyl alcohol	Sulfuric acid
Poly (hexafluorobutylmeth-acrylate)	Phosphates	Hydrogen peroxide
	Tetramethyl-ammonium hydroxide	Hydrochloric acid
Negative:		Nitric acid
Isoprene	Alkyl amine	Chromic acid
Ethyl acrylate	Ethyl acetate	Ammonium hydroxide
Glycidylmetharcylate	Methyl isobutyl ketone	Hexamethyldisilazane
Copolymer-ethylacrylate		Xylene
	Negative:	Cellosolve acetate
	Xylene	n-Butyl acetate
	Aliphatic Hydrocarbons	Ethylbenzene
	N-Butyl acetate	Chlorofluorocarbons
	Cellosolve acetate	Chlorotoluene
	Isopropyl alcohol	Glycol ethers
	Stoddard solvent	
	Glycol ethers	

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Semiconductor Industry: Preliminary Draft.

During the next step, **dopants** are applied to the patterned wafer surface typically using diffusion or ion implantation. See Step two for a list of materials used and wastes generated during the doping process.

Additional layers of silicon may also be applied to the wafer using **deposition** techniques, typically epitaxial growth or chemical vapor deposition.

- Epitaxyl allows the growth of another layer of silicon on top of the wafer. A silicon layer is grown using high temperatures and dopant compounds. This top layer of

R0074969

silicon is where the final device will be formed. Not all semiconductors need this layer.

- Chemical vapor deposition deposits a thin coating on materials by a chemical process. Vapor deposition is a low pressure process that combines appropriate gases in a reactant chamber at elevated temperatures to produce a uniform film thickness.

Materials that may be used during deposition include silane, silicon tetrachloride, ammonia, nitrous oxide, tungsten hexafluoride, arsine, phosphine, diborane, nitrogen, and hydrogen.

Wastes that may be generated from these processes include: acid fumes from etching operations; organic solvent vapors from cleaning resist drying, developing, and resist stripping; hydrogen chloride vapors from etching; rinsewaters containing acids and organic solvents from cleaning, developing, etching, and resist stripping processes; rinsewaters from aqueous developing systems; spent etchant solutions; spent solvents (including F003) and spent acid baths.

Many products require that steps two through three be repeated several times in order to create the specified structure.

Step Four: Final Layering and Cleaning

Once the wafer is patterned, the wafer surface is coated with thin layers of metal by a process called **metallization**. These metal layers perform circuit functions within the finished semiconductor. External connections to the silicon wafer are provided by evaporation of thin metal films onto areas of the semiconductor chip surface in a vacuum. Almost every metal can be used to make this electrical connection to the silicon; aluminum, platinum, titanium, nickel/chromium, silver, copper, tungsten, gold, germanium, and tantalum are most common. Argon gas is also used in some operations. **Sputtering** and **high vacuum evaporation** are two types of metallization.

- Sputtering (also called partial vacuum evaporation) is a physical, rather than chemical process. This process occurs in a vacuum chamber which contains a target (solid slab of the film material) and the wafers. Argon gas is introduced in the chamber and ionized to a positive charge. The positively charged argon atoms accelerate toward and strike the target, dislodging the target atoms. The dislodged atoms are deposited onto the wafer surface. A uniform thickness of the coating is produced over the silicon slice.

- High vacuum evaporation is a process that uses an electron beam, a ceramic bar heated by thermal resistance, or a wire heated by electrical resistance. This method coats the surface of the wafer with metal.

Photolithography and etching are also used to remove any unnecessary metal using chlorinated solvents or acid solutions. Wastes generated include: acid fumes and organic solvent vapors from cleaning, etching, resist drying, developing, and resist stripping; liquid organic waste; aqueous metals; and wastewaters contaminated with spent cleaning solutions.

In the next step, **passivation** is used to apply a final layer of oxide over the wafer surface to provide a protective seal over the circuit. This coating protects the semiconductor from exterior influences and may range in thickness from a single layer of silicon dioxide to a relatively thick deposit of special glass. It also insulates the chip from unwanted contact with other external metal contacts. Materials used to form the passivation layer are silicon dioxide or silicon nitride.

After all layers have been applied to the wafer, the wafer is typically **rinsed** in deionized water. The back of the wafer is then mechanically ground (also called **lapping** or **backgrinding**) to remove unnecessary material. A film of gold may be applied to the back of the wafer by an evaporation process to aid the connection of leads to the bonding pads during a later process step.

Testing with alcohol compounds is conducted to ensure that each chip is performing the operation for which it was designed. Chips that do not meet specifications are marked with an ink droplet for discard during assembly operations. The wafer is cleaned again after testing, using solvents such as deionized water, isopropyl alcohol, acetone, and methanol.

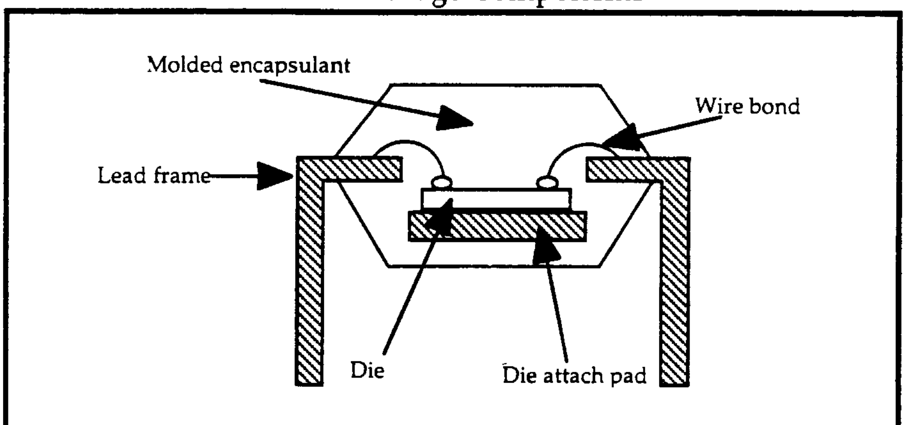
Wastes generated from these processes include: spent solvents and acids in the wastewater and rinsewater from cleaning, developing, etching, resist stripping, and rinsing processes; acid fumes and organic solvent vapors from cleaning, rinsing, resist drying, developing, and resist stripping; spent silicon dioxide or nitride; hydrogen chloride vapors from etching; rinsewaters from aqueous developing systems; spent etchant solutions; spent acid baths; and spent solvents.

Step Five: Assembly

Semiconductors are assembled by mounting chips onto a metal frame, connecting the chips to metal strips (leads), and enclosing the device to protect against mechanical shock and the external environment. There are many types of packaging; such as plastic or ceramic. Plastic packages comprised more than 90 percent of the market in 1990.

Each package contains five parts: the die (e.g., chip), the lead frame of the package, the die-attach pad, the wire bond, and the molded encapsulant (i.e., plastic housing) (See Exhibit 8). This section describes how plastic packages are assembled. All semiconductor packages whether plastic or ceramic share the same basic parts and are assembled using the same general processes.

Exhibit 8
Plastic Package Components



Source: Based on 1993 Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics Industry.

The lead frame consists of a rectangular-shaped metal frame connected to metal strips or leads. The leads connect the chip to the electronic product. Plastic package lead frames are fabricated from sheets of metal, either copper or alloy 42, that is either **punched** or **etched**. The lead frame and leads provide the connections for the electronic components.

- The punching process consists of an array of small mechanical punches that remove sections of the metal sheet until the lead frame is complete. The leads are cleaned with water-based cleaning systems. In the past, manufacturers used chlorinated fluorocarbons (CFCs) or other solvents to remove cutting fluids. The lead frame is coated with a layer

R0074972

of photoresist, exposed, and developed. The manufacturer etches the lead frame, removes the photoresist, and cleans the lead frame again with water based cleaning systems.

- If the lead frames are etched, the process is similar to that used during PWB manufacturing. Acids or metal chlorides are usually used during etching. Sometimes ammonia is used to stabilize the metal chloride. The photoresist contains solvents (such as trichloroethylene or TCE) that are baked out and generate VOC emissions. Developers that are typically used include either an amine or metal hydroxide. Once the photoresist is removed, it is cleaned with solvents such as a mild hydrochloric acid (HCL) solution or with a brightener that contains sulfuric acid.

Wastes generated during punching or etching may include: spent organic vapors generated from cleaning, resist drying, developing, and resist stripping; spent cleaning solutions; rinsewaters contaminated with organic solvents; and spent aqueous developing solutions. Scrap copper or alloy 42 may be recycled during the punching process.

The chip is then **attached** to an "attach pad," with a substance such as an epoxy material (thermoset plastic). Once mounted, the chips are inspected. The chip parts are bonded to the leads of the package with tiny gold or aluminum wires. A package may have between 2 and 48 wire bonds. The assembly is cleaned and inspected again. The combined components are then placed into a **molding press**, which encases the chip, wire bonds, and portions of the leads in plastic. The plastic-molding compound used in the press contains primarily fused silica. After the molding compound cures and cools around the package, the package is heated again to ensure that the plastic is completely cured. Excess material is removed using a chemical or mechanical **deflash** process. M-Pyrol is one organic solvent used during the deflash process. The final steps in package fabrication include **trimming** and **forming** the leads.

Waste generated during these steps includes excess epoxy/thermoset plastic; antimony trioxide (from the molding process); and spent organic solvents. Excess gold or aluminum from trimming processes can be reclaimed and reused.

Final computer tests are conducted to evaluate whether the product meets specifications. Even though the chips are produced using the same process, some may work better (e.g., faster) than others. As a result, packages are separated into low- and high-quality circuits. Often, low-quality circuits can still be sold. Final process steps include marking the circuits with a product brand. The finished product is then packaged, labeled, and shipped according to customer specifications.

III.A.2. Printed Wiring Board Manufacturing

Printed wiring boards (PWBs) are the physical structures on which electronic components such as semiconductors and capacitors are mounted. The combination of PWBs and electronic components is an electronic assembly or printed wiring assembly (PWA). According to Microelectronics and Computer Technology Corporation's (MCC) *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry,* PWB manufacturing is the most chemical intensive process in the building of a computer workstation.

PWBs are subdivided into single-sided, double-sided, multilayer, and flexible boards. Multilayer boards are manufactured similarly to single and double-sided boards, except that conducting circuits are etched on both the external and internal layers. Multilayer boards allow for increased complexity and density. PWBs are produced using three methods: additive, subtractive, or semi-additive technology. The subtractive process accounts for a significant majority, perhaps 80 percent, of PWB manufacturing.

The conventional subtractive manufacturing process begins with a board, consisting of epoxy resin and fiberglass, onto which patterns are imaged. In most operations, conducting material, usually copper, is bonded onto the substrate surface to form copper-clad laminate. After drilling holes through the laminate and making those holes conductive, unwanted copper is etched off, leaving copper patterns. The patterns on the board form the electric circuits that conduct electricity. Multilayer boards typically use metals such as platinum, palladium, and copper to form electric circuits. Specialized PWBs may use nickel, silver, or gold.

Additive technology is used less often than substractive technology because it is a more difficult and costly production process. This capital-intensive technology is used primarily for small interconnection components used in multi-chip devices. The production process begins with a base plate upon which a dielectric material is deposited. An interconnecting layer of copper is plated onto the dielectric layer which connects the layers of dielectric material and copper. Copper posts are plated-up and another layer of dielectric material is deposited exposing the posts. The next interconnect layer is plated and makes contact with the posts. Layers of dielectric material, copper, and copper posts are added to complete the interconnect. A lithographic process, similar to the one used in semiconductor manufacturing, diminishes the spaces and widths of the PWB.

This section provides a simplified discussion of the steps commonly performed during conventional subtractive manufacturing. The actual steps and materials used by a PWB manufacturer vary depending on customer requirements and the product being manufactured. The information provided in this section comes from various sources, including documents developed by MCC, IPC, EPA's Center for Environmental Research Information, EPA's DfE Program, California Department of Toxic Substances, EPA's CSI, and EPA's Office of Research and Development. PWB manufacturing can be grouped into five steps:

- Board preparation
- Application of conductive coatings (plating)
- Soldering
- Fabrication
- Assembly.

Step One: Board Preparation

Board preparation begins with a **lamination** process. Two-side etched copper dielectric boards (consisting usually of fiberglass and epoxy resin) are separated by an insulating layer and laminated or bonded together, usually by heat and pressure. Photographic tools are used to transfer the circuit pattern to the PWB, and computer control programs are used to control the drilling, routing, and testing equipment. Preparing the copper-clad board involves **drilling** holes to establish an electrical path between the layers and to mount components. The boards are then mechanically **cleaned** to remove drilling wastes (i.e., fine particulate contaminants, such as copper). Vapor degreasing, abrasive cleaning, chemical cleaning with alkaline solutions, acid dips, and water rinses are techniques used to clean the boards and prepare them for the next process, **electroless plating**. See Exhibit 9 for a list of materials used during lamination, drilling, and cleaning processes.

Exhibit 9
Chemicals Used in Lamination, Drilling, and Cleaning

Lamination	Drilling	Cleaning
Epoxies	Sulfuric Acid Potassium Permanganate Ammonium bifluoride Oxygen Fluorocarbon gas	Acetone 1,1,1-Trichloroethane Silica (and other abrasives) Sulfuric acid Ammonium hydroxide Hydrochloric acid

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

Wastes generated include: airborne particulates, acid fumes, and organic vapors from cleaning, surface preparation, and drilling; spent acid and alkaline solutions; spent developing solutions, spent etchants, and waste rinsewaters in the wastewater; and scrap board materials and sludges from wastewater treatment. Drilling and routing dust (copper, aluminum, and gold) are collected and recycled.

Step Two: Electroless Plating

The first process in this step is to prepare the surfaces of the drilled holes. The holes are prepared by an etchback process to remove smeared epoxy resin and other contaminants using one of the following: sulfuric or hydrochloric acid; potassium permanganate; or carbon tetrafluoride, oxygen and nitrogen. The holes are then coated with a material such as copper or graphite carbon, by a chemical process called **electroless plating.**

Electroless plating coats a uniform conducting layer of copper or other material on the entire surface including the barrels of the holes of the prepared board without outside power sources. According to *Printed Circuit Board Basics*, this coating of copper is not thick enough to carry an electrical current, but provides a base upon which additional copper can be deposited electrolytically. According to DfE, copper is the industry standard, but many are switching to direct metallization processes. Chemical deposition is the technique used to coat the board. After the electroless plating, the boards are dried to prevent the board from oxidation (e.g., rusting). The board may also be cleaned to prepare for a following electroplating processing. See Exhibit 12 for a list of materials used. Waste generated include: spent electroless copper baths; spent catalyst solutions; spent acid solutions; waste rinsewaters; and sludges from wastewater treatment.

Step Three: Imaging

During imaging, circuit patterns are transferred onto the boards through **photolithography** or a **stencil printing** process. Photoresist (i.e., a light sensitive chemical) is applied to the board in areas where the circuit pattern will not be set. The board is exposed to a radiation source and **developed** to remove the unwanted areas of the resist layer. Stencil printing uses a printing process, such as silk screening, to apply a protective film that forms the circuit pattern.

After photolithography, the boards are subjected to a light **etching** process, typically using ammoniacal etchants, to remove rust inhibitor (applied by the company that produced the material from which the board is made) or other metals (usually copper). After the stencil printing process, the protective film is dried, and the exposed copper is etched away. Sulfuric acid and hydrogen peroxide are common etchants used during imaging. After plating or etching, the photoresist is removed with an photoresist stripper.

See Exhibits 10 and 11 for a list of materials used during photolithography and etching processes. Wastes generated during the cleaning and etching processes include: RCRA listed F001, F002, F003, F004, and F005 depending on the concentration of the spent solvents and the mixture of spent halogenated and non-halogenated solvents; spent resist material; and wastewater containing metals (copper). Other wastes generated include organic vapors and acid fumes, spent developing solutions, spent resist material, spent etchant, spend acid solutions, and sludges from waste water treatment.

Exhibit 10
Chemicals Used in Photolithography for Printed Wiring Boards

Resists	Photopolymer Developers	Photopolymer Strippers
Mylar Vinyl Photoresists	Isopropyl alcohol Potassium bicarbonate Sodium bicarbonate 1,1,1-Trichloroethane Amines Glycol ethers	Sodium hydroxide Potassium hydroxide Methylene chloride

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

Exhibit 11
Materials Used During Etching

Ammonia	Cupric chloride	Nickel	Permanganates
Ammonium chloride	Hydrochloric acid	Nickel chloride	Sodium citrate
Ammonium hydroxide	Hydrofluoric acid	Nickel sulfamate	Sodium hydroxide
Ammonium persulfate	Hydrogen peroxide	Nitrate	Stannous chloride
Ammonium sulfate	Lead	Nitric acid	Sulfuric acid
Boric acid		Nitrogen	Tin
Carbon tetrafluoride		Orthophosphate	
Chlorine		Oxygen	
		Peptone	

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

Step Four: Electroplating

Electroplating is a process in which a metal is deposited on a substrate through electrochemical reactions. Electroplating is required to build up the thickness and strength of the conducting layers to provide reliable electrical conductivity between inner layers or from one side of the PWB to the other. Electroplating can also protect against corrosion, wear, or erosion. This process involves immersing the article to be coated/plated into a bath containing acids, bases, or salts. The industry standard for this process is copper, although many are switching to direct metallization techniques according to DfE.

The **electroplating** process for PWBs usually begins with the copper laminate which is coated with a plating resist (**photolithography**), by stenciling, leaving the area exposed to form the circuit pattern. The resist prevents the conductive material from adhering to other areas of the board and forms the circuit pattern.

The PWB plating process typically uses as copper and tin-lead as plating materials, although silver, nickel, or gold can be used. Copper in a plating bath solution is deposited to a sufficient thickness, and a solvent or aqueous solution is applied to remove the plating resist. The copper coating forms interconnections between the layers and provides electrical contact for electronic parts mounted or assembled on the PWB surface. PWB manufacturers then typically electroplate a tin or tin-lead solder on the board to protect the circuit pattern during the following etching or stripping processes. An acid etch solution (ammoniacal, peroxide solutions, sodium persulfate, cupric chloride, or ferric chloride) removes the exposed copper foil, leaving the thicker copper plating to form the circuit pattern. Ammoniacal and cupric chloride are the primary etchants used by PWB manufacturers. Fluoroboric acid is used in the tin-lead plating process to keep the metals dissolved in the solution and to ensure a consistent deposition of the tin-lead alloy onto the circuit board.

After the plating bath, the board is **rinsed** with water, scrubbed, and then dried to remove the copper, spray etch solutions, and other materials. Rinsing ends the chemical reactions during plating and prevents contamination or dragout from being released in the next bath or rinse water (dragout is the plating solution that sticks to parts after taken out of the plating bath). Dragout can occur in any bath step, not just in one plating bath. The tin-lead layer is generally removed and the panel is electrically tested for discontinuities in the electrical pathway and shorts. See Exhibit 12 for a list of materials used during the electroplating process.

Exhibit 12
Materials Used in Copper and Tin-Lead Electro- and Electroless Plating Processes

Type of Plating	Electroplating Chemicals	Electroless Chemicals
Copper	Copper pyrophosphate Orthophosphate Pyrophosphate Nitrates Ammonia Acid copper Copper sulfate Sulfuric acid	Hydrochloric acid Palladium chloride Stannous chloride Metallic tin pellets Sodium hydroxide Copper sulfate Formaldehyde
Tin-Lead	Tin-Lead Fluoroboric acid Boric acid Peptone	Tin chloride Sodium hypophosphite Sodium citrate

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

The primary RCRA hazardous wastes generated during plating include: photoresist skins, F006 sludge from plating wastewater treatment, D008, F007, and F008 from plating and etching; spent acid solutions, waste rinsewaters, spent developing solutions, spent etchant, and spent plating baths in the wastewater; organic vapors from spent developing solution and spent resist removal solution; and acid and ammonia fumes. According to IPC, photoresist skins or the stripped resist material are exempt from categorical F006 classification if the skins stripping is separate from electroplating and if the boards are rinsed and dried.

Step Five: Soldering Coating

Solder coating is used to add solder to PWB copper component before component assembly. Fabricators use several methods of solder coating, but all of them involve dipping the panel into molten solder. The solder, an alloy consisting of 60 percent tin and 40 percent lead, coats the pads and holes not covered by solder mask. The excess solder is removed with a blast of hot oil or hot air. However, the hot oil or hot air does not remove the solder that has formed a chemical (intermetallic) bond with the copper. The removal of the excess solder is called "solder leveling." The most common process is hot-air leveling. According to *Printed Circuit Board Basics: Quick and Easy Guide*, final solder coating thicknesses of 50 to 1,200 microinches can be achieved with most solder-leveling processes. Solder is only applied to desired areas so there is no metal or "objectionable fluid" discharged to the wastestream, according to MCC. MCC considers it to be the most environmental friendly solder application method.

Step Six: Electrical and Mechanical Testing

A cross section is cut from a sample panel from each lot using a grinding process called **routing,** and the plated holes are examined with a photomicrograph. Individual circuit boards are cut out of panels that pass quality control. Routing generates dust which may contain copper, lead, or other metals plated to the panel, but the dust is recycled. Electrical tests, dimensional and visual inspections, and quality audits are performed to ensure compliance with customer requirements. Finally, the finished PWBs are packaged, labeled, and shipped to the customer which in most cases is the original equipment manufacturer (OEM) or contract electronic assembly company.

Step Seven: Printed Wiring Board Assembly and Soldering

After the PWBs are manufactured, the electrical components are attached during **assembly**. Adhesives are applied to the boards, and then the components are attached and soldered to the boards. Components are attached to the PWB by a process called **soldering**. There are several different kinds of soldering processes, including wave, dip, and drag. In wave soldering, the PWA is passed over the crest of a wave of molten solder, thereby permanently attaching the components to the board. A type of chemical known as "flux" is used before soldering to facilitate the production of the solder connection. Not only does flux clean the surface and remove oxidized material, it prevents oxidation from occurring during the solder process. After the solder has been applied, flux residue may be removed from the board. According to a leading PWB manufacturer, deionized water instead of CFCs (such as Freon 113) and trichloroethane (TCA), are now used to remove flux. Although the residue may not affect the PWB's performance, it may lower the board's cosmetic quality. After soldering, the board may be cleaned and dried. Many assemblies, however, are looking at no-clean soldering operations.

The wastes generated during assembly include: solder dross, post-solder scrap boards, filters, gloves, rags, and spent gaseous or semi-gaseous solvents from cleaning processes. The wastes that may be generated during soldering, flux application, and cleaning include: organic vapors and CFCs (although CFC usage will be eliminated by 1996); copper, lead, spent solvents, and spent deionized water into the wastewater; solder dross; and wastewater treatment sludge. Solder dross is primarily oxidized solder skin that forms on any molten solder exposed to oxygen and can be recycled off-site.

III.A.3. Cathode Ray Tube Manufacturing

Cathode Ray Tubes (CRTs) have four major components: the glass panel (faceplate), shadow mask (aperture), electron gun (mount), and glass funnel. The glass funnel protects the electron gun and forms the back end of the CRT. In response to electrical signals, the electron gun emits electrons that excite the screen. The shadow mask forms a pattern on the screen. The shadow mask itself is a steel panel with a mask pattern applied through one of several kinds of photolithography.

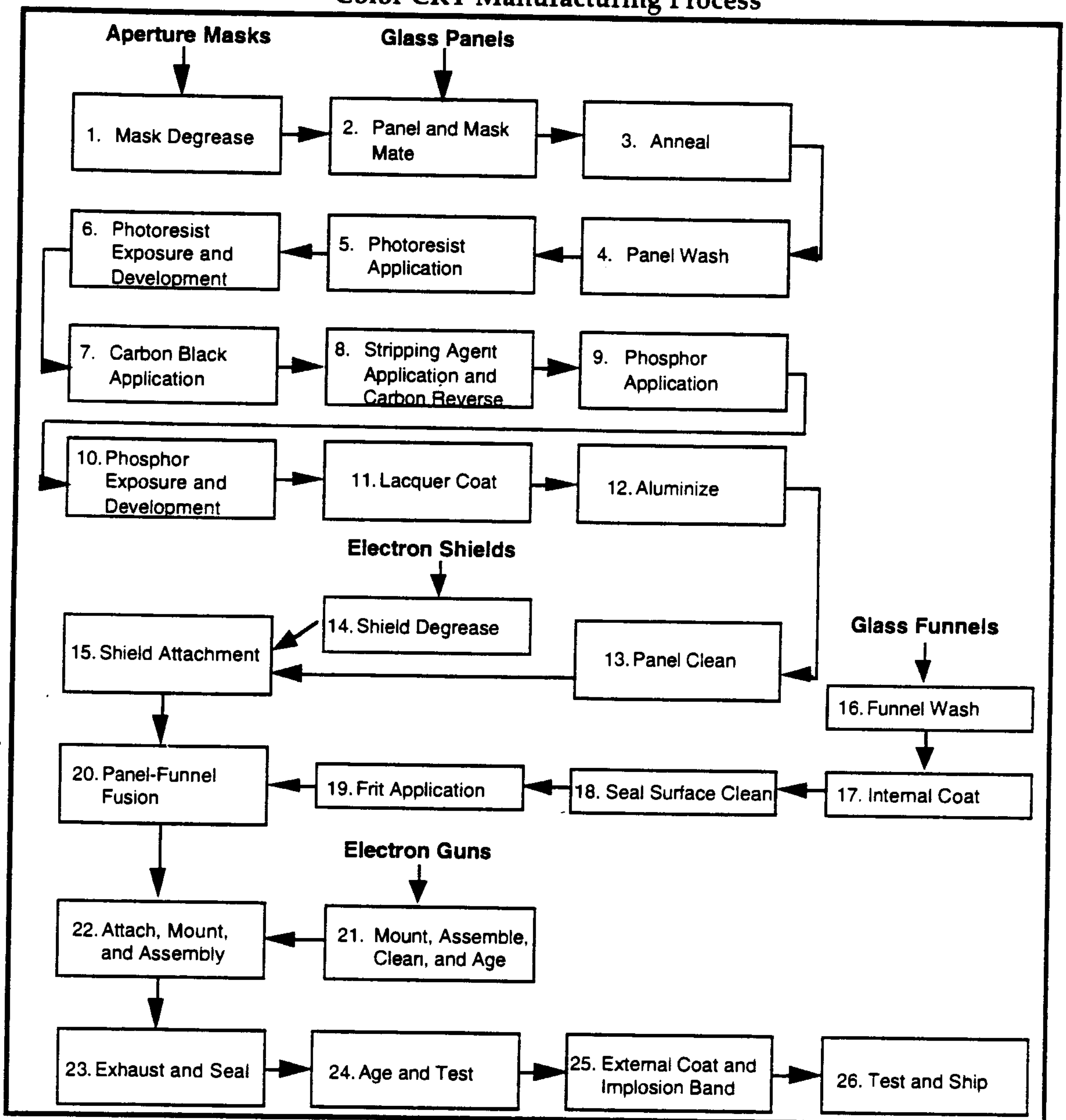
This section summarizes the manufacturing process for color CRTs. Information used to describe CRT manufacturing comes from a variety of sources such as MCC, EPA's Common Sense Initiative (CSI), Corporate Environmental Engineering, and EPA's Effluent Guideline Division. For this discussion, the process is grouped into six steps:

- Preparation of the glass panel and shadow mask
- Application of the coating to the glass panel interior
- Installation of the electron shield
- Preparation of the funnel and joining to the glass panel/shadow mask assembly
- Installation of the electron gun
- Finishing.

Color CRTs

Exhibit 13 presents the steps for manufacturing a color CRT. The names of the operations may vary by manufacturer, but the basic processing sequence is identical in all color CRT manufacturing facilities. Lead in CRT display components and end-of-life concerns have been the most significant environmental issues in CRT manufacturing.

Exhibit 13
Color CRT Manufacturing Process



Source: *Based on 1995 EPA Common Sense Initiative (CSI) documents.*

R0074983

Step One: Preparation of the Panel and Shadow Mask

The shadow mask is constructed from a thin layer of aluminum steel (referred to as a flat mask) which is etched with many small slits or holes, and a metal frame that supports the flat mask. The shadow mask serves as a template for preparing a pattern on the glass panel surface. Shadow masks are commonly manufactured overseas and shipped to CRT manufacturers in the United States. The shadow mask is then **molded** to match the contour of the glass panel's interior surface and "blackened" in an oven to provide corrosion resistance. Finally, the shadow mask is **welded** to a blackened metal frame, usually steel, that provides support. Degreasing solvents and caustics are frequently used for **cleaning** the shadow mask assembly and production equipment. Oils are used for lubricating the press and other production equipment.

The front end glass panel is purchased from a glass manufacturer and shipped to the CRT manufacturer. Metal "pins," provided as part of the glass panel, are attached to the inside of the glass to serve as connection points for the shadow mask.

The shadow mask is carefully positioned inside the glass panel. Steel springs are then placed over the pins in the glass panel and attached to "hook-plates" or "clips" located on the mask assembly frame. With the glass panel and shadow mask assembly positions fixed in relation to each other, the springs are **welded** to the hook-plates. The glass panel and mask must remain as a matched pair through the remaining processes. The glass panel and shadow mask preparation operation frequently uses organic solvents or caustic cleaners for degreasing, oil for equipment maintenance, and oxidizers, such as hydrogen peroxide, for cleaning reclaimed masks.

Wastes generated during this step include spent solvents in the wastewater, vapors from solvent degreasing tanks, and waste glass from breakage.

Step Two: Application of Coating to Panel Interior

For the panel-mask to create images, a special coating is applied to the interior surface through a process called screening. Screening, the most complex part of the manufacturing process, is comparable to a photographic development process.

The screening operation begins with a **panel wash**. The mask is removed and the glass panel is washed to remove dust, oil, grease, and other contamination. The glass panel wash commonly uses

R0074984

acids and caustics followed by deionized water rinses for cleaning the glass.

The glass panel undergoes the **carbon stripe** process, which uses organic photoresist, chromate, deionized water, dilute acids and oxidizers, carbon slurry with binding agents, and surfactants to produce the black and clear striped pattern called the "black matrix." The clear areas will eventually be filled with color-producing phosphors. The glass panels are coated with a photoresist, which contains chromate (a toxic heavy metal compound) as a catalyzer. The panel is spun to even out the photoresist and then dried.

The shadow mask is re-inserted in the glass panel and a series of exposures are made on the panel surface using ultraviolet (UV) light in a **photolithography** process. The light passes through the mask openings to imprint the mask pattern on the photoresist. The mask also shadows the areas of the photoresist that will not be exposed. When UV light contacts the photoresist, polymerization occurs, and the exposed areas become less soluble in water than the non-exposed areas.

After the exposure, the shadow mask is removed and the glass panel is sprayed with water to remove the non-polymerized material. The imprinted pattern of exposed photoresist remains on the glass panel. The glass panel is then coated and developed again. The resulting image is essentially a "negative image" of the original photoresist exposure pattern.

During the **phosphor stripe** process, three phosphor colors (green, blue, and red) are used to make a color CRT and are applied using the same steps as the carbon stripe process. The phosphor stripe process uses various chemicals, including phosphor slurries containing metals (such as zinc compounds) and organic photoresists, chromate, deionized water, dilute oxidizers, and surfactants. The phosphor materials that are spun off the panels and removed in the developers are recovered and reclaimed either onsite or by a phosphor vendor. The reclaiming process involves the use of acids and caustics, chelating agents, and surfactants.

Two **coatings** are then added to the glass panel, which now has the black matrix and the three phosphor colors on it: lacquer (a wax-like layer) to smooth and seal the inside surface of the screen, and aluminum to enhance brightness. The panel is then ready to be joined to the back end of the CRT, known as the funnel. In preparation for joining, the panel edges must be **cleaned** to remove all traces of contaminants. A clean edge is critical to ensuring a good panel-to-seal connection in the finished CRT. The shadow mask and glass panel are reattached. Chemicals used in these processes include organic solvents and alcohol, caustics, silica-based coatings, aluminum, acids, ammonia, and deionized water. The material removed in the cleaning process is sent to a smelter to recover metals and sulfites.

Wastes generated during this step include: vapors from the lacquer area; wastewater containing deionized water, acids, oxidizers, carbon slurry, surfactants, chromate, phosphor solutions, chelating agents, caustics, organic solvents, alcohol, silica-based coatings, ammonia, zinc, and aluminum; process cooling waters, liquid wastes from precipitation, washing, filtration, and scrubber blowdown; lacquer wastes from spun off and over-sprayed lacquer; and lacquer remaining in lacquer containers.

Step Three: Installation of the Electron Shield

Most CRT manufacturers employ an internal **electron shield** to prevent stray electrons from reaching outside the screen area. Computer monitor CRTs often use external shielding, which is installed on the outside of the CRT's glass bulb. Before installation, the shields are cleaned with degreasing solvents or caustic cleaners. The internal-type electron shield is made of thin aluminum and is typically **welded** to the shadow mask assembly before the panel and shadow mask are connected with the funnel. Metal (steel) springs are also **welded** to the mask frame at this time. The springs provide an electrical connection between the mask and the funnel interior surface. Wastes generated from these processes include electron shield degrease wastewaters and metals from the welding.

Step Four: Preparation of the Funnel and Joining to Panel-Mask Assembly

The back end of the CRT (funnel) is purchased from a glass vendor and washed prior to use. The funnel is made of high lead content glass and the resulting wash water contains elevated lead levels. After the funnel is **washed**, the interior surface is **coated** with a black graphite coating which is a good electrical conductor and a non-reflective coating. The seal edge of the funnel is **cleaned** to facilitate bonding with the panel, and **frit** or **solder** glass is applied in a bead along the entire surface of the seal edge. The frit, approximately 70 percent lead, has the consistency of toothpaste or caulking. The viscosity of the frit is controlled by the addition of organic solvents. The frit serves as an adhesive to join the panel-mask assembly to the funnel.

After the frit is applied, the panel-mask assembly is connected to the funnel, and the whole glass package is placed in a positioning clamp to hold the two parts in place. The connected panel-mask and funnel assembly is then exposed to high temperatures in an oven to fuse the frit joint between the panel and funnel at the seal edges. The frit forms a strong bond between the two pieces of glass. During the **frit-seal fusion** process, the organic chemicals from the screening operation and in the frit are "burned out" of the CRT. The organic materials must "burn" cleanly to minimize any remaining residue. Wastes generated include wastewaters contaminated with spent black graphic, lead, and chemicals associated with the funnel wash, frit application, and seal surface cleaning. Wastes generated include frit contaminated clothing, instruments and utensil used to prepare the frit, unusable frit glass, and waste glass from breakage.

Step Five: Installation of the Electron Gun

Each CRT contains three guns: one dedicated to each of the phosphor colors used in the screen (red, green, and blue). To produce an electron gun, several metal components are **assembled** and loaded onto spindles to align the various elements. Glass parts are placed into fixture blocks and **heated**. When the glass reaches the proper temperature, the metal parts are embedded in the glass. The combination of metal parts and glass make up the gun. The guns are **cleaned** with organic solvents or caustic cleaners before they are mounted in the neck of the CRT funnel. Materials commonly found in the gun assemblies include metals, high lead glass stem (for electrical connection feed-through and exhaust purposes), ribbon connectors, and other manufacturer-specific parts.

The gun assembly is then inserted in the neck of the CRT funnel. The gun is aligned and the CRT funnel neck is **fused** to the gun by rotating the parts in front of open flame burners. An additional component is **welded** to the gun assembly to allow for removal of gases from the electron gun in subsequent steps. Wastes generated from this step include waste glass from breakage and wastewaters contaminated with spent organic solvents and caustic cleaners from mount cleaning.

Step Six: Finishing

The CRT "bulb" is still open to the atmosphere after the gun mount is sealed in the neck of the funnel. To complete the tube, the gases are removed by applying a vacuum to the bulb. Organic solvents are used to clean and maintain the vacuum pumps.

The bulb is "aged" by an electronic treatment applied to the gun or mount. The CRT is then coated with an external carbon black paint, and a metal band is placed around the outside of the panel with adhesives for implosion protection and safety. The band also provides mounting brackets for installing the CRT. The finished tube is tested in a high voltage testing station, and the CRT tested thoroughly to ensure that it meets all specifications before shipment. Each tube is packaged prior to shipment to the customer. Wastes generated from finishing processes include spent solvents and VOC emissions.

In some cases where the bulb face needs a special application, such as reference lines for an oscilloscope, a separate panel and funnel are used. A photoresist and mask are used to apply the reference lines on the panel. The single phosphor is applied in the same way as for a one-piece bulb, using a settling solution that contains potassium silicate and, usually, an electrolyte.

Tube Salvage

Cathode ray tubes may or may not be salvaged. Picture tube salvage operations reclaim spent or rejected picture tubes and return them to production. Salvage operation processes include a panel-funnel acid defrit, acid cleaning of panels and funnels (i.e., nitric acid), and cleaning of the shadow mask. These reclaimed components are returned to the process for reuse or are returned to the glass manufacturer for recycling. A product with knocks, scratches, chips, etc., is repaired. New necks are spliced onto funnels. Electron guns are usually discarded. Glass that cannot be used because of serious defects is recycled back to a glass plant directly or is sent off-site for cleaning and segregation before going to a glass plant.

CRT technology is a mature and efficient process; however, the use of a new technology called Flat Panel Displays (FPD) is becoming more common. FPDs offer certain environmental advantages over CRTs because of the tenfold reduction in glass used and substantial power savings. Existing performance deficiencies, such as poorer screen brightness and substantially higher prices, are limiting the widespread incorporation of FPDs into electronics products.

III.B. Raw Materials Inputs and Pollution Outputs

Outputs from the electronics and computer industry manufacturing processes affect the land, air, and water. Exhibits 14-16 describe the wastes generated during each manufacturing process.

Exhibit 14
Semiconductor Pollution Outputs

Process	Air Emissions	Process Wastes (Liquids/Waste Waters)	Other Wastes (Solids/RCRA)
Crystal Preparation	Acid fumes, VOCs, dopant gases	Spent deionized water, spent solvents, spent alkaline cleaning solutions, spent acids, spent resist material	Silicon,
Wafer Fabrication	VOCs and dopant gases	Spent solvents, spent acids, aqueous metals, spent etchant solution, and spent aqueous developing solutions.	F003
Final Layering and Cleaning	Acid fumes and VOCs	Spent deionized water, spent solvents, spent acids, spent etchants, spent aqueous developing solutions, spent cleaning solutions, aqueous metals, and D007 (chromium).	Spent solvents
Assembly	VOCs	Spent cleaning solutions, spent solvents, aqueous developing solutions, and P & U wastes.	Spent epoxy material and spent solvents

Exhibit 15
Printed Wiring Board Pollution Outputs

Process	Air Emissions	Process Wastes (Liquids/Waste Waters)	Other Wastes (Solids/RCRA)
Board Preparation	Particulates, acid fumes, and VOCs	Spent acids and spent alkaline solutions	Sludge and scrap board material
Electroless Plating		Spent electroless copper baths, spent catalyst solutions, spent acid solutions	Waste rinse water and sludges from waste water treatment
Imaging	Organic vapors and acid fumes	Spent developing solutions, spent resist material, spent etchants, spent acid solutions, and aqueous metals	F001-5, depending on concentration and mixture of solvents. Sludges from waste water treatment
Electroplating	Acid fumes, ammonia fumes, and VOCs	D008 (lead), D002, D003, spent etchants, spent acid solutions, spent developing solutions, spent plating baths	F006, F007, and F008

Exhibit 15 (cont'd)
Printed Wiring Board Pollution Outputs

Process	Air Emissions	Process Wastes (Liquids/Waste Water)	Other Wastes (Solids/RCRA)
Solder Coating	VOCs and CFCs		
PWB Assembly And Soldering	VOCs and CFCs	Metals (nickel, silver, and copper), D008 (lead), flux residue, spent deionized water, spent solvents	Solder dross, scrap boards, filters, gloves, rags, waste water treatment sludge

Exhibit 16
Cathode Ray Tubes Pollution Outputs

Process	Air Emissions	Process Wastes (Liquid/Waste Waters)	Other Wastes (Solids/RCRA)
Preparation of the Panel and Shadow Mask	Solvent vapors	Spent solvents	Glass (lead) from breakage
Application of Coating to Panel Interior	Vapors from lacquer area	Spent photoresists, deionized water, acids, oxidizers, carbon slurry, surfactants, chromate, phosphor solutions, chelating agents, caustics, solvents, alcohol, coatings, ammonia, aluminum, and process cooling waters	Lacquer wastes
Installation of Electron Shield		Electron shield degrease and metals	
Preparation of Funnel and Joining to Panel-Mask Assembly		Funnel wash, seal surface cleaning, and frit application wastewaters	Frit contaminated clothing, instruments, utensils, unusable frit glass (lead), glass (lead) from break-age
Installation of Electron Gun		Spent solvents and caustic cleaners	Glass from breakage
Finishing	VOCs	Spent solvents	

R0074990

III.C. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and are meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 17 shows that the electronics/computer industry managed about 122 million pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 44 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 81 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (6.7 percent), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

R0074991

Exhibit 17
Source Reduction and Recycling Activity for SIC 36

A	B	C	D	E	F	G	H	I	J
			On-Site			Off-Site			
Year	Production Related Waste Volume (10^6 lbs.)	% Reported as Released and Transferred	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	Remaining Releases and Disposal
1992	121	49%	8.27%	0.41%	70.75%	3.21%	3.96%	4.83%	8.52%
1993	122	44%	9.38%	0.20%	72.12%	3.41%	3.77%	4.41%	6.70%
1994	121	—	7.63%	0.13%	74.99%	4.33%	3.88%	3.58%	5.44%
1995	129	—	8.87%	0.59%	74.45%	4.61%	3.65%	3.04%	4.78%

R0074992

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act (EPCRA), TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

R0074994

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Electronics/Computer Industry

The follow section provides TRI data for the semiconductor, printed wiring board (PWB) and cathode ray tube (CRT) industries. The manufacture of these products results in the release of similar substances, including solvents, acids, and heavy metals. The commonly released solvents include acetone, xylene, and methanol. Commonly released acids include sulfuric, hydrochloric, and nitric. A significant amount of ammonia is also released by the electronics/computer industry.

IV.A.1. TRI Data for Semiconductor Industry

The following exhibits present TRI data pertaining to semiconductor manufacturing. Exhibit 18 presents the top ten facilities in terms of TRI releases. Many of these companies are also among the top companies in terms of sales. Exhibit 19 presents the top TRI releasing facilities for all of electronics and other electric facilities. Exhibit 20 displays the number of TRI-reporting semiconductor manufacturing facilities per State. As expected, California and Texas contain the largest number of semiconductor manufacturing facilities.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported <u>only</u> the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, <u>and</u> one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 18
Top 10 TRI Releasing Semiconductor Manufacturing Facilities (SIC 3674)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	225,840	Micron Semiconductor Inc.	Boise	ID
2	203,120	Motorola Inc.	Mesa	AZ
3	159,465	Intel Corp.	Hillsboro	OR
4	142,256	Texas Instruments Inc.	Dallas	TX
5	138,950	AT&T Microelectronics	Reading	PA
6	134,208	Intel Corp.	Rio Rancho	NM
7	112,250	Advanced Micro Devices Inc.	Austin	TX
8	82,854	IBM Corp. E. Fishkill Facility	Hopewell Junction	NY
9	81,719	Dallas Semiconductor Corp.	Dallas	TX
10	80.545	Sgs-Thomson Microelectronics Inc.	Carrollton	TX

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 19
Top 10 TRI Releasing Electronics/Computer Industry Facilities

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
3671	861,508	Zenith Electronics Corp. Rauland Div.	Melrose Park	IL
3671	378,105	Philips Display Components Co.	Ottawa	OH
3469, 3674, 3089, 3694	297,150	Delco Electronics Corp. Bypass	Kokomo	IN
3672, 3471	274,950	Photocircuits Corp.	Glen Cove	NY
3671	257,954	Toshiba Display Devices Inc.	Horseheads	NY
3672	255,395	IBM Corp.	Endicott	NY
3674	225,840	Micron Semiconductor Inc.	Boise	ID
3674	203,120	Motorola Inc.	Mesa	AZ
3672	193,720	Hadco Corp. Owego Div.	Owego	NY
3674	159,465	Intel Corp.	Hillsboro	OR

Source: US EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0074997

Exhibit 20
TRI Reporting Semiconductor Manufacturing Facilities (SIC 3674) by State

State	Number of Facilities	State	Number of Facilities
AZ	9	OR	7
CA	56	PA	7
CO	4	PR	1
FL	2	RI	1
ID	3	SC	1
MA	9	TX	20
MD	2	UT	3
ME	1	VT	1
MN	4	WA	1
MO	1	WI	1
NC	2		
NH	2		
NM	2		
NY	6		
OH	4		

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibits 21 and 22 show the chemical releases and transfers for the semiconductor industry. Sulfuric acid and hydrochloric acid, two of the most commonly-released chemicals, are used during etching and cleaning processes. Solvents such as acetone, glycol ethers, xylene, and Freon 113 are used during photolithography and cleaning processes. 1,1,1-trichloroethane is used during oxidation and ammonia is used during photolithography and cleaning. A significant amount of methyl ethyl ketone is released during the degreasing and cleaning processes. Most of these solvents are released into the air. Facilities with zero releases of certain chemicals are reported here because transfers of the chemical may have been reported.

Exhibit 21
Releases for Semiconductor Manufacturing Facilities (SIC 3674) in TRI, by Number of Facilities (Releases Reported in Pounds/Year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Sulfuric Acid	125	13644	88209	17	250	139	102259	818
Hydrochloric Acid	78	8262	69429	3	0	10	77704	996
Hydrogen Fluoride	71	4940	55479	9902	0	5	70326	991
Phosphoric Acid	69	4039	25674	0	0	5	29718	431
Nitric Acid	57	5403	47628	23	0	5	53059	931
Acetone	53	121794	890290	1460	659	5	1014208	19136
Ammonia	42	42770	101717	42082	17805	8600	212974	5071
Glycol Ethers	27	41317	212900	500	0	82000	336717	12471
Xylene (Mixed Isomers)	25	9952	252661	0	139	0	262752	10510
Ethylene Glycol	16	1688	9316	1600	0	0	12604	788
Methanol	16	31049	135566	0	129	0	166744	10422
Freon 113	10	41211	73335	0	0	0	114546	11455
1,1,1-Trichloroethane	8	1691	82366	0	1	0	84058	10507
Methyl Ethyl Ketone	6	1332	128250	0	0	5	129587	21598
Tetrachloroethylene	4	514	55034	1	0	0	55549	13887
Ammonium Nitrate (Solution)	3	0	0	0	0	0	0	0
Ammonium Sulfate (Solution)	3	250	0	0	0	0	250	83
Lead	3	0	0	0	0	0	0	0
Phenol	3	50	2745	0	0	0	2795	932
Toluene	3	25170	33580	0	0	0	58750	19583
Trichloroethylene	3	14009	21896	0	0	0	35905	11968
Copper	2	0	0	12	0	0	12	6
Ethylbenzene	2	175	1300	0	0	0	1475	738
Methyl Isobutyl Ketone	2	750	9325	0	0	0	10075	5038
1,2-Dichlorobenzene	2	200	49234	0	0	0	49434	24717
1,2,4-Trichlorobenzene	2	0	6519	0	0	0	6519	3260
Antimony Compounds	1	18	5	1	0	0	24	24
Chlorine Dioxide	1	5	5	0	0	0	10	10
Cobalt Compounds	1	5	2	0	0	0	7	7
Isopropyl Alcohol (Manufacturing)	1	0	0	0	0	0	0	0
Lead Compounds	1	0	0	0	0	0	0	0
N-Butyl Alcohol	1	21	84	0	0	0	105	105
Nickel Compounds	1	0	0	0	0	0	0	0
Nitrilotriacetic Acid	1	5	5	0	0	0	10	10
P-Xylene	1	0	430	0	0	0	430	430
Totals	-------	370,264	2,352,984	55,601	18,983	90,774	2,888,606	-------

Source: US EPA, Toxics Release Inventory Database, 1993.

R0074999

Exhibit 22
Transfers for Semiconductor Manufacturing Facilities (SIC 3674) in TRI, by Number of Facilities (Transfers Reported in Pounds/Year)

Chemical Name	# Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfer per Facility
Sulfuric Acid	125	147449	500380	1039071	169372	0	1856272	14850
Hydrochloric Acid	78	236415	29599	21664	84745	5	372428	4775
Hydrogen Fluoride	71	11733	198630	525	151929	0	362817	5110
Phosphoric Acid	69	1103	269124	200000	33594	0	503821	7302
Nitric Acid	57	56177	99817	20910	62904	0	239808	4207
Acetone	53	104090	1582	136987	116610	1075656	1442137	27210
Ammonia	42	944298	52771	650	10806	0	1008525	24013
Glycol Ethers	27	30889	3345	139100	56330	1049440	1279104	47374
Xylene (Mixed Isomers)	25	3891	824	31304	127501	728688	892208	35688
Ethylene Glycol	16	458412	2027	15194	623	102016	578272	36142
Methanol	16	14474	0	27715	64502	716413	823104	51444
Freon 113	10	25	592	36937	2435	5660	45649	4565
1,1,1-Trichloroethane	8	263	5	75267	18264	8000	101799	12725
Methyl Ethyl Ketone	6	869	750	0	2105	276109	279833	46639
Tetrachloroethylene	4	0	0	10215	59628	53000	122843	30711
Ammonium Nitrate (Solution)	3	224302	0	0	0	0	224302	74767
Ammonium Sulfate (Solution)	3	1488462	0	122000	0	0	1610462	536821
Lead	3	0	1500	59125	13961	0	74586	24862
Phenol	3	2331	0	0	27	94679	97037	32346
Toluene	3	0	0	0	17000	5970	22970	7657
Trichloroethylene	3	0	0	59736	0	0	59736	19912
Copper	2	0	18	0	166	0	184	92
Ethylbenzene	2	0	146	0	190	16800	17136	8568
Methyl Isobutyl Ketone	2	0	0	0	9300	12190	21490	10745
1,2-Dichlorobenzene	2	10	0	0	2157	93600	95767	47884
1,2,4-Trichlorobenzene	2	1413	0	0	32273	0	33686	16843
Antimony Compounds	1	0	18100	0	0	0	18100	18100
Chlorine Dioxide	1	0	0	0	0	0	0	0
Cobalt Compounds	1	0	3780	0	0	0	3780	3780
Isopropyl Alcohol (Manufacturing)	1	5	0	10165	0	0	10170	10170
Lead Compounds	1	0	6630	0	0	0	6630	6630
N-Butyl Alcohol	1	10430	0	0	0	1433	11863	11863
Nickel Compounds	1	381	0	3574	0	0	3955	3955
Nitrilotriacetic Acid	1	0	0	0	0	0	0	0
P-Xylene	1	0	0	0	10380	0	10380	10380
Zinc Compounds	1	0	267300	0	0	0	267300	267300
Totals	-------	3,737,422	1,456,920	2,010,139	1,046,802	4,239,659	12,498,154	-------

Source: US EPA, Toxics Release Inventory Database, 1993.

IV.A.2. TRI Data for Printed Wiring Board Industry

The following exhibits present TRI data pertaining to PWB manufacturing. Exhibit 23 presents the top ten TRI-reporting PWB manufacturing facilities in terms of TRI releases. IBM is one of these companies which is also among the top ten electronics sales generating companies. Exhibit 24 displays the number of TRI-reporting facilities per State. California has the largest number of PWB manufacturing facilities.

Exhibit 23
Top 10 TRI Releasing Printed Wiring Board Manufacturing Facilities (SIC 3672)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	255,395	IBM Corp.	Endicott	NY
2	193,720	Hadco Corp. Oswego Div.	Oswego	NY
3	127,283	Continental Circuits Corp.	Phoenix	AZ
4	120,864	Thomson Consumer Electronics Inc.	Dunmore	PA
5	96,191	Hadco Corp.	Derry	NH
6	79,250	QLP Laminates Inc.	Anaheim	CA
7	74,653	Synthane-Taylor	La Verne	CA
8	68,456	Circuit-Wise Inc.	North Haven	CT
9	67,050	American Matsushita Electronics Corp.	Troy	OH
10	65,088	Pec Viktron	Orlando	FL

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 24
TRI Reporting Printed Wiring Board Manufacturing Facilities (SIC 3672) by State

State	Number of Facilities	State	Number of Facilities
AZ	9	NJ	3
CA	82	NY	8
CO	3	OH	7
CT	7	OK	1
FL	11	OR	6
GA	2	PA	5
IA	2	PR	4
IL	18	SC	2
IN	3	SD	1
KS	1	TX	8
MA	9	UT	4
MD	1	VA	3
MI	1	VT	1
MN	14	WA	6
MO	4	WI	4
NC	1		
NH	9		

Source: US EPA, Toxics Release Inventory Database, 1993.

R0075001

As seen in Exhibits 25 and 26, the top releases of acids from PWB facilities include sulfuric acid, hydrochloric acid, and nitric acid, all of which are used during cleaning, electroless plating and electroplating operations. Hydrochloric acid is also used during etching. The acids are primarily released to the air or recycled. Glycol ethers are released during image application and cleaning; most of the releases are emitted into the air. Freon 113 is used primarily for flux removal and is released into the air. Nearly all Freon 113 transfers are recycled. Acetone, a solvent used to clean the board before imaging, is released primarily into the air. Ammonium sulfate solution is used during electroplating, imaging, and etching processes and is released to the water or transferred to POTWs. Metals such as lead and copper are commonly used during electroplating, etching, and soldering (i.e., lead) processes. These metals and their compounds are primarily recycled.

Exhibit 25
Releases for Printed Wiring Board Manufacturing Facilities (SIC 3672) in TRI, by Number of Facilities (Releases Reported in Pounds/Year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Release per Facility
Sulfuric Acid	208	25640	98477	0	0	250	124367	598
Ammonia	117	80332	480081	28029	0	0	588442	5029
Copper	89	1345	1860	27	0	8500	11732	132
Copper Compounds	73	6830	7532	1831	0	9739	25932	355
Hydrochloric Acid	70	13268	40342	32189	0	27	85826	1226
Nitric Acid	59	7572	12750	0	0	0	20322	344
Glycol Ethers	25	82099	132118	23057	0	0	237274	9491
Formaldehyde	22	3225	14912	255	0	0	18392	836
Chlorine	16	1545	5992	50	0	0	7587	474
Lead	12	250	750	5	0	3500	4505	375
Acetone	10	117974	70711	0	0	0	188685	18869
Freon 113	9	83258	37550	0	0	0	120808	13423
Lead Compounds	7	760	1260	252	0	0	2272	325
Ammonium Sulfate (Solution)	6	0	0	100000	0	0	100000	16667
Methyl Ethyl Ketone	6	13770	25023	0	0	0	38793	6466
Phosphoric Acid	6	510	505	0	0	0	1015	169
Methanol	5	62978	7394	0	0	0	70372	14074
Dichloromethane	4	51269	125288	5	0	0	176562	44141
1,1,1-Trichloroethane	3	24930	8310	0	0	0	33240	11080
2-Methoxyethanol	3	5000	40960	0	0	0	45960	15320
Hydrogen Fluoride	2	0	250	0	0	0	250	125
Nickel	2	0	0	0	0	0	0	0
Toluene	2	29425	14125	0	0	0	43550	21775
Zinc Compounds	2	750	0	0	0	0	750	375
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Barium Compounds	1	250	0	0	0	0	250	250
Ethylbenzene	1	250	2600	0	0	0	2850	2850
Ethylene Glycol	1	600	1200	0	0	0	1800	1800

R0075002

Exhibit 25 (cont'd)
Releases for Printed Wiring Board Manufacturing Facilities (SIC 3672) in TRI, by Number of Facilities (Releases Reported in Pounds/Year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Isopropyl Alcohol (Manufacturing)	1	0	0	0	0	0	0	0
Methylenebis (Phenylisocyanate)	1	0	0	0	0	0	0	0
Phenol	1	750	750	250	0	0	1750	1750
Silver	1	0	0	.	0	0	0	0
Tetrachloroethylene	1	12900	22300	0	0	0	35200	35200
Trichloroethylene	1	14920	26000	0	0	0	40920	40920
Xylene (Mixed Isomers)	1	1000	16560	0	0	0	17560	17560
1,2-Dichlorobenzene	1	1800	2130	0	0	0	3930	3930
Totals	-------	**645,200**	**1,197,730**	**185,950**	**0**	**22,016**	**2,050,896**	-------

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 26
Transfers for Printed Wiring Board Manufacturing Facilities (SIC 3672) in TRI, by Number of Facilities (Transfers Reported in Pounds/Year)

Chemical Name	# Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Sulfuric Acid	208	34596	15558	85488	456242	28400	620284	2982
Ammonia	117	412348	2513	6102550	212950	0	6730361	57524
Copper	89	18527	77880	5159806	104791	0	5361004	60236
Copper Compounds	73	31441	101998	7949551	263240	0	8346230	114332
Hydrochloric Acid	70	1317	750	1056064	1453601	3100	2514832	35926
Nitric Acid	59	265	8500	169722	202665	0	381152	6460
Glycol Ethers	25	475285	1350	6974	240182	21792	745583	29823
Formaldehyde	22	64501	0	0	2500	0	67001	3046
Chlorine	16	655	0	94152	111000	0	205807	12863
Lead	12	1025	13297	268496	4231	40	287089	23924
Acetone	10	2100	45	3000	1600	188153	194898	19490
Freon 113	9	250	0	77460	1700	5	79415	8824
Lead Compounds	7	1559	14454	92233	5125	0	113371	16196
Ammonium Sulfate (Solution)	6	338933	0	0	0	0	338933	56489
Methyl Ethyl Ketone	6	0	250	0	750	397048	398048	66341
Phosphoric Acid	6	250	0	0	460	0	710	118
Methanol	5	41902	170	0	10746	0	52818	10564
Dichloromethane	4	253	0	71940	2526	38970	113689	28422
1,1,1-Trichloroethane	3	0	0	115750	1410	8180	125340	41780
2-Methoxyethanol	3	0	0	0	0	12250	12250	4083
Hydrogen Fluoride	2	0	0	0	5600	0	5600	2800
Nickel	2	251	0	381	0	0	632	316
Toluene	2	8905	0	0	0	121600	130505	65253
Zinc Compounds	2	4334	10876	0	1087	0	16297	8149
Ammonium Nitrate (Solution)	1	73000	0	0	0	0	73000	73000
Barium Compounds	1	0	500	0	0	0	500	500

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 26 (cont'd)
Transfers for Printed Wiring Board Manufacturing Facilities (SIC 3672) in TRI, by Number of Facilities (Transfers Reported in pounds/year)

Chemical Name	# Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfer per Facility
Ethylbenzene	1	0	5	0	500	117430	117935	117935
Ethylene Glycol	1	9300	230	0	0	0	9530	9530
Isopropyl Alcohol (Manufacturing)	1	0	3900	0	5460	0	9360	9360
Methylenebis (Phenylisocyanate)	1	0	0	0	16800	0	16800	16800
Phenol	1	0	0	0	10340	22870	33210	33210
Silver	1	0	0	3	0	0	3	3
Tetrachloroethylene	1	0	0	0	1091590	49020	1140610	1140610
Trichloroethylene	1	0	0	0	61600	0	61600	61600
Xylene (Mixed Isomers)	1	0	250	0	2360	559310	561920	561920
1,2-Dichlorobenzene	1	0	0	0	0	109810	109810	109810
Totals	-------	**1,524,043**	**252,526**	**21,253,570**	**4,271,056**	**1,677,978**	**28,976,127**	-------

Source: US EPA, Toxics Release Inventory Database, 1993.

IV.A.3. TRI Data for Cathode Ray Tube Industry

Exhibits 27 present the top ten TRI-reporting CRT manufacturers in terms of releases, and Exhibit 28 presents the number of TRI reporting CRT manufacturing facilities by State. It is not surprising that few facilities are reported in TRI because most manufacturing occurs outside the United States. Exhibits 29 and 30 show TRI releases and transfers per chemical. As expected, a significant amount of lead (used during the frit sealing process) is released, much of which is transferred off-site for disposal and recycling. Zinc compounds are used during the phosphor stripe process and are transferred for recycling. Nitric acid, which is used during tube salvaging, is released into the air. Freon 113 is used as a cleaning agent during panel shadow mask preparation and is also released into the air. Solvents (i.e., acetone, methyl ethyl ketone, toluene, and methanol) are used for cleaning and degreasing and are released primarily into the air or transferred for recycling.

R0075004

Exhibit 27
Top 10 TRI Releasing Cathode Ray Tube Manufacturing Facilities (SIC 3671)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	861,508	Zenith Electronics Corp., Rauland Div.	Melrose Park	IL
2	378,105	Philips Display Components Co.	Ottawa	OH
3	257,954	Toshiba Display Devices Inc.	Horseheads	NY
4	78,756	Varian X-Ray Tube Prods.	Salt Lake City	UT
5	47,000	Richardson Electronics Ltd.	Lafox	IL
6	43,055	Thomson Consumer Electronics	Marion	IN
7	42,323	Varian Assoc. Inc. Power Grid Tube Prods.	San Carlos	CA
8	24,901	Clinton Electronics Corp.	Loves Park	IL
9	21,613	Hitachi Electronic Devices USA Inc.	Greenville	SC
10	6,250	ITT Corp., ITT Electron Technology Div.	Easton	PA

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 28
TRI Reporting Cathode Ray Tube Manufacturing Facilities (SIC 3671) by State

State	Number of Facilities
CA	1
IL	4
IN	2
KY	1
MA	1
NY	1
OH	1
PA	2
RI	1
SC	1
UT	1

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 29
Releases for Cathode Ray Tube Manufacturing Facilities (SIC 3671) in TRI, by Number of Facilities (Releases Reported in Pounds/Year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Average Releases per Facility
Hydrochloric Acid	9	359	589	0	0	0	948	105
Acetone	8	121559	102405	0	0	0	223964	27996
Nitric Acid	8	2767	77073	0	0	0	79840	9980
Lead Compounds	7	99	2637	435	0	0	3171	453
Sulfuric Acid	7	1580	152	0	0	0	1732	247
Methanol	6	41906	35307	1550	0	0	78763	13127
Trichloroethylene	6	151543	393048	0	0	0	544591	90765
Barium Compounds	5	6	5	476	0	0	487	97
Hydrogen Fluoride	5	1760	4175	0	0	0	5935	1187
Toluene	5	38856	480286	1681	0	0	520823	104165
Zinc Compounds	4	205	5017	164	0	0	5386	1347
Copper	3	10	255	65	0	0	330	110
Ammonia	2	1069	8411	3103	0	0	12583	6292
Arsenic Compounds	2	0	0	2	0	0	2	1
Freon 113	2	34718	5227	0	0	0	39945	19973
Methyl Ethyl Ketone	2	72778	54045	0	0	0	126823	63412
1,1,1-Trichloroethane	2	1484	35983	5	0	0	37472	18736
Chromium Compounds	1	0	0	146	0	0	146	146
Copper Compounds	1	10	200	5	0	0	215	215
Methyl Isobutyl Ketone	1	139	13777	0	0	01	13916	13916
Methylenebis (Phenylisocyanate)	1	0	0	0	0	0	0	0
Nickel	1	5	5	0	0	0	10	10
Nickel Compounds	1	0	0	50	0	0	50	50
Tetrachloroethylene	1	0	0	0	0	0	0	0
Xylene (Mixed Isomers)	1	70	70418	0	0	0	70488	70488
Totals	-------	470,923	1,289,015	7,682	0	1	1,767,620	-------

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 30
Transfers for Cathode Ray Tube Manufacturing Facilities (SIC 3671) in TRI, by Number of Facilities (Transfers Reported in Pounds/Year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Hydrochloric Acid	9	250	0	0	250	0	500	56
Acetone	8	173	0	21712	60	38674	60619	7577
Nitric Acid	8	0	0	0	333274	0	333274	41659
Lead Compounds	7	1175	1924617	487010	137506	0	2550308	364330
Sulfuric Acid	7	0	0	250	20639	0	20889	2984
Methanol	6	202029	0	64240	5000	5820	277089	46182
Trichloroethylene	6	250	0	151155	150000	0	301405	50234
Barium Compounds	5	255	295228	138785	1850	0	436118	87224
Hydrogen Fluoride	5	39347	0	0	215536	0	254883	50977
Toluene	5	81	0	626179	277	106983	733520	146704
Zinc Compounds	4	1397	56654	212504	59710	0	330265	82566
Copper	3	61	279	80492	0	0	80832	26944
Ammonia	2	0	0	0	0	0	0	0
Arsenic Compounds	2	0	7388	7579	0	0	14967	7484
Freon 113	2	0	0	7170	0	0	7170	3585

Source: US EPA, Toxics Release Inventory Database, 1993.

R0075006

Exhibit 30 (cont'd)
Transfers for Cathode Ray Tube Manufacturing Facilities (SIC 3671) in TRI, by Number of Facilities (Transfers Reported in Pounds/Year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Methyl Ethyl Ketone	2	0	0	0	0	15549	15549	7775
1,1,1-Trichloroethane	2	7	0	10845	0	0	10852	5426
Chromium Compounds	1	0	162	2	0	0	164	164
Copper Compounds	1	45	0	68700	0	0	68745	68745
Methyl Isobutyl Ketone	1	0	0	0	0	1722	1722	1722
Methylenebis (Phenylisocyanate)	1	0	4192	0	0	0	4192	4192
Nickel	1	63	0	24146	0	0	24209	24209
Nickel Compounds	1	0	36	40260	0	0	40296	40296
Tetrachloroethylene	1	0	0	0	20600	0	20600	20600
Xylene (Mixed Isomers)	1	0	0	0	0	0	0	0
Totals	-------	245,133	2,288,556	1,941,029	944,702	168,748	5,588,168	-------

Source: US EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

R0075007

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[2]. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

The following chemicals are those released in the greatest quantity by the electronics/computer manufacturing industry:

Acetone
Ammonia
Dichloromethane
Freon 113
Glycol Ethers
Methanol
Methyl Ethyl Ketone
Sulfuric Acid
Toluene
Trichloroethylene
Xylene

[2] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

Acetone

Toxicity. Acetone is irritating to the eyes, nose, and throat. Symptoms of exposure to large quantities of acetone may include headache, unsteadiness, confusion, lassitude, drowsiness, vomiting, and respiratory depression.

Reactions of acetone (see environmental fate) in the lower atmosphere contribute to the formation of ground-level ozone. Ozone (a major component of urban smog) can affect the respiratory system, especially in sensitive individuals such as asthmatics or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released into water, acetone will be degraded by microorganisms or will evaporate into the atmosphere. Degradation by microorganisms will be the primary removal mechanism.

Acetone is highly volatile, and once it reaches the troposphere (lower atmosphere), it will react with other gases, contributing to the formation of ground-level ozone and other air pollutants. EPA is reevaluating acetone's reactivity in the lower atmosphere to determine whether this contribution is significant.

Physical Properties. Acetone is a volatile and flammable organic chemical.

Note: Acetone was removed from the list of TRI chemicals on June 16, 1995 (60 FR 31643) and will not be reported for 1994 or subsequent years.

Freon 113 (Trichlorotrifluoroethane)

Toxicity. No adverse human health effects are expected from ambient exposure to Freon 113. Inhalation of high concentrations of Freon 113 causes some deterioration of psychomotor performance (loss of ability to concentrate and a mild lethargy), and an irregular heartbeat. Chronic exposure to Freon 113 caused reversible weakness, pain, and tingling in the legs of one occupationally-exposed woman. There is some evidence of a higher incidence of coronary heart disease among hospital personnel and refrigerant mechanics exposed to fluorocarbons. Exposure to high concentrations of Freon 113 may cause eye and throat irritation.

Fluorocarbons are, however, considerably less toxic than the process materials used in their manufacture (e.g., chlorine). In addition, under certain conditions, fluorocarbon vapors may decompose on contact with flames or hot surfaces, creating the potential hazard of inhalation of toxic decomposition products.

Populations at increased risk from exposure to Freon 113 include people with existing skin disorders, and people with a history of cardiac arrhythmias.

The most significant toxic effect associated with Freon 113 is its role as a potent ozone-depleter. Stratospheric ozone depletion causes an increase in the levels of ultraviolet solar radiation reaching the earth's surface, which in turn is linked to increased incidence of skin cancers, immune system suppression, cataracts, and disruptions in terrestrial and aquatic ecosystems. In addition, increased UV-B radiation is expected to increase photochemical smog, aggravating related health problems in urban and industrialized areas.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. All of the Freon 113 produced is eventually lost as air emissions and builds up in the atmosphere. If released on land, Freon 113 will leach into the ground and volatilize from the soil surface. No degradative processes are known to occur in the soil. Freon 113 is not very water soluble and is removed rapidly from water via volatilization. Chemical hydrolysis, bioaccumulation and adsorption to sediments are not significant fate processes in water.

Freon 113 is extremely stable in the lower atmosphere and will disperse over the globe and diffuse slowly into the stratosphere where it will be lost by photolysis. In this process, chlorine atoms are released that attack ozone.

Glycol Ethers

Due to data limitations, data on diethylene glycol (glycol ether) are used to represent all glycol ethers.

Toxicity. Diethylene glycol is only a hazard to human health if concentrated vapors are generated through heating or vigorous agitation or if appreciable skin contact or ingestion occurs over an extended period of time. Under normal occupational and ambient exposures, diethylene glycol is low in oral toxicity, is not irritating to the eyes or skin, is not readily absorbed through the skin, and has a low vapor pressure so that toxic concentrations of the vapor can not occur in the air at room temperatures.

At high levels of exposure, diethylene glycol causes central nervous depression and liver and kidney damage. Symptoms of moderate 0 diethylene glycol poisoning include nausea, vomiting, headache, diarrhea, abdominal pain, and damage to the pulmonary and cardiovascular systems. Sulfanilamide in diethylene glycol was once used therapeutically against bacterial infection; it was withdrawn from the market after causing over 100 deaths from acute kidney failure.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Diethylene glycol is a water-soluble, volatile organic chemical. It may enter the environment in liquid form via petrochemical plant effluents or as an unburned gas from combustion sources. Diethylene glycol typically does not occur in sufficient concentrations to pose a hazard to human health.

Methanol

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed 1 mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microorganisms in soils and surface waters.

Physical Properties. Methanol is highly flammable.

Methylene Chloride (Dichloromethane)

Toxicity. Short-term exposure to dichloromethane (DCM) is associated with central nervous system effects, including headache, giddiness, stupor, irritability, and numbness and tingling in the limbs. More severe neurological effects are reported from longer-term exposure, apparently due to increased carbon monoxide in the blood from the break down of DCM. Contact with DCM causes irritation of the eyes, skin, and respiratory tract.

Occupational exposure to DCM has also been linked to increased incidence of spontaneous abortions in women. Acute damage to the eyes and upper respiratory tract, unconsciousness, and death were reported in workers exposed to high concentrations of DCM. Phosgene (a degradation product of DCM) poisoning has been reported to occur in several cases where DCM was used in the presence of an open fire.

Populations at special risk from exposure to DCM include obese people (due to accumulation of DCM in fat), and people with impaired cardiovascular systems.

Carcinogenicity. DCM is a probable human carcinogen via both oral and inhalation exposure, based on inadequate human data and sufficient evidence in animals.

Environmental Fate. When spilled on land, DCM is rapidly lost from the soil surface through volatilization. The remainder leaches through the subsoil into the groundwater.

Biodegradation is possible in natural waters but will probably be very slow compared with evaporation. Little is known about bioconcentration in aquatic organisms or adsorption to sediments but these are not likely to be significant processes. Hydrolysis is not an important process under normal environmental conditions.

DCM released into the atmosphere degrades via contact with other gases with a half-life of several months. A small fraction of the chemical diffuses to the stratosphere where it rapidly degrades through exposure to ultraviolet radiation and contact with chlorine ions. Being a moderately soluble chemical, DCM is expected to partially return to earth in rain.

Methyl Ethyl Ketone

Toxicity. Breathing moderate amounts of methyl ethyl ketone (MEK) for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes, nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. No agreement exists over the carcinogenicity of MEK. One source believes MEK is a possible carcinogen in humans based on limited animal evidence. Other sources believe that there is insufficient evidence to make any statements about possible carcinogenicity.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a flammable liquid.

Sulfuric Acid

Toxicity. Concentrated sulfuric acid is corrosive. In its aerosol form, sulfuric acid has been implicated in causing and exacerbating a variety of respiratory ailments.

Ecologically, accidental releases of solution forms of sulfuric acid may adversely affect aquatic life by inducing a transient lowering of the pH (i.e., increasing the acidity) of surface waters. In addition, sulfuric acid in its aerosol form is also a component of acid rain. Acid rain can cause serious damage to crops and forests.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of sulfuric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

In the atmosphere, aerosol forms of sulfuric acid contribute to acid rain. These aerosol forms can travel large distances from the point of release before the acid is deposited on land and surface waters in the form of rain.

Toluene

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also affect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatilized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene is a volatile organic chemical.

Trichloroethylene

Toxicity. Trichloroethylene was once used as an anesthetic, though its use caused several fatalities due to liver failure. Short term inhalation exposure to high levels of trichloroethylene may cause rapid coma followed by eventual death from liver, kidney, or heart failure. Short-term exposure to lower concentrations of trichloroethylene causes eye, skin, and respiratory tract irritation. Ingestion causes a burning sensation in the mouth, nausea, vomiting and abdominal pain. Delayed effects from short-term trichloroethylene poisoning include liver and kidney lesions, reversible nerve degeneration, and psychic disturbances. Long-term exposure can produce headache, dizziness, weight loss, nerve damage, heart damage, nausea, fatigue, insomnia, visual impairment, mood perturbation, sexual problems, dermatitis, and rarely jaundice. Degradation products of trichloroethylene (particularly phosgene) may cause rapid death due to respiratory collapse.

Carcinogenicity. Trichloroethylene is a probable human carcinogen via both oral and inhalation exposure, based on limited human evidence and sufficient animal evidence.

Environmental Fate. Trichloroethylene breaks down slowly in water in the presence of sunlight and bioconcentrates moderately in aquatic organisms. The main removal of trichloroethylene from water is via rapid evaporation.

Trichloroethylene does not photodegrade in the atmosphere, though it breaks down quickly under smog conditions, forming other pollutants such as phosgene, dichloroacetyl chloride, and formyl chloride. In addition, trichloroethylene vapors may be decomposed to toxic levels of phosgene in the presence of an intense heat source such as an open arc welder.

When spilled on the land, trichloroethylene rapidly volatilizes from surface soils. The remaining chemical leaches through the soil to groundwater.

Xylene (Mixed Isomers)

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylenes can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylenes (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur.

Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years.

Xylenes are volatile organic chemicals. As such, xylenes in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

IV.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 31 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 31
Pollutant Releases (Short Tons/Years)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Electronics/ Computer	**367**	**1,129**	**207**	**293**	**453**	**4,854**
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

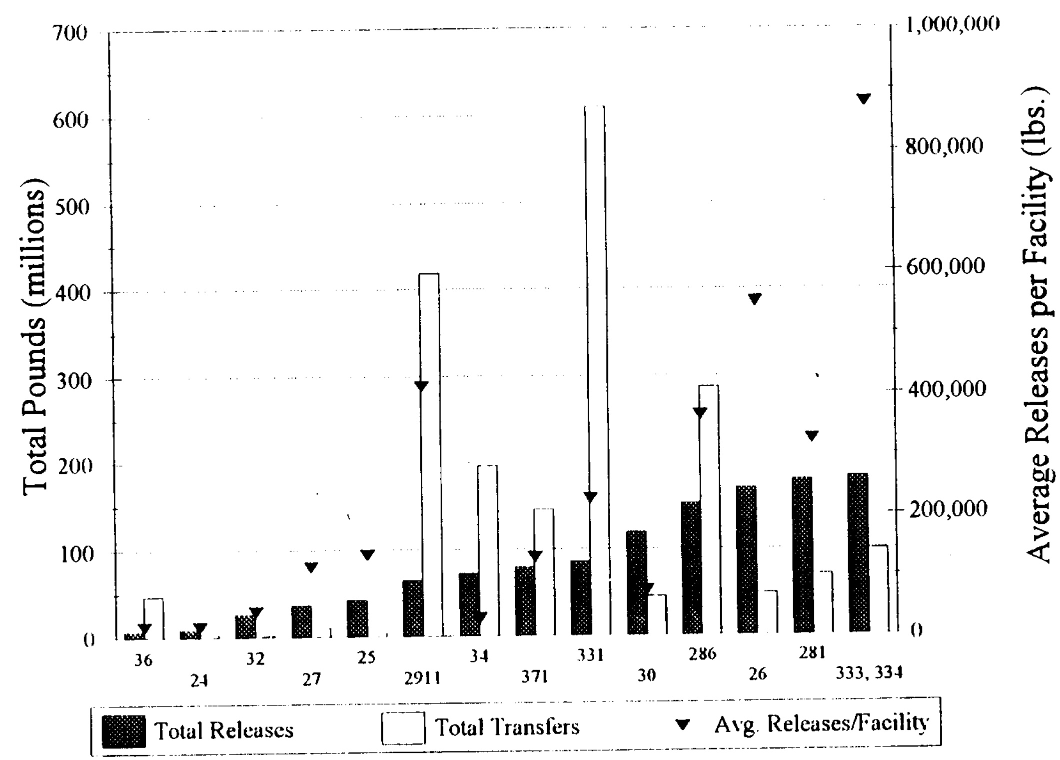
R0075017

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 32 is a graphical representation of a summary of the 1993 TRI data for the electronics/computer industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 33 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of electronics/computer industry, the 1993 TRI data presented here covers 406 facilities. These facilities listed SIC 36 Electronics/Computer Industry as a primary SIC code.

Exhibit 32: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accecessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0075019

Exhibit 33
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases		Transfers		Total Releases + Transfers (10^6 pounds)	Average Release+ Transfers per Facility (pounds)
			Total Releases (10^6 pounds)	Average Releases per Facility (pounds)	1993 Total (10^6 pounds)	Average Transfers per Facility (pounds)		
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	24	491	8.4	17,036	3.5	7,228	11.9	24,000
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronics/Computers	**36**	**406**	**6.7**	**16,520**	**47.1**	**115,917**	**53.7**	**133,000**
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	371	609	79.3	130,158	145.5	238,938	224.8	369,000
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72.0	30,476	195.7	82,802	267.7	123,000
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,269	98.2	472,335	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0075020

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the electronics/computer industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

Pollution prevention (sometimes referred to as source reduction) is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water or other resources, and practices that protect natural resources through conservation or more efficient use.

EPA is promoting pollution prevention because it is often the most cost-effective option to reduce pollution and the environmental and health risks associated with pollution. Pollution prevention is often cost effective because it may reduce raw material losses; reduce reliance on expensive "end-of-pipe" treatment technologies and disposal practices; conserve energy, water, chemicals, and other inputs; and reduce the potential liability associated with waste generation. Pollution prevention is environmentally desirable for these very same reasons: pollution itself is reduced at the source while resources are conserved.

V.A. Identification of Pollution Prevention Activities in Use

The electronics and computer industries have participated in many pollution prevention projects and have been the focus of many case studies. Pollution prevention techniques and processes used by these industries can be grouped into four general categories:

- Process or equipment modification
- Raw material substitution or elimination
- Waste segregation/separation/preparation
- Recycling.

Each of these categories is briefly discussed below. Refer to Section V.B. for a list of specific pollution prevention techniques and associated costs, savings, and other information.

Process or equipment modification is used to reduce the amount of waste generated. For example, manufacturers can change equipment or processes to: enhance water conservation by installation of countercurrent rinsing systems; reduce alkaline and acid concentration in tanks by installing a pH controller; and reduce drag-out by decreasing the withdrawal rate of parts from plating tanks.

Raw material substitution or elimination is the replacement of existing raw materials with other materials that produce less waste, or a non-toxic waste. Examples include substituting non-cyanide solution for a sodium cyanide solution in copper plating baths and replacing hexavalent chromium with trivalent chrome plating system.

Waste segregation/separation/preparation involves avoiding the mixture of different types of wastes and avoiding the mixture of hazardous wastes with non-hazardous wastes. This makes the recovery of hazardous wastes easier by minimizing the number of different hazardous constituents in a given waste stream. Also, it prevents the contamination of non-hazardous wastes. A specific example is segregation of wastewater sludge by metal contaminants.

Recycling is the use or reuse of a waste as an ingredient or feedstock in the production process on-site. Examples of recycling include: recovering copper during the etching processes, recovering lead and tin from printed wiring boards, and installing a closed-loop recycling system to reuse freon (which is being phased-out) and reduce/reuse water consumption.

V.B. Pollution Prevention Techniques for the Electronics/Computer Industry

This section provides examples of pollution prevention techniques used in the electronics/computer industry. Much of the information provided in this section is from the following EPA offices/programs: the Common Sense Initiative (CSI), EPA's DfE Program, the Pollution Prevention Information Center, the Office of Environmental Engineering and Technology Demonstration, the Office of Pollution Prevention, and Office of Research and Development. Other sources include the Oregon Department of Environmental Quality and the California Department of Toxic Substances and Control. Where available, cost information is provided. However, source documents did not always provide cost information.

V.B.1. Examples of Source Reduction and Recycling Options for Electroplating Operations

Technique - Process or Equipment Modification

Option 1 - Modify rinsing methods to control drag-out by:

- Increasing bath temperature
- Decreasing withdrawal rate of parts from plating bath
- Increasing drip time over solution tanks; racking parts to avoid cupping solution within part cavities
- Shaking, vibrating, or passing the parts through an air knife, angling drain boards between tanks
- Using wetting agents to decrease surface tension in tank.

Contact: Braun Intertec Environmental, Inc., and MN Office of Waste Management (612) 649-5750.

Option 2 - Utilize water conservation methods including:

- Flow restrictors on flowing rinses
- Counter current rinsing systems
- Fog or spray rinsing
- Reactive rinsing
- Purified or softened water
- Dead rinses
- Conductivity controllers
- Agitation to assure adequate rinsing and homogeneity in rinse tank
- Flow control valves.

Contact: Braun Intertec Environmental, Inc., and MN Office of Waste Management (612) 649-5750.

Option 3 - Implement counter flow rinsing and cascade rinsing systems to conserve consumption of water. **Costs and Savings:** Costs: $75,000 to upgrade existing equipment and purchasing new and used equipment. Waste Savings/Reduction: reduce water use and wastewater treatment costs. **Contact:** Eastside Plating and OR Department of Environmental Quality (800) 452-4011.

Option 4 - Use drip bars to reduce drag-out. **Costs and Savings:** Capital Investment: $100/tank. Savings: $600/year. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 5 - Use drain boards between tanks to reduce generations of drag-out. **Costs and Savings:** Capital Investment: $25/tank. Savings: $450/year . **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 6 - Install racking to reduce generations of drag-out. **Costs and Savings:** Capital Investment: zero dollars. Operating Costs: minimal. Savings: $600/year. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 7 - Employ drag out recovery tanks to reduce generations of drag-out. **Costs and Savings:** Capital Investment: $500/tank. Savings: $4,700/year. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 8 - Install counter-current rinsing operation to reduce water consumption. **Costs and Savings:** Capital Investment: $1,800-2,300. No direct costs. Savings: $1,350/year. Waste Savings/Reductions: reduce water use by 90-99%. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 9 - Redesign rinse tank to reduce water conservation. **Costs and Savings:** Capital Investment: $100. No direct costs. Savings: $750/year. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 10 - Increase parts drainage time to reduce drag-out. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 11 - Regenerate plating bath by activated carbon filtration to remove built up organic contaminants. **Costs and Savings:** Capital Investment: $9,192. Costs: $7,973/year. Savings: $122,420/year. Waste Savings/Reduction: 10,800 gallons/year. Reduce volume of plating baths disposed and requirements for virgin chemicals. **Contact:** EPA Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, Harry Freeman.

Option 12 - Install pH controller to reduce the alkaline and acid concentrations in tanks. **Contact:** Securus, Inc., DBA Hubbard Enterprises.

Option 13 - Install atmospheric evaporator to reduce metal concentrations. **Contact:** Securus, Inc., DBA Hubbard Enterprises.

Option 14 - Install process (e.g., CALFRAN) to reduce pressure to vaporize water at cooler temperatures and recycle water by condensing the vapors in another container, thus concentrating and precipitating solutes out. **Costs and Savings:** Waste Savings/Reduction: reduce volume and quantity of aqueous waste solutions by recovering pure water. **Contact:** CALFRAN International, Inc., (413) 525-4957.

Option 15- Use reactive rinsing and multiple drag-out baths. **Costs and Savings:** Savings: Reduce cost of treating spent process baths and rinsewaters. Waste Savings/Reduction: increase lifetime of process baths and reduce the quantity or rinsewater requiring treatment. **Contact:** SAIC, Edward R. Saltzberg.

Option 16 - Improve control of water level in rinse tanks, improve sludge separation, and enhance recycling of supernatant to the process by aerating the sludge. **Costs and Savings:** Savings: $2,000/year. Waste Savings/Reduction: reduce sludge generation by 32%. **Contact:** NJ Hazardous Waste Facilities Siting Commission, Hazardous Waste Source Reduction and Recycling Task Force.

Option 17 - Install system (e.g., Low Solids Fluxer) that applies flux to printed wiring boards, leaving little residue and eliminates the need for cleaning CFCs. **Costs and Savings:** Waste Savings/Reduction: reduce CFC emissions over 50%. **Contact:** AT&T Bell Laboratories, Princeton, NJ.

Option 18 - Install ion exchange system to reduce generation of drag-out. **Costs and Savings:** Savings: $1,900/year. Capital Investment: $78,000. Operating Costs: $3,200/year. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 19 - Employ reverse osmosis system to reduce generation of drag-out. **Costs and Savings:** Savings: $40,000/year. Capital Investment: $62,000. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 20 - Use electrolytic metal recovery to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $1,000. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 21- Utilize electrodialysis to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $50,000. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 22 - Implement evaporative recovery to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $2,500. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 23- Implement the electrodialysis reversal process for metal salts in wastewater. **Costs and Savings**: Savings: $40,100/year in operating costs. **Contact:** Ionics, Inc., Separations Technology Division.

Technique - Raw Material Substitution

Option 1 - Substitute cyanide plating solutions with alkaline zinc, acid zinc, acid sulfate copper, pyrophosphate copper, alkaline copper, copper fluoborate, electroless nickel, ammonium silver, halide silver, methanesulfonate-potassium iodide silver, amino or thio complex silver, no free cyanide silver, cadmium chloride, cadmium sulfate, cadmium fluoborate, cadmium perchlorate, gold sulfite, and cobalt harden gold. **Contact:** Braun Intertec Environmental, Inc. and MN Office of Waste Management (612) 649-5750.

Option 2 - Substitute sodium bisulfite and sulfuric acid for ferrous sulfate in order to oxidize chromic acid wastes, and substitute gaseous chlorine for liquid chlorine in order to reduce cyanide reduction. **Costs and Savings:** Savings: $300,000/year. Waste Savings/Reduction: reduces feedstock by 50%. **Contact:** Eastside Plating and OR Department of Environmental Quality (800) 452-4011.

Option 3 - Replace hexavalent chromium with trivalent chromium plating systems. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 4 - Replace cyanide with non-cyanide baths. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 5 - Replace conventional chelating agents such as tartarates, phosphates, EDTA, and ammonia with sodium sulfides and iron sulfates in removing metal from rinse water which reduces the amount of waste generated from precipitation of metals from aqueous wastestreams. **Costs and Savings:** Costs: $178,830/year. Savings: $382,995/year. Waste Savings/Reduction: 496 tons of sludge/year. **Contact:** Tyndall Air Force Base, FL, Charles Carpenter (904) 283-2942; EG & G, Dan Sucia, Penny Wilcoff, & John Beller (208) 526-1149.

Option 6 - Replace methylene chloride, 1,1,1-trichloroethane, and perchloroethylene (solvent-based photochemical coatings) with aqueous base coating of 1% sodium carbonate. **Costs and Savings:** Waste Savings/Reduction: reduce solvent use by 60 tons/year. **Contact:** American Etching and Manufacturing, Pacoima, CA.

Option 7 - Replace methanol with nonflammable alkaline cleaners. **Costs and Savings:** Waste Savings/Reduction: eliminate 32 tons/year of flammable methyl alcohol. **Contact:** American Etching and Manufacturing, Pacoima, CA.

Option 8 - Substitute a non-cyanide for a sodium cyanide solution used in copper plating baths. **Costs and Savings:** Waste Savings/Reduction: reduce 7,630 pounds/year. **Contact:** Highland Plating Company, Los Angeles, CA.

Technique - Recycling

Option 1 - Send drag-out waste to another company for waste exchange. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 2 - Reuse rinse water. **Costs and Savings:** Savings: $1,500/year. Capital Investment: $340/tank. No direct costs. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 3- Reuse drag-out waste back into process tank. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 4- Recover process chemicals with fog rinsing parts over plating bath. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 5 - Evaporate and concentrate rinse baths for recycling. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 6 - Use ion exchange and electrowinning, reverse osmosis, and thermal bonding when possible. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 7 - Use sludge slagging techniques to extract and recycle metals. **Costs and Savings:** Capital Investment: $80,000 for 80 tons/year and $400,000 for 1,000 tons/year. Operating Costs: $18,000 per year for an 80 ton facility. Waste Savings/Reduction: reduces volume of waste by 94%. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 8 - Use hydrometallurgical processes to extract metals from sludge. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 9- Convert sludge to smelter feed. **Contact:** City of Los Angeles Hazardous and Toxic Material Project; Board of Public Works (213) 237-1209.

Option 10 - Remove and recover lead and tin from boards by electrolysis or chemical precipitation. **Contact:** Control Data Corporation and MN Office of Waste Management (612) 649-5750.

Option 11 - Install a closed loop batch treatment system for rinsewater to reduce water use and waste volume. **Costs and Savings:** Savings: $58,460/year. Capital Investment: $210,000. Waste Savings/Reduction: 40,000 gallons/year (40%). **Contact:** Pioneer Metal Finishing, Inc., Harry Desoi (609) 694-0400.

Option 12 - Install an electrolytic cell which recovers 92 percent of dissolved copper in drag-out rinses and atmospheric evaporator to recover 95 percent of chromatic acid drag-out, and recycle it into chromic acid etch line. **Contact:** Digital Equipment Corporation and Lancy International Consulting Firm, William McLay (412) 452-9360.

Option 13- Oxidize cyanide and remove metallic copper to reduce metal concentrations. **Contact:** Securus, Inc., DBA Hubbard Enterprises.

V.B.2. Examples of Source Reduction and Recycling Options for Etching Operations

Technique - Raw Material Substitution

Option 1 - Substitute sodium persulfate etchant (acid etch solution) with hydrogen peroxide/ sulfuric acid. **Contact:** ADC Products and MnTAP (612) 625-4949.

Technique - Recycling

Option 1 - Recover copper by electrolytic processes. **Contact:** ADC Products and MnTAP (612) 625-4949.

V.B.3. Examples of Source Reduction and Recycling Options for Semiconductor Manufacturing

Technique - Process or Equipment Modification

Option 1 - Install a system (e.g., the CALFRAN process) to reduce pressure to vaporize water at cooler temperatures, recycle water by condensing the vapors in another container, and concentrate and precipitate solutes. **Costs and Savings**: Waste Savings/Reduction: reduce volume and quantity of aqueous waste solutions by recovering pure water. **Contact**: CALFRAN International, Inc. Springfield, MA 01101, Val Partyka (413) 525-4957.

Option 2 - Reduce chrome waste generation by :

- Installing a rain cover over on outdoor tanks to reduce chrome waste
- Treating on-site with caustics and sodium bisulfite to reduce chrome VI liquid to chrome III sludge
- Repairing water leaks in process rinse tank to reduce chrome waste.

Costs and Savings: Capital Investment: $30,000 for the rain cover, pipe repairs, and on-site treatment system. Waste Savings/Reduction: Savings: $15,000/year in disposal costs, and reduce 95% of chrome wastes from 6,000 gallons to two or three drums generated per quarter. **Contact**: Wacker Siltronic Corporation and University of MN (612) 625-4949.

Technique - Raw Material Substitution

Option 1 - Replace chlorinated solvent baths with a non-hazardous product to reduce, and later, eliminate use of chlorinated solvents. **Costs and Savings**: Waste Savings/Reduction: reduce chlorinated solvent use by 93%, and then completely eliminate the use of the chemical. **Contact**: Wacker Siltronic Corporation and University of MN (612) 625-4949.

Technique - Recycling

Option 1 - Convert an open-top still into a closed loop system to recycle Freon 113. **Costs and Savings**: Costs: $20,000. Waste Savings/Reduction: $57,000/year in disposal and feedstock costs, and reduce waste volume by 85%. **Contact**: Wacker Siltronic Corporation and University of MN (612) 625-4949.

Option 2 - Use Athens system to reprocess sulfuric acid generated during wafer fabrication operations. The acid is heated to boil off water and other impurities, purified through distillation, and pumped back into wet stations to continue wafer processing. Costs and savings: Annual savings/Reductions: $2.9 million from not purchasing sulfuric acid and 28% reduction in sulfuric acid generated in 1993. Contact: Intel or Alameda Instruments, Inc. and Athens Corporation (manufacturers of this type of equipment).

V.B.4. Examples of Source Reduction and Recycling Options for Printed Wiring Board Manufacturing

V.B.4.a. General Operations

Technique - Process or Equipment Modification

Option 1 - Modify sludge pretreatment processes by:

- Adding flow control valves
- Installing metal recovery equipment
- Adding of deionization system

Costs and Savings: Costs: lower chemical treatment costs. Waste Savings/Reduction: $90,000 in disposal costs. **Contact**: Unisys Corporation and MnTAP (612) 625-4949.

Option 2 - Redesign board during board assembly. **Contact:** Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

Option 3 - Install a system (e.g., CALFRAN process) to reduce pressure to vaporize water at cooler temperatures, recycle water by condensing the vapors in another container, concentrate and precipitate solutes. **Costs and Savings**: Waste Savings/Reduction: reduce volume and quantity of aqueous waste solutions by recovering pure water. **Contact:** CALFRAN International, Inc. Springfield, MA 01101, Val Partyka (413) 525-4957.

Option 4 - Alternatives to wet chemical processes include:
- Mechanical cleaning as an alternative to chemical methods;
- Process efficiency improvements for applying photopolymers, printing, and developing;
- Alternative processes for connecting the PWB layers together; and
- Alternatives to lead-based soldering involving the use of lasers, reactive gases, or ultrasonics.

Contact: EPA CSI.

Technique - Raw Material Substitution

Option 1 - Substitute semiaqueous or aqueous photoresist for TCA and methylene chloride during board manufacturing. **Contact**: Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

Option 2 - Substitute no-clean fluxes for CFC 113 and TCA during board assembly. **Contact**: Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

Option 3 - Substitute aqueous clean fluxes for CFC 113 and TCA during board assembly. **Contact**: Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

Option 4 - Substitute semi-aqueous cleaning materials for CFC 113 and TCA during board assembly. **Contact:** Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

Option 5 - Substitute other solvents for CFC 113 and TCA during board assembly. **Contact**: Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

Technique - Waste Segregation/Separation/Preparation

Option 1 - Segregate wastewater sludge to prepare for metal recovery. **Contact**: Unisys Corporation and MnTAP (612) 625-4949.

Technique - Recycling

Option 1 - Remove and recover lead and tin from boards by electrolysis-chemical precipitation. **Contact**: Control Data Corporation and MN Office of Waste Management (612) 649-5750.

V.B.4.b. Cleaning Operations

Technique - Process or Equipment Modification

Option 1 - Install a system (e.g., Low Solids Fluxer (LSF)) which applies flux to printed wiring boards, leaves little residue, and eliminates the need for cleaning with CFCs. **Costs and Savings**: Waste Savings/Reduction: reduce CFC emissions over 50%. **Contact**: AT&T Bell Laboratories, Princeton, NJ.

Technique - Raw Material Substitution

Option 1 - Substitute for CFC 113 used in defluxing with:
- Fully aqueous system using water soluble fluxes
- Aqueous system using saponifiers to remove rosin based fluxes
- Semi-aqueous system using terpenes as a solvent
- Hydrogenated CFCs with chlorinated solvents

Contact: Medtronic Inc. and MN Technical Assistance Program (MnTAP) (612) 627-4848 Maria Scheller.

Option 2 - Substitute CFC 113 used in hand cleaning boards with:
- Blend of HCFC and methanol dispensed from a trigger-grip device that limits the amount of solvent lost to the atmosphere

Contact: Medtronic Inc. and MN Technical Assistance Program (MnTAP) (612) 627-4848 Maria Scheller.

V.B.4.c. Electroplating Operations

Technique - Raw Material Substitution

Option 1 - During tin-lead electroplating process, substitute fluoboric acid with:
- Organic sulfonic acid (OSA) plating
- Acid tin sulfate plating which eliminates lead use
- Hot air leveling
- Conductive, solderable polymer solutions

Contact: Capsule Environmental Engineering Inc. and MN Office of Waste Management (612) 649-5750.

V.B.5. Examples of Source Reduction and Recycling Options for Cathode Ray Tube Manufacturing

Technique - Process or Equipment Modification

Option 1- Reduce building of contamination in bath solutions by increasing process efficiency (e.g., implement ion exchange technology). **Contact:** EPA CSI.

R0075030

Technique - Raw Material Substitution

Option 1 - Replace lacquer in panel preparation with a wax-like material similar to floor wax. It provides the necessary coating without a high VOC content. One potential drawback, however, is the use of ammonia. **Contact:** EPA CSI.

Option 2 - Replace Freon as a cleaning agent for removing particulate contaminants from panel mask frames with air blow cleaning and an aqueous wash (nearly all CRT manufacturers have implemented this change). **Contact:** EPA CSI.

Option 3 - Identify less hazardous cleaning chemicals, such as isopropyl alcohol, as alternatives to acetone or chlorinated solvents in maintenance and cleanup processes. **Contact:** EPA CSI.

Option 4 - Find substitutes for chromium-based photoresists. **Contact:** EPA CSI.

Option 5 - Identify alternatives to the lead-based frit used in sealing the funnel with the panel mask. **Contact:** EPA CSI.

Technique - Recycling

Option 1 - Regenerate acids for glass cleaning and frit removal in waste glass recovery operations using existing technologies and equipment. **Contact:** EPA CSI.

Option 2 - Reclaim and reuse photoresists from one of the panel preparation processes. **Contact:** EPA CSI.

Option 3 - Recover soluble lead generated during the waste glass recovery operation by ion exchange resins. Reuse in lead smelting operations. **Contact:** EPA CSI.

Option 4 - Improve phosphor solution recovery and recycling efficiencies to further reduce discharge of metals to the environment. **Contact:** EPA CSI.

Option 5- Reduce or recover the following:
- Chrome wastes
- Cleaning materials (hydrofluoric acids)
- EP effluent
- Furnaces slag
- Cullet dust
- Fugitive dust
- Refractory brick wastes
- Alcohols

Contact: EPA CSI.

V.C. Pollution Prevention Case Studies

The electronics/computer industry is actively involved in pollution prevention activities, especially for products such as semiconductors and printed wiring boards. Pollution prevention techniques are available and have been implemented successfully for processes such as cleaning, etching, electroplating, and wastewater treatment. California's *Assessment of the Semiconductor Industry Source Reduction Planning Efforts* provides additional information and case studies on pollution prevention techniques. Eastside Plating, Unisys Corporation, and Wacker Siltronic Corporation are examples of companies with successful pollution prevention programs. The pollution prevention activities employed in these three case studies provided each company with significant savings.

Eastside Plating, Portland, Oregon's oldest and largest electroplating facility, demonstrated that complying with environmental laws and implementing pollution prevention activities is cost effective. Eastside used three major pollution prevention techniques: water conservation, material substitution, and machinery automation and upgrade.

The first activity addressed the challenge of diminishing the use of water. Ninety percent of water required for electroplating is used during the rinsing process (to clean the wafer, end chemical reactions, and prevent contaminants from being released into the next bath). Eastside modified the rinsing process by installing two systems that conserve water: counter flow and cascade rinsing systems. Counter flow rinsing recycles and reuses water throughout a multiple tank system, reducing significantly the volume of water required. Fresh water is only introduced in the last tank of the system. Cascade rinsing also reduces the volume of water required. This system uses one tank with a center divider which allows the water to spill into the other side. During cascade rinsing, the tank is filled and drained slowly and continuously in order to reduce water consumption. Overflow from one tank can be used as the water supply for another compatible rinsing system.

Eastside also reduced chromium and cyanide wastes through material substitution. The reducing agent for chromic acid wastes was changed from ferrous sulfate to bisulfite and sulfuric acid, which reduced the volume of sludge produced. Cyanide wastes are reduced more efficiently with gaseous instead of liquid chlorine.

Finally, three major waste treatment components were upgraded or automated: the cyanide oxidation tank, chromium reduction tank, and the acid/alkali neutralization tank. The goal of automating and upgrading this equipment was to increase efficiency, separate tank flow, and eliminate contamination of acid/alkali neutralization tank. Automated metering equipment was installed and reduced the expensive caustic chemicals required to treat acid wastes by 50 percent. The cyanide and chromic acid oxidation tanks were redesigned as gravity flow systems to equalize flow rate and to eliminate the risks associated with plumbing failure. To prevent cross contamination of the tanks, the plumbing was segregated.

Other important steps taken by Eastside Plating to enhance pollution prevention included collaborating with suppliers on modifications to reaction and neutralization tanks, working with regulators to solve problems, and providing employee education.

The new rinsing systems, materials substitution, and upgrade/ automation of equipment cost Eastside $75,000. Overall, Eastside implemented changes to the operation which has saved the company more than $300,000 annually. In addition, pollution prevention and waste minimization has resulted in a cleaner facility, increased productivity, and a better product.

Unisys is a manufacturer of both large and small computers. In 1986, Unisys implemented pollution prevention/waste minimization techniques associated with the automated copper plating process in its printed circuit board manufacturing plant in Roseville, Minnesota. Unisys worked with Minnesota Technical Assistance Program (MnTAP) to reduce the two to three drums of wastewater treatment sludge produced each day.

MnTAP recommended several changes in the pretreatment process such as: segregation of the wastestreams; addition of flow control valves; installation of metal recovery equipment; and addition of a deionization system. Wastestream segregation involved changing the plumbing to separate the wastestreams containing metal contaminants. Another modification reduced overall water usage through the installation of flow control valves. Metal recovery techniques, such as ion exchange and electrolytic metal recovery, reclaim copper from metal-bearing wastestreams. The deionization systems allow the pretreatment process to operate more efficiently. Ion exchange and electrolytic recovery is enhanced by deionization by removing hard water ions in the process and rinse tanks. The modifications ensure environmental compliance, lower treatment chemical costs, and reduce sludge disposal costs by an estimated $90,000 per year. In addition, the pollution prevention and waste minimization changes have allowed Unisys to expand its plating line.

Wacker Siltronic Corporation, a semiconductor manufacturer, successfully implemented pollution prevention and waste minimization techniques similar to those employed by Unisys and Eastside. In order to maintain cleanliness in silicon wafer production, Wacker made extensive use of chloride solvent baths. Once the disposal of chlorinated solvent wastes at a Oregon hazardous waste facility was prohibited by Federal regulations, Wacker sought to recycle the solvents. However, the potential liability associated with transporting thousands of gallons of solvents to a recycling facility led Wacker to seek other alternatives. A six month pilot project was first implemented to decrease chlorinated solvent use which resulted in the elimination of 93 percent of Wacker's chlorinated solvent waste. Ultimately, Wacker eliminated completely the use of chlorinated solvents through replacement with non-hazardous cleaning products.

Wacker used to generate 2000 gallons of chrome VI waste each month, which needed to be sent off-site for disposal. Reduction of chrome waste to two to three drums each quarter involved three techniques: installation of a rain cover over the outdoor tanks; on-site treatment of chrome VI waste using caustics and sodium bisulfite; and repairing water leaks in the process rinse tank. The rain cover cost $7,000, but reduced the volume of waste shipments by 25 percent. The new treatment of the chrome VI liquid reduced it to a less hazardous chrome III sludge which can be dried and sent off-site for disposal. Repair of small leaks in the rinse tanks resulted in a 50 percent reduction of wastes. The cover, pipe repairs, and on-site treatment system cost $30,000 and led to a 95 percent reduction of chrome waste as well as annual savings of $15,000. The initial costs were recovered within three years.

A final pollution prevention waste minimization technique involved recycling Freon 113. An open-top still was converted into a closed-loop system at a cost of $20,000. The conversion reduced the volume of Freon waste by 85 percent and saves the company $57,000 each year. Overall, Wacker states that pollution prevention and waste minimization has resulted in annual savings of $300,000.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations (CFR) and other State or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.
- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.
- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the

designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and States can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about

R0075038

chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQS) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQS for a given pollutant are classified as attainment areas; those that do not meet NAAQS are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPS are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAP), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date, EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996.

provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Requirements

Clean Air Act (CAA)

Under the CAA, the National Ambient Air Quality Standards (NAAQS) have been established for six pollutants. The only one that significantly impacts the electronics/computer industry is the standard for ozone. While the electronics/computer industry is not a major source of ozone, it is a major source of volatile organic compounds (VOC). A source defined as "major" in ozone nonattainment areas must install Reasonable Available Control Technology (RACT) as prescribed in the applicable State Implementation Plan (SIP). A major source is both defined by the size of the source's emissions and the category of the nonattainment area. A determination of the necessary RACT requirements is made on the basis of a case by case review of each facility. In an attempt to issue uniform guidelines, EPA has begun to issue Control Technology Guidance (CTG) for each industrial category. The following CTGs may apply to the semiconductor industry:

- Miscellaneous Metal Parts and Products
- Plastic Parts
- Alternative Control Technology (ATG) for Solvent Cleaning.

Clean Water Act (CWA)

The National Pollution Discharge Elimination System (NPDES) permit program regulates the discharge of pollutants to the waters of the United States. A permit is required if a source discharges directly to surface waters. Facilities must provide the results of biological toxicity tests and any information on its "effluent characteristics." The electronics/computer industry must test for all 126 priority pollutants listed in 40 CFR 122, Appendix D. Facilities must provide quantifiable data only for discharges of priority pollutants which the applicant knows or has reason to believe will be greater than trace amounts. Priority pollutants likely to be discharged by facilities in the electronics/computer industry include

R0075047

copper, lead, lead compounds, silver, chromium, and trichloroethylene.

Quantitative testing is required for non-conventional pollutants if they are expected to be present in discharges. Examples of hazardous substances and non-conventional pollutants likely to be discharged by the electronics/computer industry include butyl acetate, xylene, formaldehyde, tin-total, nitrate/nitrites, titanium-total, and chlorine-total residual.

The electronics/computer industry must satisfy the following technology-based effluent limitation guidelines:

- 40 CFR Part 469 applies to discharges from all processes associated with semiconductor manufacturing except sputtering, vapor deposition, and electroplating.
- 40 CFR Part 433 applies to semiconductor manufacturing plants that perform any of six metal finishing operations - electroplating, electroless plating, anodizing, coating, chemical etching, milling, and printed wired board manufacturing.
- 40 CFR Part 433 applies to discharges associated with the manufacture of printed wiring boards (PWB), except indirect discharging job shops and independent PWB manufacturers who discharge to POTWs, which are covered by Part 413.
- 40 CFR Part 469, Subpart C applies to discharges from display manufacturing.
- 40 CFR Part 469, Subpart D applies to discharges from the manufacturing of luminescent materials which are used in coatings in fluorescent lamps and cathode ray tubes. Luminescent materials include, but are not limited to, calcium halophosphate, zinc sulfide, and zinc-cadmium.
- 40 CFR Part 413 applies to electroplating of common metals, chemical etching and milling, and electroless plating. Subpart A refers to discharges of pollutants from processes that involve ferrous or nonferrous material electroplated with (or any combination of) copper, nickel, chromium, zinc, tin, lead, cadmium, iron, or aluminum. Subpart F applies to process wastewaters from chemical milling or etching of ferrous or nonferrous materials. Subpart G applies to process wastewaters from the electroless plating of a metallic layer on a metallic or nonmetallic substrate.

Facilities that discharge to POTWs must comply with categorical and general pretreatment requirements:

- 40 CFR Part 413, Subpart B applies to electroplating of precious metals or to discharges from a process in which a ferrous or nonferrous material is plated with, or a combination of, gold, silver, iridium, palladium, platinum, rhodium, or ruthenium.

Resource Conservation and Recovery Act (RCRA)

Many wastes generated by the electronics/computer industry are considered RCRA toxicity characteristic (TC) hazardous wastes due to constituents such as silver, trichloroethylene, and lead. The greatest quantities of RCRA listed waste and characteristic hazardous waste present in the electronics/computer industry are identified in Exhibit 30. For more information on RCRA hazardous waste, refer to 40 CFR Part 261.

Exhibit 34
Hazardous Wastes Relevant to the Electronics/Computer Industry

EPA Hazardous Waste No.	Hazardous Waste
D006 (cadmium) D007 (chromium) D008 (lead) D011 (silver)	Wastes which are hazardous due to the characteristic of toxicity for each of the constituents.
F001	Halogenated solvents used in degreasing: tetrachloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	Spent halogenated solvents; tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, one or more of the above halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	Spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of 10% or more (by volume) of one of those solvents listed in F001, F002, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	Spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005	Spent non-halogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures.
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
F007	Spent cyanide plating bath solutions from electroplating operations.
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.

Source: Based on 1994 Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report.

R0075050

VI.B.1. Notable State Regulations

California's *Hazardous Waste Source Reduction and Management Review Act of 1988,* commonly referred to as SB14, requires generators that produce over 12,000 kilograms of hazardous waste or 12 kilograms of extremely hazardous waste to produce two documents every four years. The documents include a Source Reduction Plan and a Management Performance Report. The Act intends to promote hazardous waste reduction at the source and recycling. For more information on the compilation of these reports by the semiconductor industry, see the October 1994 *Assessment of the Semiconductor Industry Source Reduction Planning Efforts,* by the California Department of Toxic Substances Control.

According to Daryl Burn of the California Air Resources Board, the Board has promulgated Rule 830, Semiconductor Manufacturing Operations, which regulates VOC emissions from semiconductor manufacturing facilities. VOCs are released during wafer preparation, photolithography, and cleaning operations. Rule 830 was developed in 1988 for the Bay Area Air Quality Management District (San Francisco area) because a large concentration of semiconductor manufacturing facilities are located in South Bay and San Francisco. The Board does not provide assistance to facilities to help achieve compliance.

VI.C. Pending and Proposed Regulatory Requirements

SDWA/Underground Injection Control Wells (UIC)

New regulations are being developed for UIC which will amend 40 CFR 144 and 146. The regulations will establish minimum Federal requirements for the permitting, operating, monitoring, and closure of several types of shallow injection wells. Restrictions will be imposed on the operation of certain types of shallow disposal wells, especially those that inject industrial wastes. Computer manufacturing facilities located in areas without sewer systems that rely on shallow waste injection wells to dispose of industrial and non-sanitary wastes will be impacted by these regulations.

Resource Conservation and Recovery Act (RCRA)

RCRA prohibits the land disposal of most hazardous wastes until they meet a waste specific treatment standard. While most hazardous wastes have already been assigned treatment standards,

R0075051

EPA must still promulgate additional rule makings to address newly listed wastes and to make changes to the land disposal restrictions (LDR) program. Rules are required every time EPA lists a waste.

The Phase III LDR rulemaking proposes to establish treatment standards for some newly listed wastes and RCRA equivalent treatment standards for certain formerly characteristic hazardous wastes that are injected into UIC wells under the Safe Drinking Water Act (SDWA) or managed in Subtitle D surface impoundments prior to discharge pursuant to the Clean Water Act (CWA). By consent decree, EPA must promulgate the final rule for Phase III by January 1996.

Phase IV will similarly consider restrictions on other newly listed or identified wastes from land disposal and evaluate what, if any, treatment standards may be needed to mitigate the impact of sludges, leaks, and air emissions from surface impoundments that manage decharacterized wastes. In addition to considering restrictions on the land disposal of the previously exempt Bevill wastes and wastes from wood preserving, Phase IV will also consider adjustments to the treatment standards applicable to wastes that exhibit the toxicity characteristic for a metal constituent. Subject to the same consent decree, Phase IV has been assigned a judicial deadline of June 1996 for promulgation of a final rule.

Clean Air Act (CAA)

Lead NAAQS may impact the electronics/computer industry in the future. It is believed that emissions from the use of lead in soldering and other processes are not significant enough to subject facilities to air pollution control requirements. However, EPA has not yet studied the electronics/computer industry as a source of lead emissions.

Clean Air Act Amendments of 1990 (CAAA)

EPA promulgated a final NESHAP for chromium emissions from new and existing electroplating operations on January 25, 1995. The 1990 CAA Amendments (CAAA) list chromium compounds as a criteria air pollutant under §112. The purpose of the rule is to limit chromium emissions to the level of Maximum Achievable Control Technology (MACT) (60 FR 4948).

A NESHAP for halogenated solvent cleaning was issued December 2, 1994. The regulation applies to organic halogenated solvent cleaners (degreasers) using specified halogenated HAP solvents.

Several hazardous air pollutants (HAP) which are used in printed wired board manufacturing as well as semiconductor manufacturing and assembly are scheduled for MACT standards. According to IPC and EPA, these HAPs include: ethylene glycol; hydrochloric acid; hydrofluoric acid; lead compounds; and nickel compounds.

EPA is in the process of identifying industries that emit any substantial quantities of the 189 HAPs. Regulations that apply specifically to the semiconductor industry are expected in 1997.

Clean Water Act (CWA)

EPA is scheduled to propose effluent limitation guidelines and standards for metal products and machinery. These guidelines and standards will address facilities that generate wastewater while processing metal parts, products, and machinery. The proposal will also include facilities that generate wastewater during the following processes: manufacturing, assembly, repairing, rebuilding, and maintenance. Phase I of these guidelines and standards covers seven industries. The industries relevant to SIC code 36 and 35 are stationary industrial equipment (electrical equipment) and electronic equipment (including communication equipment). A notice of proposed rule making is expected to be published by November 1994, and final action on this proposed regulation is scheduled for May 1996.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[3] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

[3] EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Electronics/Computer Industry Compliance History

The exhibit below contains a Regional breakdown of the inspection and enforcement action over the last five years in the electronics/computer industry. As expected, the largest number of electronics/computer industry facilities is located in Region IX. However, other Regions (i.e., Regions I and II) inspected a greater number of electronics facilities than Region IX. Also, Regions IX and X have significantly higher enforcement to inspection ratios than the other Regions. In addition, 100 percent of Region VI and VII enforcement actions are led by the Federal government and 100 percent of Region VIII were enforcement actions were State-lead.

Exhibit 35
Five Year Enforcement and Compliance Summary for the Electronics/Computer Industry

A	B	C	D	E	F	G	H	I	J
Electronics/Computer Industry SIC 36	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	47	39	147	20	13	40	72%	27%	0.27
Region II	27	20	135	13	9	6	83%	17%	0.04
Region III	24	19	114	13	2	10	90%	10%	0.09
Region IV	24	17	116	13	13	43	98%	2%	0.37
Region V	68	34	118	36	14	25	88%	12%	0.21
Region VI	36	23	55	41	4	6	0%	100%	0.11
Region VII	8	7	34	15	2	4	0%	100%	0.12
Region VIII	17	10	50	21	4	18	100%	0%	0.36
Region IX	165	62	112	93	23	59	57%	43%	0.53
Region X	23	16	39	37	6	16	94%	6%	0.41
Total/Average	439	247	920	30	90	227	77%	23%	0.25

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 36 and 37 below present five and one year enforcement and compliance summaries for selected industries. The exhibits show that the number of inspections for the electronics/computer industry is low in comparison to other industries, and the average time between inspections is longer than other industries.

Exhibit 38 and 39 present five and one year inspection and enforcement summaries by statute. As expected, a significant percentage of inspections and enforcement actions involving electronics facilities are RCRA-related. This is in part due to the large amount of solvents used and sludges generated during various stages of the manufacturing process. The exhibit also shows a significantly lower percentage of Clean Air Act and Clean Water Act inspections and actions. This is somewhat surprising in light of the VOC emissions and the wastewaters and rinsewaters contaminated with spent solvents and acids generated by this industry.

Exhibit 36
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics/Computers	**405**	**222**	**777**	**31**	**68**	**212**	**79%**	**21%**	**0.27**
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

R0075061

Exhibit 37
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

R0075062

Exhibit 38
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

R0075063

Exhibit 39
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

VII.C. Review of Major Legal Actions

This section provides a listing of major legal cases and supplemental enforcement projects that pertain to the Electronics/Computer Industry. Information in this section is provided by EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* and the Office of Enforcement.

VII.C.1. Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in the EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* publications, 16 significant enforcement actions involving the electronics/computer industry were resolved between 1991 and 1993. CERCLA violations comprised nine of these cases, the most of any statute. Following CERCLA violations were five cases involving CWA violations, three involving RCRA violations, and one involving a TSCA violation. Two of the sites were Superfund sites. Several of the settlements required reimbursement of Superfund response costs or payment of the remedial costs. The companies against which the cases were brought are primarily manufacturers of electrical components such as printed wiring boards. The other companies performed electroplating operations and manufactured electrical equipment.

Four of the sixteen actions resulted in the assessment of a penalty. Penalties ranged from $25,000 to $300,000. The average penalty was approximately $178,125. In a case involving General Electric, the company was subject to a penalty and agreed to pay for removal and disposal of PWB electrical equipment over a period of three years at an estimated cost of one million dollars. In the case of U.S. v. Electrochemical Co., Inc., the court stated it would suspend $225,000 of a $250,000 fine if the company would clean up the contaminated area.

Although many cases involved civil penalties, four of the cases involved criminal convictions, resulting in penalties and/or jail sentences for the owners and operators of the facilities. All of these cases involved electroplating facilities and CWA violations. In one case, U.S. v. Robert H. Schmidt and Lawrence B. Schmidt, the owner was sentenced to 30 months in prison, followed by two years of probation. His son, the plant supervisor, was sentenced to 24 months of jail and two years of probation. Father and son were subject to penalties of $50,000 and $25,000 respectively.

VII.C.2. Supplemental Environmental Projects

Below is a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. Exhibit 40 contains a representative sample of the Regional responses addressing the electronics and computer industries. The information contained in the chart is not comprehensive and provides only a sample of the types of SEPs developed for the electronics and computer industries.

Exhibit 40
Supplemental Environmental Projects
Electronics/Computer Industry (SIC 36)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Lane Electronic Cooperative Eugene, OR	10	TSCA	Pollution Reduction	$ 9,775	Early disposal of PCBs or PCB contaminated electrical equipment.	$ 9,775	$ 4,888
Cirtech, Inc.	9	RCRA	Pollution Prevention	$ 9,900	Purcahse and install a device to eliminate copper from the waste stream and to reduce the hazardous waste stream. Will allow corrosive etch water to be reused.	$11,400	$ 7,630
Universal Circuits	9	EPCRA	Pollution Prevention		Implement a waste water recycling project which permanently reduces the consumption of water. Sponsor and conduct an outreach program		
Trojan Battery	9	EPCRA			Eliminate wastewater discharges. Operate a battery recycling center.		
G & W Electric Company Blue Island, IL	5	EPCRA	Pollution Prevention	$ 97,000	Implement process modifications designed to eliminate the use of 72,000 lbs/yr of 1,1,1,-trichloroethane.	$ 68,000	$ 7,825
Manu-Tronics Kenosha, WI	5	EPCRA	Pollution Prevention	$ 81,700	Modify the industrial processes eliminate the use and release of 25,000 lbs/yr of Freon 113.	$ 34,000	$ 3,400
Anchor Electric Co. Manchester, NH	1	EPCRA	Pollution Prevention	$40,000	Purchase, install, and operate an aqueous washer system in place of current vapor degreaser. Change will result in virtual elimination of the use of 1,1,1,-trichloroethane.	$51,000	$13,650

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

VIII.A.1. Federal Activities

Common Sense Initiative (CSI)

The Common Sense Initiative (CSI), a partnership between EPA and private industry, aims to create environmental protection strategies that are cleaner for the environment and cheaper for industry and taxpayers. As part of CSI, representatives from Federal, State, and local governments; industry; community-based and national environmental organizations; environmental justice groups; and labor organizations, come together to examine the full range of environmental requirements affecting the following six selected industries: automobile manufacturing; computers and electronics, iron and steel, metal finishing, petroleum refining; and printing.

CSI participants are looking for solutions that:

- Focus on the industry as a whole rather than one pollutant
- Seek consensus-based solutions
- Focus on pollution prevention rather than end-of-pipe controls
- Are industry-specific.

The Common Sense Initiative Council (CSIC), chaired by EPA Administrator Browner, consists of a parent council and six subcommittees (one per industry sector). Each of the subcommittees have met and identified issues and project areas for emphasis, and workgroups have been established to analyze and make recommendations on these issues.

Design for the Environment (DfE)

DfE is an EPA program operated by the Office of Pollution Prevention and Toxics. DfE is a voluntary program which promotes the use of safer chemicals, processes, and technologies in the earliest product design stages. The DfE program assists industry in making informed, environmentally responsible design choices by providing standardized analytical tools for industry application and providing information on the comparative environmental and human health risk, cost, and performance of chemicals, processes, and technologies. DfE also helps small businesses by analyzing pollution prevention alternatives and disseminating the information to industry and the public. By helping to translate pollution prevention into meaningful terms, DfE contributes to building the institutional structure in corporations to support pollution prevention. DfE activities fall into two broad categories: (1) the industry-specific projects which encourage businesses to incorporate pollution prevention into their designs; and (2) long-term projects that translate pollution prevention into terms that make sense to professions such as chemistry, chemical engineering, marketing, accounting, and insurance.

DfE currently is working with the PWB industry because it is a critical component of the electronics, automotive, and defense industries. Also, MCC's lifecycle assessment of a computer work station study recognized that chemical processes such as those used in PWB fabrication are a significant source of hazardous waste and consume large amounts of water and energy. The potential for improvement in those areas led EPA's DfE Program to sponsor a project to assist the PWB industry in evaluating substitute materials and processes for making PWB holes conductive. DfE also plans to help the PWB industry identify multi-media environmental issues and the trade-offs of competing environmental objectives.

Industry/Government Partnerships

In 1993, the initial results of a six month lifecycle assessment of a computer workstation was released in a report called *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry; Comprehensive Report: Analyses and Synthesis, Task Force Reports, and Appendices*. The study was conducted by Microelectronics and Computer Technology Corp. (MCC), SEMATECH (sponsored by the Semiconductor Industry Association), EPA, and the Department of Energy (DOE).

As a result of the assessment, the Department of Defense funded an industry led effort, the first phase of which involved development of the *Electronics Industry Environmental Roadmap*, which prioritizes the electronics and computer industries' environmental needs over the next ten years. The goal of the *Roadmap* is to assist U.S. companies to compete with foreign competitors who have established partnerships with their governments. MCC produced the *Electronics Industry Environmental Roadmap* in November 1993. MCC has received funding from the Department of Defense Advanced Research Projects Agency (ARPA) and EPA to continue to working with industry task groups to compile information, learn the needs of industry, and to suggest possible solutions to environmental/economic problems.

VIII.A.2. State Activities

Several States are actively involved in promoting pollution prevention by initiating partnerships with industry to develop and implement pollution prevention and waste minimization practices. Following is a description of some State pollution prevention initiatives related to the electronics/computer industry.

The **Minnesota Technical Assistance Program (MnTAP)** is supported by a grant to the University of Minnesota's School of Public Health. MnTAP staff and interns assists Minnesota businesses in the electronics and computer industries by identifying effective waste reduction opportunities. MnTAP researches treatment options, makes on-site visits to discuss recommendations, and coordinates documentation. MnTAP developed a checklist for businesses to evaluate their waste streams and identify waste reduction opportunities. MnTAP gathered vendor and technical information that may assist facilities in the industry in their evaluations in addition to a list of recycling vendors if the options on the checklists are not feasible to implement. Pollution prevention techniques for the electronics and computer industries that were recommended by MnTAP include material substitution, process modification, and recycling.

The **State of Minnesota's Office of Waste Management (OWM)** also has a Pollution Prevention Research Award Program. The program is part of Minnesota's efforts to promote pollution prevention. OWM contracts with private industry to investigate available pollution prevention alternatives in the electronics and computer industries. The process involves literature searches, telephone surveys, case study development, and working with trade associations and MnTAP. In July 1992, four cases studies were written as part of a report on alternatives to cyanide solutions in electroplating. OWM encourages implementation of pollution prevention techniques such as material substitution, recycling, process modification, wastewater treatment, electroplating, and the recycling of spent printed wiring boards.

The **North Carolina Department of Natural Resources and Community Development** has a Pollution Prevention Pays Program. The program provides technical, cost (operating and capital), economic benefit, and environmental benefit information to the public and facilities in the electronics and computer industries. The program recommends equipment modification, recycling, and process modification/pollution prevention techniques for the treatment of wastewater generated by electroplating processes.

The **City of Los Angeles' Board of Public Works** has a Hazardous and Toxic Materials Project (HTMP). HTMP provides fact sheets to the public and facilities in the electronics and computer industry describing different strategies to reduce the cost and quantity of waste generated. Pollution prevention techniques include material substitution, process modification, and recycling. HTMP also provides information on vendors who provide alternative waste management services.

The **City of Santa Monica's Department of General Services** provides fact sheets and information on pollution prevention to businesses. The City outlines pollution prevention techniques for printed circuit board manufacturing in fact sheets. The fact sheets rate waste reduction practices in terms of easiest, more difficult, and most difficult to implement. The fact sheets also provide contacts from the Department of Health Services, small business assistance loan programs, and California agencies with waste reduction programs.

Other pollution prevention initiatives that have targeted the electronics and computer industries include: the Hazardous Waste Reduction Program of the Oregon Department of Environmental Quality (DEQ); the New Jersey Hazardous Waste Facilities Siting Commission of the Hazardous Waste Source Reduction and Recycling Taskforce; and the San Diego County Department of Health Services.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who met their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

Thirty-four companies and 72 facilities listed under SIC 36 (the electronics/computer industry) are currently participating in the 33/50 program. They account for approximately 17 percent of the 406 companies under SIC 36, which is slightly higher than the average for all industries of 14 percent participation. (Contact: Mike Burns 202-260-6394 or the 33/50 Program 202-260-6907)

Exhibit 41 lists those companies participating in the 33/50 program that reported under SIC code 36 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to electronics/computer industry. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

R0075072

Exhibit 41
Electronics/Computer Industry Facilities (SIC 36) Participating in the 33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Aluminum Company Of America	Pittsburgh	PA	3674	1	2,403,017	51
American Telephone & Telg Co	New York	NY	3672, 3661	3	512,618	50
Amp-Akzo Corporation	Chadds Ford	PA	3672	3	51,196	1
Benton International Inc	North Haven	CT	3672	1	26	2
Boeing Company	Seattle	WA	3728, 3769, 3672	1	4,789,875	50
Buckbee-Greig Holding Corp	Minneapolis	MN	3672	1	500	**
Burle Industries Inc	Lancaster	PA	3671, 3663, 3699	1	12,200	*
Eaton Corporation	Cleveland	OH	3674	1	450,211	50
General Motors Corporation	Detroit	MI	3651, 3694, 3679, 3672, 3471	3	16,751,198	
Gti Corporation	San Diego	CA	3674	1	13,961	*
Hadco Corporation	Salem	NH	3672	2	63,469	91
Harris Corporation	Melbourne	FL	3674	3	110,355	**
Hewlett-Packard Company	Palo Alto	CA	3674	2	7,400	50
IBM	Armonk	NY	3674	6	1,411,304	1
Intel Corporation	Santa Clara	CA	3674	3	18,105	50
Itt Corporation	New York	NY	3670, 3674	2	735,332	7
Litton Industries Inc	Beverly Hills	CA	3672	1	332,264	**
Lucerne Products Inc	Hudson	OH	3699, 3674	1	2,505	***
Martin Marietta Corporation	Bethesda	MD	3672, 3761, 3812	1	223,286	73
Motorola Inc	Schaumburg	IL	3674	4	226,357	50
National Semiconductor Corp.	Santa Clara	CA	3674	3	23,173	6
North American Philips Corp	New York	NY	3674	2	1,281,928	50
Photocircuits Corporation	Glen Cove	NY	3672, 3471	2	292,178	92
Raytheon Company	Lexington	MA	3674	2	706,045	50
Rockwell International Corp	Seal Beach	CA	3669, 3672	1	1,007,043	50
Seh America Inc.	Vancouver	WA	3674, 3339	1	53,140	100
Sony USA Inc	New York	NY	3674	2	869,577	51
Talley Industries Inc	Phoenix	AZ	3672, 3822, 3548	1	3,804	***
Tektronix Inc	Beaverton	OR	3672	1	12,393	*
Texas Instruments Incorporated	Dallas	TX	3674	5	344,225	25
Thomson Consumer Electronics	Indianapolis	IN	3671	4	2,110,314	43
Varian Associates Inc	Palo Alto	CA	3671	3	67,417	50
Westinghouse Electric Corp	Pittsburgh	PA	3672, 3812	3	1,137,198	28
Zenith Electronics Corporation	Glenview	IL	3671	1	917,894	25

*** = not quantifiable against 1988 data.**
**** = use reduction goal only.**
***** = no numerical goal.**

R0075073

Energy Star Computer Program

The Energy Star Computer program is a voluntary partnership between the EPA and computer companies that manufacture energy-efficient computer equipment such as desktop computers, printers, and monitors. The companies that participate in this program comprise 70 percent of all U.S. sales of desktop computers and 90 percent of laser printers. In order for a computer to qualify and display the EPA Energy Star logo, it must operate on low power when inactive and can "sleep" or "power-down," and then awaken by touching the mouse or keyboard. The program requires that the central processing unit, printer, and monitor of the computer must enter a standby mode when not in use and use no more than 30 watts. Energy-efficient computers were available to the public and businesses as of June 1993.

Computer equipment is the fastest growing user of electricity in the commercial sector. Currently, computers account for five percent of commercial electricity consumption, and this is expected to grow to 10 percent by the year 2000. The Energy Star sleep feature can reduce electricity consumption by 50 to 75 percent. In addition, the efficient systems generate less heat while the computer sleeps, which reduces electricity needed to cool a building by five to ten percent. These computers are predicted to diminish electricity consumption by 25 billion kilowatts hours per year by the year 2000. The reduction of electricity use would eliminate the need for 10 coal-fired plants and reduce carbon-dioxide emissions by up to 20 million tons. An Executive Order, which was issued in April 1993 and took effect in October 1993, directed the U.S. government to purchase only Energy Star computer equipment where available and if performance needs are met. Implementation of the Executive Order is expected to save $40 million annually. (Contact: Maria Tikoff (202) 233-9178)

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director (202) 564-5081 or Robert Fentress (202) 564-7023)

Motorola ELP Project

Motorola is participating in a pilot phase of the Environmental Leadership Program with EPA and the State of Texas. Their Oak Hill facility located in Austin, Texas, will encompass two key projects, both in the pursuit of better environmental compliance. They are mentoring another facility and applying an environmental management system that aims to go beyond compliance status. (Contact: Steve Hoover (202) 564-7007)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Jon Kessler at (202) 260-4034)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at (202) 233-9065 or the Green Light/Energy Star Hotline at (202) 775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWiSe logo for promotional purposes. (Contact: Lynda Wynn (202) 260-0700 or the WasteWi$e Hotline at (800) 372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman (202) 260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office (303) 275-4729)

VIII.C. Trade Association Activity

Many trade associations have been involved in researching ways to reduce pollution associated with the manufacturing of semiconductors, printed wiring boards, and cathode ray tubes. Following is description of the trade association environmental programs or partnerships. A list of some of the major trade associations and contacts is also provided.

VIII.C.1. Environmental Programs

The Semiconductor Industry Association (SIA), in association with EPA and DOE, released a report in March 1993 called *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry.* This report contains the initial results of a six month, lifecycle assessment of a computer workstation. The report indicates that the industry should pursue the development of pollution prevention and waste minimization techniques in the printed wired board (PWB) manufacturing industry. As a result of this study, EPA provided funding to the Institute for Interconnecting and Packaging Electronic Circuits (IPC) and Microelectronics and Computer Technology Corporation (MCC) to redesign PWB manufacturing processes in order to reduce the amount of chemicals used during production.

According to IPC, environmental research is also being conducted by the Interconnection Technology Research Institute (ITRI) and by many independent companies.

According to SIA, the Department of Defense has awarded SEMATECH $10 million to perform research into pollution prevention and environmentally friendly microchip manufacturing processes. As part of a separate initiative, SIA produced a report, *The National Technology Roadmap for Semiconductors*. The *Roadmap* acts as a guide for R&D investment decisions.

SIA's *Roadmap* calls for reducing the use of approximately 60 hazardous chemicals in various stages of the manufacturing process (e.g., mask making, photolithography, cleaning, leadframe plating, deflashing, and soldering). The chemicals include solvents, acids, toxics, alcohols, and other organic and inorganic substances. The goal of the *Roadmap* is to phase out ozone depleting substances and targeted ethylene glycol ethers during the next 15 years. The *Roadmap* identifies 46 projects for implementation in 1994 that involved process modifications. The majority of the process modifications center around alternatives to wet chemical processes and continued progress in development of alternative technologies for applying layers of silicon to the wafer. The development of water-based (or gas process) cleaners and resists is also a priority.

VIII.C.2. Trade Associations

Electronic Industries Association (EIA) 2500 Wilson Boulevard Arlington, VA 22201 Phone: (703) 907-7500 Fax: (703) 907-7501	Members: 1200 Staff: 150 Budget: $25,000,000 Contact: Peter McCloskey

EIA was founded in 1924, and represents manufacturers of electronic components, parts, systems, and equipment for communications, industrial, government, and consumer use. EIA publishes a free, semiannual *EIA Publications Index* that contains price, content, and ordering information for their publications. EIA works to develop sound environmental practices by promoting research, workshops, and tool development through a variety of industry committees.

American Electronics Association (AEA) 5201 Great American Parkway, Suite 520 Santa Clara, CA 95054 Phone: (408) 987-4200 Fax: (408) 970-8565	Members: 3500 Staff: 140 Budget: NA Contact: J. Richard Iverson

AEA was founded in 1943, and is a trade association that represents the U.S. electronics/computer industry. Formerly known as the West Coast Electronic Manufacturer Association (WEMA), AEA's programs and services include: public affairs, educational meetings conferences, and executive summits. AEA publishes an annual directory; a monthly association and trade news publication, *American Electronics Association,* which includes legislative briefs, industry statistics, and a calendar of events; a periodic California Legislative Bulletin; and handbooks, manuals, and surveys. In addition, AEA sponsors an annual Systems/USA trade show.

National Electronic Manufacturing Association (NEMA) 2101 L Street, NW, Suite 300 Washington, DC 20037 Phone: (202) 457-8400 Fax: (202) 457-8411	Members: 600 Staff: 100 Budget: $10,000,000 Contact: Malcolm O'Hagan

NEMA was established in 1926. NEMA represents companies that manufacture equipment used for the generation, transmission, distribution, control, and utilization of electric power. NEMA was formed by the merger of Associated Manufacturers of Electrical and Supplies and the Electronic Power Club. NEMA's areas of interest include: electrical machinery; motors; and industrial automation, construction, utility, medial diagnostic imaging, transportation, communication, and lighting equipment. NEMA's objectives are to maintain and enhance the quality and reliability of products, ensure safety standards in the manufacturing and use of products, and to organize and act upon members' interest in areas such as energy conservation, efficiency and foreign competition. NEMA conducts regulatory and legislative analysis on issues of concern to electronic manufacturers, and compiles periodic summaries of statistical data on sales and production. In addition, NEMA publishes a periodic directory; a free, semiannual catalog of its publications and materials; *Tech Alert* bimonthly; and manuals, guidebooks, and other material on wiring, equipment installation, lighting, and standards.

Semiconductor Equipment and Materials International (SEMI) 805 E. Middlefield Road Mountain View, CA 94043 Phone: (415) 964-5111 Fax: (415) 967-5375	Members: 1750 Staff: NA Budget: NA Contact: William H. Reeds

SEMI was founded in 1970, and represents firms, corporations, and individuals who participate in supplying fabrication equipment, materials, or services to the semiconductor industry. SEMI operates an industry data collection program, conducts SEMI Technical Education Programs, and provides an annual Information Services Seminar (ISS) forecast. SEMI is the former Semiconductor Equipment and Materials Institute. SEMI publishes an annual *Book of SEMI Standards*, the annual *Business Outlook for the Semiconductor Equipment and Materials Industry*; a bimonthly newsletter providing general industry news; a quarterly newsletter, *SEMI Outlook*, that provides information on industry trends, analyses, and opinions; and the SEMICON Technical Proceedings which contains the proceedings and paper topics from the Institute's technical symposia.

Institute for Interconnecting and Packaging Electronic Circuits (IPC) 2215 Sanders Road, Suite 200 South Northbrook, IL 60062 Phone: (708) 677-2850 Fax: (708) 677-9570	Members: 1900 Staff: 42 Budget: NA Contact: Thomas Dammrich

Founded in 1957, IPC represents companies that produce and use electronic interconnections for electronic equipment. IPC's primary members are independent PWB manufacturers and contract assembly companies that mount components onto bare PWBs to produce printed wiring assemblies (PWAs) or electronic assemblies. IPC also represents original equipment manufacturers (OEMs), suppliers, academia, and technical members of the industry. IPC has over 100 committees, that cover all aspects of the industry including: technical standards; specifications and guidelines; education and training; technology research and development; market research and publications; management practices; environmental and safety programs; and government regulations.

Semiconductor Industry Association (SIA) 4300 Stevens Creek Boulevard Suite 271 San Jose, CA 95129 Phone: (408) 246-2711 Fax: (408) 246-2830	Members: 40 Staff: 14 Budget: $2,000,000 Contact: Andrew Procassini

SIA represents companies that produce semiconductor products including discrete components, integrated circuits, and microprocessors. This association compiles industry trade statistics and maintains a private library and sponsors the Semiconductor Research Corporation and SEMATECH. SIA's publications include the following: *Circuit*, a free, quarterly newsletter; Semiconductor Yearbook and Directory, which contains a review of programs sponsored by the association, key industry statistics, analyses by industry experts, public policy discussions, and sales volume; and essays, research reports, and proceedings.

Computer and Communications Industry Association (CCIA) 666 11th Street, NW Washington, DC 20001 Phone: (202) 783-0070 Fax: (202) 783-0534	Members: 60 Staff: 10 Budget: $1,000,000 Contact: A.G.W. Biddle

Comprised of computer manufacturers, CCIA provides information processing and telecommunication-related products and services. CCIA represents the interests of its members before Congress, Federal agencies, and the courts in the areas of domestic and foreign trade, tax policy, Federal procurement policy, and telecommunication policy. It hosts policy briefings on legislative and regulatory matters to keep members aware of policy, political, technological, and market and economic developments and trends. CCIA publishes *CEO Report* semimonthly and *Federal Procurement Policy Report*, *International Trade Report*, and *Telecommunication Report* on a monthly basis.

IX. BIBLIOGRAPHY/OTHER MATERIALS AVAILABLE

For further information on selected topics within the electronic and computer industries, a list of publications are provided below:

General Profile

1992 Census of Manufacturers Industry Series: Preliminary Report, Bureau of the Census, November 1994. (MC92-1 - 36 E(P)).

1987 Census of Manufacturers Industry Series 36A: Electronic Transmission and Distribution Equipment, Bureau of the Census, April 1990. (MC87-I-36A).

1987 Census of Manufacturers Industry Series 36B: Household Appliances, Bureau of the Census, April 1990. (MC87-I-36B).

1987 Census of Manufacturers Industry Series 36C: Electric Lighting and Wiring Equipment, Bureau of the Census, April 1990. (MC87-I-36C).

1987 Census of Manufacturers Industry Series 36D: Communication Equipment, Bureau of the Census, April 1990. (MC87-I-36D).

1987 Census of Manufacturers Industry Series 36E: Electronic Components, Bureau of the Census, April 1990. (MC87-I-36E).

1987 Census of Manufacturers Industry Series 36F: Miscellaneous Electrical Equipment and Supplies, Bureau of the Census, April 1990. (MC87-I-36F).

1992 Globalisation of Industrial Activities: Four Case Studies: Auto Parts, Chemicals, Construction and Semiconductors. Organization for Economic Co-Operation and Development, Paris, 1992.

American Electronics Association (AEA), Personal communication with Roger Stabeele, February 8, 1994.

Annual 1993 Current Industrial Reports MA36Q—Semiconductors, Printed Circuit Boards, and Other Electronic Components, Bureau of the Census Bulletin Board Service, Washington, D.C., 1994.

Annual 1992 Current Industrial Reports MA36Q(92)-I—Semiconductors, Printed Circuit Boards, and Other Electronic Components, Bureau of the Census Bulletin Board Service, Washington, D.C.

Burris, G.R., Manager of Corporate Environmental Engineering, Indianapolis, IN. Background information on cathode ray tubes, 1995.

Developing The Electronics Industry, Björn Wellenius, The World Bank, 1993.
Dun & Bradstreet, Dun's Market Identifiers, DIALOG Information Services, 1994.

Electronic Industry Environmental Roadmap, Microelectronics and Computer Technology Corporation (MCC), Austin, TX, 1994.

Electronic Industries Association (EIA), Arlington, VA, News release dated January 2, 1995.

Electronic Market Data Book, EIA, Arlington, VA, ,1994.

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc., Detroit, Michigan, 1992.

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Federal Environmental Regulations Potentially Affecting The Computer Industry, U.S. EPA, Office of Pollution Prevention and Toxics (EPA 744-B-93-002), April 1994.

Getting A Charge Out Of The Waste Stream, David Hurd, New York State Department of Economic Development, February 1992.

Industry and Trade Summary: Semiconductors, U.S. International Trade Commission, December 1993.

Institute for Interconnecting and Packaging Electronic Circuits (IPC), Washington, DC. Background information on printed wiring boards, 1995.

Options Proposed for Managing Discarded Fluorescent and Other Lights that Contain Mercury, Environmental Fact Sheet, U.S. EPA, Solid Waste and Emergency Response (EPA 530-F-94-022), July 1994.

Polychlorinated Biphenyl (PWB) Information Package, TSCA Information Service, April 1993.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Industrial Outlook 1994, Department of Commerce 1994.

Process Descriptions, Release Profiles, and Pollution Prevention

1992 Toxic Release Inventory (TRI) Public Data Release, U.S. EPA, Office of Pollution Prevention and Toxics, April 1994. (EPA/745-R94-001)

Circuit Board Packet, U.S. EPA, Pollution Prevention Information Center.

Case Studies from the Minnesota Technical Assistance Program and the Oregon Hazardous Waste Reduction Program: Metal Finishing, U.S. EPA, Office of Environmental Engineering and Technology Demonstration and the Office of Pollution Prevention, November 1989.

Case Studies from the Pollution Prevention Information Center (PPIC): Electroplating, U.S. EPA, Office of Environmental Engineering and Technology Demonstration and the Office of Pollution Prevention, November 1989.

Electroplating Packet, U.S. EPA, Pollution Prevention Information Center.
Facility Pollution Prevention Guide, U.S. EPA, Office of Research and Development (EPA/600/R-92/088), May 1992.

"Etching Away with Ion Beams", *The Washington Post,* Elizabeth Corcoran, April 18, 1995, p. D1.

Guidelines for Waste Reduction and Recycling: Metal Finishing, Electroplating, and Printed Circuit Board Manufacturing, Oregon Department of Environmental Quality, Hazardous Waste Reduction Program, July 1989.

Green Lights: Third Annual Report, U.S. EPA, Office Air and Radiation (EPA 430-R-94-005), March 1994.

Hazard Assessment and Control Technology in Semiconductor Manufacturing II, American Conference of Government Industrial Hygienists, 1993.

Industry Profile and Description of chemical for the Semiconductor Industry, March 1993.

Industry Profile for the Metal Finishing Industry: Preliminary Draft, U.S. EPA, Office of Pollution Prevention and Toxics, Design for the Environment, June 24, 1994.

Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft, U.S. EPA, Office of Pollution Prevention and Toxics, Design for the Environment, March 1993.

Industry Profile and Description of Chemical Use for the Semiconductor Industry: Preliminary Draft, U.S. EPA, Office of Pollution Prevention and Toxics, Design for the Environment, March 1993.

Light Brief: Green Lights Program, U.S. EPA, Office Air and Radiation (EPA 430-F-92-009), August 1992.

Lighting Waste Disposal, U.S. EPA Office Air and Radiation, January 1994.

McGraw-Hill Encyclopedia of Science & Technology, vols. 4, 6, 7, 9, 11, 14, 16, 17,18, 19 McGraw-Hill Book Company, New York, New York, 1987, 1992.

Metals Handbook: Cleaning and Finishing Stainless Steel, 9th ed., American Society for Metals, 1982.

Metals Handbook: Fabrication of Wrought Stainless Steel, 9th ed., American Society for Metals, 1982.

Microchip Fabrication: A Practical Guide to Semiconductor Processing, 2nd ed., Peter Van Zant, McGraw Hill, Inc. 1990.

Metal Industries - Metal Finishing Manufacturing Packet, U.S. EPA, Pollution Prevention Information Center.

Pollution Prevention 1991 Progress on Reducing Industrial Pollutants, U.S. EPA, Office of Pollution Prevention (EPA 21 P-3003), October 1991.

Pollution Prevention in Metal Manufacturing: Saving Money Through Pollution Prevention, U.S. EPA, Office of Pollution Prevention and Toxics (EPA/530-SW-89/056), October 1989.

Pollution Prevention Research Project: Evaluation of Alternatives to Halogenated Solvents for Cleaning and Drying Printed Circuit Boards-Final Report, Minnesota Office of Waste Management and Capsule Environmental Engineering Inc., July 30, 1992.

Printed Circuit Board Basics: Quick and Easy Guide, 2nd Ed., Michael Flatt, 1992.

Semiconductor Business: The Economics of Rapid Growth and Decline, Franco Malerba, University of Wisconsin, 1985.

Semiconductor Technology for the Non-Technologist, 2nd ed., Robert I. Scace, U.S. Department of Commerce, September 1990.

Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, Office of Emergency and Remedial Response, June 1994.

Title II Section 313 Release Reporting Guidance: Estimating Chemical Releases from Semiconductor Manufacturing, U.S. EPA, Office of Pesticides and Toxic Substances (EPA 560/4-88-004e), January 1998.

Contacts*	Organization	Telephone
John Kim	EPA Region IX Inspector	415-744-1263
Greg Arthur	EPA Region IX Inspector	415-744-1900
Bill Hurley	AEA	408-987-4200
Debbie Boger	EPA Design for the Environment	202-260-0880
Steven Pederson	MCC	512-250-2758
Karen Phillips	EPA Region IX Inspector	415-749-4979
Dave Dellarco	EPA Region X, Office of Policy, Planning, and Pollution Prevention	206-553-4978
Daryl Burns	CA Air Resource Board	916-445-0960
Jack Bean	EPA Region IX, Air Quality Manager	415-749-4748
Michael Avery	West Coast Circuits, Inc.	408-728-4271
Christopher Rhodes	IPC	708-677-2850
Melissa Coggeshall Carey	EIA	703-907-7501
George Burris	Thompkins Consumer Electronics	317-587-4335
Bill Rowe	Zenith	708-450-4122

* Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies: environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROSEN$E WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

R0075087

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Order Processing Code:
* 3212

Qty.	Stock Number	**Published in 1995** Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	**Published in 1997** Title	Price Each	Total Price
	055-000-00570-2	Air Transportation Industry, 90 pages	$ 7.50	
	055-000-00571-1	Ground Transportation Industry, 130 pages	10.00	
	055-000-00572-9	Water Transportation Industry, 90 pages	7.50	
	055-000-00573-7	Metal Casting Industry, 150 pages	13.00	
	055-000-00574-5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055-000-00575-3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055-000-00576-1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055-000-00577-0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055-000-00578-8	Textile Industry, 130 pages	10.00	
	055-000-00579-6	Sector Notebook Data Refresh -1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

- ❑ Check payable to Superintendent of Documents
- ❑ GPO Deposit Account
- ❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) ***Thank you for your order!***

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250-7954

Important: Please include this completed order form with your remittance.

R0075088

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

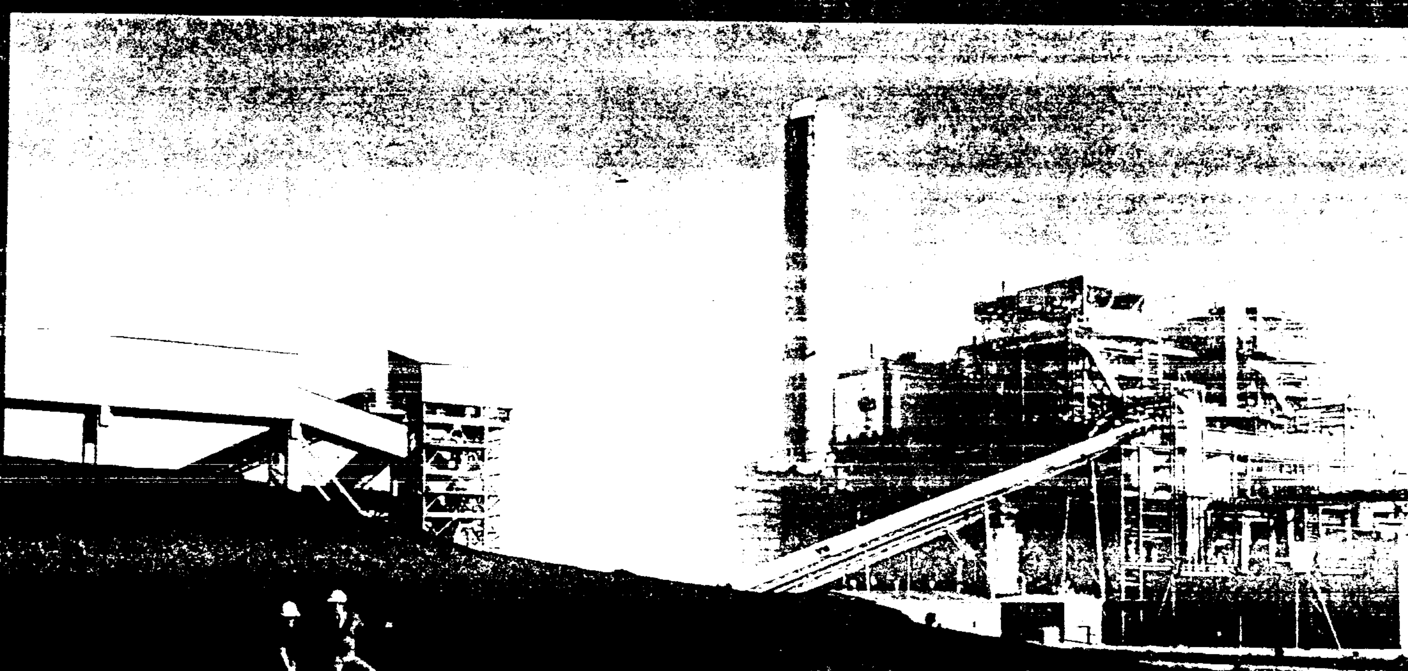
United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2223A)

EPA [illegible]
September [illegible]

EPA

Profile Of The Fossil Fuel Electric Power Generation Industry



SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

R0075090

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 18 1997

THE ADMINISTRATOR

Message from the Administrator

Since EPA's founding over 25 years ago, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and those as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper and smarter. As a result, we no longer have rivers catching fire. Our skies are clearer. American environmental technology and expertise are in demand around the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

The Environmental Protection Agency has undertaken its Sector Notebook Project to compile, for major industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with an extensive series covering other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to understand better their regulatory requirements, and learn more about how others in their industry have achieved regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that we together achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-97-007

EPA Office of Compliance Sector Notebook Project

Profile of the Fossil Fuel Electric Power Generation Industry

September 1997

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2223-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-049399-4

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, and local governments, and the media from EPA's National Center for Environmental Publications and Information at (800) 490-9198. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph courtesy of Arizona Electric Power Cooperative, Inc.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Questions relating to the Sector Notebook Project can be directed to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Anthony Raia	564-6045
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Anthony Raia	564-6045
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equip. Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Manmade Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Fossil Fuel Elec. Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017

[This page intentionally left blank.]

FOSSIL FUEL ELECTRIC POWER GENERATION INDUSTRY (SIC 4911, 493) TABLE OF CONTENTS

R0075096

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ACAA	American Coal Ash Association
AEE	Association of Energy Engineers
AEPCO	Arizona Electric Power Cooperative
AFS	AIRS Facility Subsystem (CAA database)
AIRS	Aerometric Information Retrieval System (CAA database)
APPA	American Public Power Association
ANL	Argonne National Laboratory
BACT	Best Available Control Technology
BIFs	Boilers and Industrial Furnaces (RCRA)
BOD	Biochemical Oxygen Demand
BPJ	Best Professional Judgment
BTU	British Thermal Unit
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
$CaCl_2$	Calcium Chloride
CAPI	Clean Air Power Initiative
CCGT	Combined-Cycle Gas Turbine
CCP	Coal Combustion Product
CCT	Clean Coal Technology Demonstration Project (DOE)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	CERCLA Information System
CEQ	Council for Environmental Quality
CFC	Chlorofluorocarbon
CHIEFs	Clearing House of Inventory Emissions Factors
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CP&L	Carolina Power and Light
CSI	Common Sense Initiative
CWA	Clean Water Act
D&B	Dun and Bradstreet Marketing Index
DOE	Department of Energy
DSA	Dimensionally stable
DSM	Demand Side Management
EA	Environmental Assessment
EDS	Effluent Data Statistics System
EEI	Edison Electric Institute
EIA	Energy Information Administration (DOE)
EIS	Environmental Impact Statement
ELP	Environmental Leadership Program
EMS	Environmental Management System

EPA	U.S. Environmental Protection Agency
EPACT	Energy Policy Act of 1992
EPCRA	Emergency Planning and Community Right-to-Know Act
EPRI	Electric Power Research Institute
EPSA	Electric Power Supply Association
EWG	Exempt Wholesale Generators
FAC	Free Available Chlorine
FBC	Fluidized Bed Combustion
FERC	Federal Energy Regulatory Commission
FGD	Flue Gas Desulfurization
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FONSI	Finding of No Significant Impact
HAPs	Hazardous Air Pollutants (CAA)
HCFC	Hydrochloroflourocarbon
HSDB	Hazardous Substances Data Bank
HSWA	Hazardous and Solid Waste Amendments of 1984
IDEA	Integrated Data for Enforcement Analysis
ICCR	Industrial Combustion Coordinated Rulemaking
IGCC	Integrated Coal Gasification Combined-cycle
IPP	Independent Power Producer
KW	Kilowatt
LAER	Lowest Achievable Emissions Rate
LDR	Land Disposal Restrictions (RCRA)
LEPC	Local Emergency Planning Committee
MACT	Maximum Achievable Control Technology (CAA)
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEK	Methyl Ethyl Ketone
MSDS	Material Safety Data Sheet
MW	Megawatt
NAAQS	National Ambient Air Quality Standards (CAA)
NAFCOG	North American Fuel Cell Owner Group
NAFTA	North American Free Trade Agreement
NAICS	North American Industry Classification System
NCDB	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NERC	North American Reliability Council
NEIC	National Enforcement Investigation Center
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGFC	Natural Gas Fuel Cell
NMHC	Non-Methane Hydrocarbon
NO_2	Nitrogen Dioxide
NOV	Notice of Violation

NO_x	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System (CWA)
NPL	National Priorities List
NRECA	National Rural Electric Cooperative Association
NRC	National Response Center
NSR	New Source Review
NSPS	New Source Performance Standards (CAA)
OAR	Office of Air and Radiation
OAQPS	Office of Air Quality Planning and Standards
OECA	Office of Enforcement and Compliance Assurance
OIT	Office of Industrial Technology (DOE)
OPA	Oil Pollution Act
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OTAG	Ozone Transport Assessment Group
OW	Office of Water
P2	Pollution Prevention
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PCB	Polychlorinated Biphenyl
PCS	Permit Compliance System (CWA Database)
PEPCO	Potomac Electric Power Company
PETC	Pittsburgh Energy Technology Center
PM	Particulate Matter
PMN	Premanufacture Notice
POTW	Publicly Owned Treatment Works
PSD	Prevention of Significant Deterioration (CAA)
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
PSE&G	Public Service Electric and Gas
PT	Total Particulate Emissions
PUHCA	Public Utility Holding Company Act
PURPA	Public Utility Regulatory Policies Act
QF	Qualifying Facility (PURPA)
RACT	Reasonably Achievable Control Technology
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System
RDF	Refuse Derived Fuel
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEP	Supplementary Environmental Project
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification

SIP	State Implementation Plan (CAA)
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
TCRIS	Toxic Chemical Release Inventory System
TDSS	Total Dissolved Suspended Solids
TOC	Total Organic Carbon
TRC	Total Residual Chlorine
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, or Disposal Facility (RCRA)
TSS	Total Suspended Solids
UARG	Utility Air Regulatory Group
UIC	Underground Injection Control (SDWA)
UST	Underground Storage Tanks (RCRA)
USWAG	Utility Solid Waste Activities Group
UWAG	Utility Water Act Group
VOC	Volatile Organic Compound

FOSSIL FUEL ELECTRIC POWER GENERATION INDUSTRY (SIC 4911, 493)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Integrated environmental policies based upon comprehensive analysis of air, water, and land pollution are a logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (i.e., air, water, and land) affect each other and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the U.S. Environmental Protection Agency (EPA) Office of Compliance led to the creation of this document.

The Sector Notebook Project was originally initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for 18 specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded to its current form. The ability to design comprehensive, common sense environmental protection measures for specific industries depends on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, however, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue and references where more in-depth information is available. Text within each profile was researched from a variety of sources and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. To check the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those who participated in this process who enabled the development of more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

The OECA Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2223-A), 401 M Street, SW, Washington, DC 20460. Comments can also be uploaded to the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing this system. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or repackage the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not covered in the original 18, please contact the Office of Compliance at (202) 564-2395.

II. INTRODUCTION TO THE FOSSIL FUEL ELECTRIC POWER GENERATION INDUSTRY

This Sector Notebook addresses the fossil fuel electric power generation industry, which comprises the majority of the total electric power generation industry. This subset of the industry includes only facilities that use either coal, petroleum, or gas as the energy source to generate electricity and does not include facilities that use nuclear or renewable (e.g., wood, solar) energy sources exclusively. However, this subset would include power generation activities at facilities that use both fossil fuels and another energy source. In addition, the scope of this profile is further limited to address only those facilities that generate electricity either as a primary activity or as an ancillary activity. The profile does not include facilities and activities associated with the transmission and distribution of electricity.

II.A Introduction, Background, and Scope of the Notebook

Fossil fuel electric power generation facilities are classified under Standard Industrial Classification (SIC) code 49, which includes establishments engaged in electric, gas, and sanitary services. These facilities can be further classified under the following three- and four-digit SIC codes from the *Standard Industrial Classification (SIC) Manual* of the Office of Management and Budget.

- **SIC 4911 - Electric Services**: Establishments that are engaged in the generation, transmission, and/or distribution of electric energy for sale.
- **SIC 493 - Combination Electric and Gas, and Other Utility Services**: Establishments providing electric or gas services in combination with other services. Establishments are classified here only if one service does not constitute at least 95 percent of revenues.

It should be noted that these SIC codes do not make the necessary distinctions between fuels used and generation versus transmission and distribution activities. Data available to characterize the fossil fuel electric power generation industry that use these SIC codes also may not distinguish between these categories of facilities. Where these categories of facilities and/or activities cannot be distinguished in the available data, it will be so noted within the profile.

Fossil fuel electric power generation facilities are also classified under a new system called the North American Industry Classification System (NAICS), which replaced the existing SIC codes in January 1997. The NAICS classification code for fossil fuel electric power generation is 221112.

Power generation facilities and activities exist in association with both traditional utilities or nonutility power producers. Traditional utilities are the regulated industry that produces and provides electricity for public use. Prior to 1980, nonutilities consisted of industrial manufacturers that produced electricity for their own use. Currently, nonutilities not only consist of industrial manufacturers, but also other industrial groups that provide electricity and other services for their own use and/or for sale to others. These categories are discussed further below.

This section provides background information on the size, geographic distribution, electricity production, sales, and economic condition of the fossil fuel electric power generation industry. The type of facilities described within the document are also described in terms of their SIC codes. Additionally, this section lists the largest companies in terms of sales.

II.B Characterization of the Fossil Fuel Electric Power Generation Industry

The U.S. Department of Energy's (DOE) Energy Information Administration (EIA) collects, evaluates, and disseminates information on the fossil fuel electric power generation industry. This information is published annually. In addition, industry trade associations collect information.

Available statistics on the fossil fuel electric power generation industry typically characterize the industry in terms of capacity, generating capability, net generation, and revenues. These terms are defined as follows:

- **Capacity** is the amount of electric power delivered or required for which a generator, turbine, or system has been rated by the manufacturer.
- **Capability** is the maximum load that a generating unit can be expected to carry under specified conditions for a given period of time without exceeding approved limits of temperature or stress. The net capability of a generating unit is always less than the rated capacity.
- **Net generation** is the total amount of electricity generated minus the electricity used by the facility itself.
- **Revenue** is the total amount of money received by a firm from sales of its products and/or services, gains from the sales or exchange assets, interest and dividends earned on investments, and other increases in the owner's equity except those arising from capital adjustments.

The following sections briefly summarize information available to characterize the industry.

II.B.1 Product Characterization

The product in fossil fuel electric power generation is electricity. Ancillary activities associated with the generation of electricity may generate other products, however. For example, cogeneration systems produce electricity, as well as another form of usable energy (i.e., steam or heat). In addition, utilities with SIC code 493 may produce other products, such as gas. These other products are beyond the scope of this profile.

II.B.2 Industry Size and Geographic Distribution of the Fossil Fuel Electric Power Generation Industry

In general, the power generation industry comprises both traditional and nontraditional electric-producing companies. They are called "utility" and "nonutility" power producers, respectively. A key difference between utilities and nonutilities is that utilities own generation, transmission, and distribution functions. Thus, utilities are "vertically" oriented. Nonutilities, on the other hand, generally own only generation capabilities. Often, the nonutilities must rely on utilities to sell the electricity they produce.

A utility power producer is generally defined as any person, corporation, municipality, State political subdivision or agency, irrigation project, Federal power administration, or other legal entity that is primarily engaged in the retail or wholesale sale, exchange, and/or transmission of electric energy. In 1995, there were 3,199 utilities in the United States; however, only 700 of these utilities generated electric power. The remainder were electric utilities that purchased wholesale power from others for the purpose of distribution over their lines to the ultimate consumer. The 700 utilities that generated power had a total of 3,094 power plants or stations.[1]

A nonutility power producer is defined as any person, corporation, municipality, State political subdivision or agency, Federal agency, or other legal entity that either (1) produces electric energy at a qualifying facility (QF)[a] as defined under the Public Utility Regulatory Policies Act (PURPA) or (2) produces electric energy but is primarily engaged in business activities other than the sale of electricity. In 1995, there were 4,190 nonutility power-generating facilities. Generation by nonutility power producers accounted for approximately 12 percent of the total U.S. electric generation. Fifty-six percent of the electricity generated by nonutilities was sold to electric utilities.[2]

---

[a] To receive status as a QF under PURPA, a facility must meet certain ownership, thermal output size, and efficiency criteria established by the Federal Energy Regulatory Commission (FERC). QFs are guaranteed that electric utilities will purchase their output at a reasonable price.

Table 1 provides electric power generation statistics for the year 1995 that allows comparison between electric power generation by both utilities and nonutilities based on the fuels used.

Table 1: Comparison of Utility and Nonutility Electric Power Generation (1995)

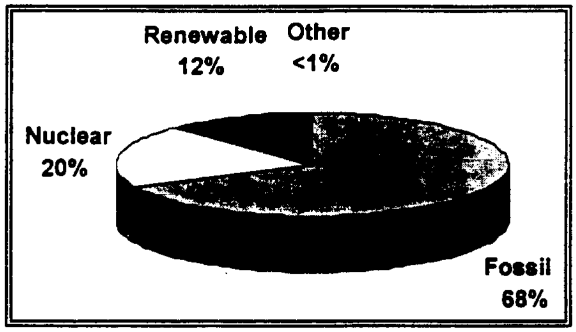
Energy Source	Utility Generation (thousand megawatthours)	Nonutility Generation (thousand megawatthours)***	Total U.S. Generation (thousand megawatthours)***
Fossil	2,021,064	287,696	2,308,760
Nuclear	673,402	—(†)	673,402
Hydroelectric*	293,653	14,515	308,168
Renewable and other**	6,409	98,295	104,704
Total	**2,994,528**	**400,505**	**3,395,033**

* Includes hydroelectric, conventional, and pumped storage.
** Includes geothermal, solar, waste, wind, photovoltaic, and biomass; projects for which there were two primary energy sources; and projects that did not identify the primary energy source. Nonutility data includes nuclear.
*** Totals may not equal sum of components because of independent rounding.
† Nonutility facilities using nuclear are including under "Renewable and other."

Sources: (a) *Electric Power Annual, 1995, Volume 1.* U.S. Department of Energy, Energy Information Administration, Washington, DC. July 1996. DOE/EIA-0348(95/1); and (b) *1995 Capacity and Generation of Non-Utility Sources of Energy.* Prepared by the Edison Electric Institute, Washington, DC. November 1996.

Based on these numbers and as shown in Figure 1, fossil fuel electric power generation represented 68 percent of the total U.S. electric power generation industry's total production of electricity in that year (both utility and nonutility combined). Nuclear energy represented 20 percent, renewable energy sources represented about 12 percent, and other energy sources represented less than 1 percent of the electricity production.

Figure 1: Total Utility and Nonutility Electric Power Net Generation Based on Fuels (1995)



In general, statistics on utility and nonutility electric power production are not aggregated. The following sections provide a more in-depth discussion of the information available to characterize the utility and nonutility electric power generators.

II.B.3 Industry Size and Geographic Distribution of Traditional Utilities

Ownership Categories and Revenues

Electric utilities are divided into four ownership categories: investor-owned, publicly owned, cooperative-owned, and Federally owned. These categories are described as follows:

- **Investor-owned utilities** produce a return for investors. They either distribute profits to stockholders as dividends or reinvest the profits. Investor-owned utilities are regulated entities that are granted a service monopoly in certain geographic areas and are obliged to serve all consumers and charge reasonable prices.

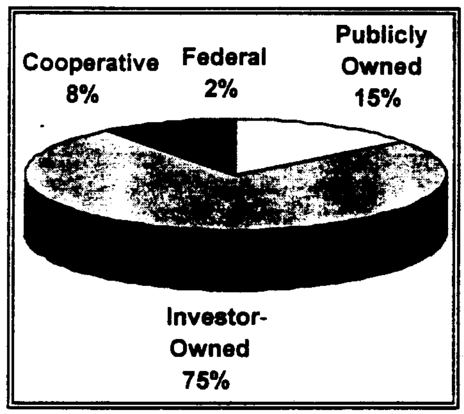
- **Publicly-owned utilities** are non-profit local government agencies (e.g., municipalities, counties, States, and public utility districts) that serve communities and nearby consumers at cost, returning excess funds to the consumer in the form of community contributions, economic and efficient facilities, and lower rates.

- **Cooperative utilities** are owned by their members and are established to provide electricity to those members. Cooperatives typically provide electric service to small rural communities of 1,500 or less.

- **Federal electrical utilities** do not generate power for profit. The Federal government is primarily a producer and wholesaler of electricity, and preference in the purchase of the electricity is given to publicly owned and cooperative electric utilities.

In 1995, there were 244 investor-owned, 2,014 publicly owned, 10 Federal, and 931 cooperative utilities. Figure 2 shows the percentage of 1995 U.S. electricity sales to ultimate consumers based on ownership type. Total sales were 1,013 billion kilowatthours. Only a portion of these utilities own and/or operate fossil fuel electric power generation capacity.

Figure 2: Total Utility Electricity Sales to Ultimate Consumers [3]



Among the ownership classes, investor-owned utilities account for more than 75 percent of all retail sales and revenues. In 1995, revenues from major utility generators totaled 208 billion dollars. Table 2 provides the revenues from major utility generators based on ownership category. Tables 3 and 4 list the 1995 top ten investor-owned and publicly owned utilities based on revenues from sales and megawatts sales to ultimate consumers, respectively. It should be noted that these data are for all electric utility activities, not just those that generate electricity.

Table 2: Revenues From Major Utility Generators (1995)

Ownership Category	Revenue (billion $)
Investor-Owned	164
Publicly Owned	26
Cooperative	17
Federal	1
Total	**208**

Source: *Electric Power Annual 1995, Volume II.* U.S. Department of Energy, Energy Information Administration, Washington, DC. July 1996. DOE/EIA-0384(95)/2.

Table 3: Top Ten Investor-Owned Utilities Ranked by Revenue From Sales to Ultimate Consumers (1995)

Utility Name	Revenue (thousand dollars)	% of Total
Southern California Edison Co.	7,575,448	4.64
Pacific Gas and Electric Co.	7,569,507	4.63
Commonwealth Edison Co.	6,634,832	4.06
Texas Utilities Electric Co.	5,450,444	3.34
Florida Power & Light Co.	5,325,258	3.26
Consolidated Edison Co. - NY, Inc.	5,005,860	3.07
Virginia Electric & Power Co.	3,979,071	2.44
Georgia Power Co.	3,972,189	2.43
Public Service Electric & Gas	3,886,566	2.38
Duke Power Co.	3,843,227	2.35
Subtotal	**53,242,403**	**32.61**

Source: *Financial Statistics of Major U.S. Investor-Owned Electric Utilities - 1995.* U.S. Department of Energy, Energy Information Administration, Washington, DC. December 1996. DOE/EIA-0437/(95)/1.

Table 4: Top Ten Publicly Owned Generator Utilities Ranked by Megawatt Sales to Ultimate Consumers (1994)

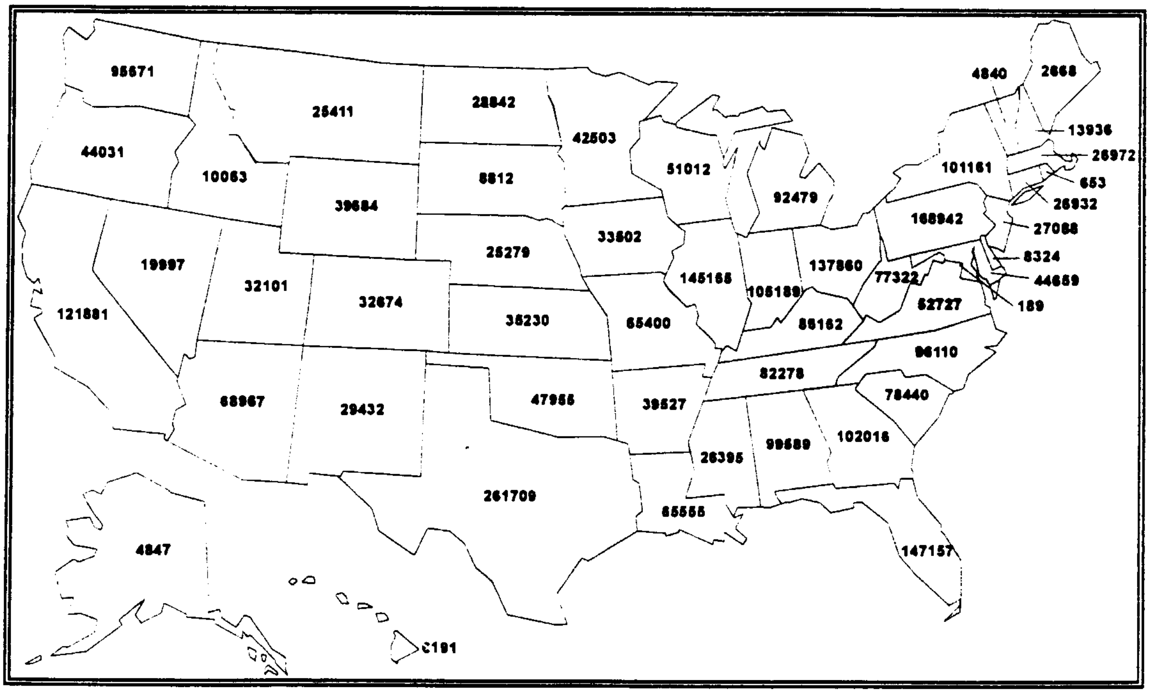
Utility Name	Megawatt Sales	% of Total
City of Los Angeles (CA)	20,430,075	8.61
Salt River Project (AZ)	16,058,298	6.77
Power Authority of State of NY	13,212,615	5.57
San Antonio Public Service Board (TX)	13,027,064	5.49
City of Seattle (WA)	8,874,039	3.74
Jacksonville Electric Authority (FL)	8,817,618	3.72
Sacramento Municipal Utility District (CA)	8,458,156	3.57
South Carolina Public Service Authority	7,423.460	3.13
City of Austin (TX)	7,308,134	3.08
Omaha Public Power District (NE)	7,066,940	2.98
Subtotal	**110,676,399**	**46.65**

Source: *Financial Statistics of Major U.S. Publicly-Owned Electric Utilities - 1994*. U.S. Department of Energy, Energy Information Administration, Washington, DC. December 1995. DOE/EIA-0437/(94)/2.

Geographic Distribution of Utilities

Fossil fuel electric power generation by utilities occurs across the United States. Figure 3 provides the total electric power net generation for each State. Higher values for net generation from utilities generally mirror higher population densities and industrial centers. The States with the highest utility net generation included were California, Texas, Illinois, Ohio, Pennsylvania, and Florida. The amount and geographical distribution of capacity by energy source are a function of availability and price of fuels and/or regulations. Energy sources used by utilities generally show a geographical pattern, such as significant coal and petroleum-fired capacity in the East and gas-fired capacity in the Coastal South.[4]

Figure 3: Geographic Distribution of U.S. Utility Electric Power Net Generation



Source: *Electric Power Annual, 1995, Volume I and II.* U.S. Department of Energy, Energy Information Administration, Washington, DC. July 1996. DOE/EIA-0348(95)/1&2.

Existing Utility Capacity and Electricity Generation

In general, electric power generation utilities use several technologies to generate electric power. These technologies, known as prime movers, are steam turbines, gas turbines, internal combustion engines, combined-cycle, hydraulic turbines, and others (e.g., geothermal, solar, and wind). Combined-cycle facilities use a technology in which electricity is produced from otherwise lost heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for utilization by a steam turbine in the production of electricity. This process increases the efficiency of the generating unit. Table 5 shows the 1995 existing capacity that employs these technologies and the percent of total U.S. utility capacity. Steam turbines are associated with 77 percent of the total U.S. utility capacity.

Table 5: Existing Capacity of All U.S. Utilities by Prime Mover (fossil fuels, renewable fuels, and other fuels) (1995)		
Prime Mover	**Generating Capacity (megawatts)****	**Percent of Total U.S. Capacity**
Steam Turbines*	579,647	77
Gas Turbines	58,329	7
Internal Combustion	4,985	>1
Combined-Cycle (gas and steam)	14,578	2
Hydraulic Turbines (hydroelectric)	91,114	12
Others	1,888	>1
Total	**750,542**	**100**

* Includes nuclear generators.
** Total may not equal sum of components because of independent rounding.

Source: *Inventory of Power Plants in the United States, as of January 1, 1996.* U.S. Department of Energy, Energy Information Administration, Washington, DC. December 1996. DOE/EIA-0095(95).

Not all of the existing capacity uses fossil fuels. Only a subsection of steam turbine, gas turbine, internal combustion, and combined-cycle capacity (657,539 megawatts) uses fossil fuels. More than 75 percent of the total existing capacity is fossil-fueled. Table 6 presents the 1995 capacity that used fossil fuels for each prime mover. In 1995, approximately 86 percent of the fossil-fueled electric power generation capacity was from steam turbine systems.

Table 6: Fossil-Fueled Utility Capacity by Prime Mover (1995)*		
Prime Mover	**Generating Capacity (megawatts)**	**% of Fossil-Fueled Capacity**
Steam Turbine	475,860	86
Gas Turbine/Internal Combustion	73,166	14
Total	**549,026**	**100**

* Includes combined-cycle capacity.

Source: *Inventory of Power Plants in the United States, As of January 1, 1996.* U.S. Department of Energy, Energy Information Administration, Washington, DC. December 1996. DOE/EIA-0095(95).

Fossil fuel-fired steam electric utilities had the capability to produce 445,627 megawatts of electricity, or more than 50 percent of the net generating capability at U.S. electric utilities. Gas turbine and internal combustion facilities combined had the capability to produce 61,424 megawatts of electricity, or 11.5 percent of generating capability at U.S. electric utilities in 1995.

In 1995, coal was used as the energy source to generate the most electricity in the utility industry, accounting for net generation of 1,652,914 thousand megawatthours of electricity, consuming 829,007 thousand short tons of coal. Gas-fired generators generated 307,306 thousand megawatthours, consuming 3,196,507 million cubic feet of gas, and petroleum-fired generators generated 60,844 thousand megawatthours of electricity, consuming 102,150 thousand barrels of petroleum (not including petroleum coke). Many utility generators have the flexibility to switch fuel sources in response to market conditions. Table 7 provides the 1995 U.S. utility generating capacity and net generation for each fossil fuel energy source.

Table 7: Utility Generating Capability and Net Generation by Energy Source (1995)

Energy Source	Generating Capability (megawatts)	Net Generation (thousand megawatthours)
Coal	301,484	1,652,914
Gas	135,749	307,306
Petroleum	70,043	60,844
Total	**507,276**	**2,020,822**

Source: *Electric Power Annual, 1995, Volume 1.* U.S. Department of Energy, Energy Information Administration, Washington, DC. July 1996. DOE/EIA-0348(95/1).

II.B.4 Industry Size and Geographic Distribution of Nonutilities

Nonutility Classifications

There are three categories of nonutilities:

- **Cogeneration** is the major technology used among nonutility power producers. This technology, which is discussed in greater detail in Section III, is the combined production of electric power and another form of useful energy (e.g., heat or steam). To receive QF status under PURPA, a cogeneration facility must meet certain operating criteria to "produce electrical energy and another form of useful thermal energy through the sequential use of energy." Depending upon the technology used, a facility may also be required to meet specific efficiency criteria. QFs are guaranteed that electric utilities will purchase their output at the incremental cost that an electric utility would incur to produce or purchase an amount of power equivalent to that purchased from QFs.

QFs are also guaranteed that electric utilities will provide backup service at prevailing (non-discriminatory) rates.

Fossil-fueled steam turbine systems are used in most industrial applications of cogenerating processes, while gas turbine systems are used in most other processes (e.g., commercial). Diesel engine systems are limited in their application to cogeneration because they provide less useable process heat per unit of electric power input.

- **Small Power Producers** are designated under PURPA regulations based on fuel consumption of a renewable energy source greater than 75 percent. This means that most nonutility fossil fuel electric power generators are not likely to carry this designation. In limited cases however, a facility may use fossil fuel in conjunction with a renewable energy source.

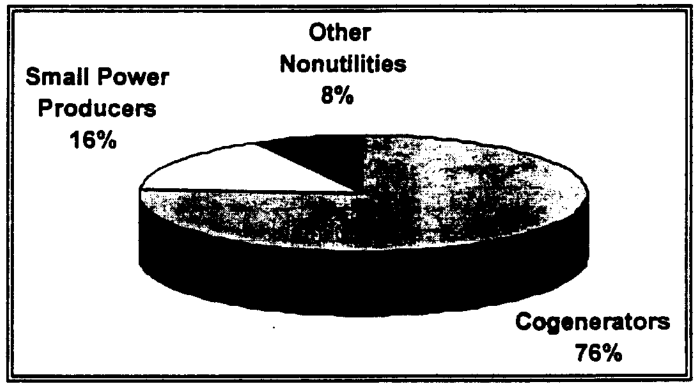
- **Other Nonutility Generators** are facilities not classified in the previous categories that produce electric power for their own use and for sale to electric utilities. These facilities include:

  - Independent power producers (IPPs)
  - Nonqualifying cogenerators
  - Exempt wholesale generators (EWGs)
  - Other commercial and industrial establishments.

FERC defines IPPs as producers of electric power other than QFs that are unaffiliated with franchised utilities in the IPP's market area and that for other reasons lack significant market power. The IPPs may lack market power due to siting or access to transmission. The EWGs are engaged exclusively in the business of wholesale electric generation and are exempt from corporate organizational restrictions under the Public Utility Holding Company Act of 1935.

In 1995, the makeup of the nonutility industry, based on capacity, included 76.2 percent cogenerators, 15.8 percent small power producers, and 8 percent other nonutility producers. Figure 4 illustrates the percent capacity of the different classes of nonutility power producers.[5]

Figure 4: Nonutility Capacity by Type of Producer



Qualified facilities comprised 78 percent of the total nonutility capacity in 1995. Non-qualified facilities were 12.9 percent of the capacity.

Nonutility power generation facilities and activities may be found in association with commercial and industrial facilities. Table 8 lists SIC codes and industries where power generation facilities and activities may be found.

In 1995, nonutility generation capacity within the chemical industry (SIC Code 28) accounted for 21 percent of the nonutility capacity and 23 percent of the total nonutility generation. The paper industry (SIC Code 26) accounted for 17 percent of the nonutility capacity and 18 percent of the generation. The coal, oil, and gas mining and refining industries (SIC Codes 12, 13, and 29) accounted for 12 percent of the total nonutility capacity and 13 percent of the generation.[6]

Table 8: Major SIC Codes and Industrial Categories Where Nonutility Power Generation Activities Are Found

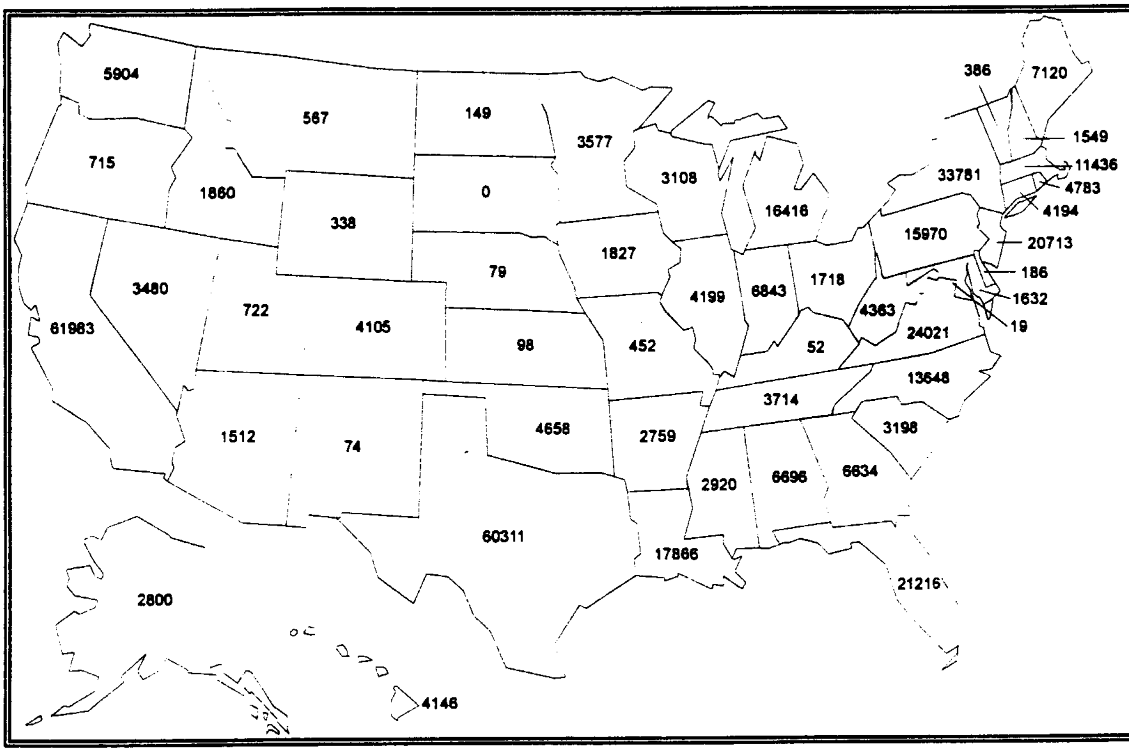
Major SIC Code	Industrial Category
01, 02	Agricultural Production - Crops, Livestock, and Animals
07	Agricultural Services
10	Metal Mining
12	Coal Mining
13	Oil and Gas Extraction
20	Food and Kindred Products
21	Tobacco Products
22	Textile Mill Products
23	Apparel & Other Finished Fabric Products
24	Lumber and Wood Products (Except Furniture)
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing, Publishing, and Allied Industries
28	Chemicals and Allied Products
29	Petroleum Refining and Related Industries
30	Rubber and Miscellaneous Plastics Products
31	Leather and Leather Products
32	Stone, Clay, Glass, and Concrete Products
33	Primary Metal Industries
34	Fabricated Metal Products (Except Machinery)
35	Industrial and Commercial Machinery/Computer Equipment
36	Electronic and Other Electrical Equipment
37	Transportation Equipment
38	Measuring, Analyzing, and Controlling Instruments
39	Jewelry, Silverware, and Plated Silver
42, 45, 47, 48, 49	Transportation, Communications , Electric, Gas, and Sanitary Services
53, 54, 55, 58	Retail Trade
60, 65	Finance, Insurance, and Real Estate
70, 72, 80, 82, 83, 84, 86, 87	Services
91, 92, 97	Public Administration

Source: *Directory of U.S. Cogeneration, Small Power, and Industrial Power Plants.* June 1995.. Giles, Ellen and Fred Yost. Twelfth Edition. Utility Data Institute, A Division of McGraw- Hill Company. UDI-2018-95.

Geographic Distribution of Nonutilities

Fossil fuel electric power generation by nonutilities occurs all across the United States. Figure 5 provides the total nonutility electric power net generation for each State. As with the utilities, higher values for net generation for nonutilities generally mirror higher population densities and industrial centers. The States with the highest nonutility net generation included were California, Texas, Virginia, New York, Florida, and New Jersey.

Figure 5: Geographic Distribution of U.S. Nonutility Electric Power Net Generation



Source: *Electric Power Annual Volume I and II.* July 1995. U.S. Department of Energy, Energy Information Administration, Washington, DC. DOE/EIA-0348(95)/1&2.

Existing Nonutility Capacity and Electricity Generation

As in the traditional utilities, nonutilities use steam turbines, gas turbines, internal combustion engines, hydraulic turbines, and combined-cycle systems to generate electricity. Steam turbines accounted for 42 percent of all the capacity and combined-cycle generating systems accounted for 27 percent. Table 9 provides existing 1995 nonutility generating capacity by prime mover technology.

The majority (more than 68 percent) of existing 1995 nonutility capacity is attributed to fossil-fueled electricity production.[7] Many facilities are able to switch from one fossil fuel to another if the fuel supply is interrupted or the economics warrant it. Some facilities are even able to switch from fossil fuels to renewable energy sources, while still others can use combustors that can burn two or more different fuels simultaneously, in varying combinations, to generate a desired heat output. Thus, the nonutility industry can be very adaptable, depending upon the type of equipment at a facility and based on economic conditions. Table 10 provides the 1995 nonutility capacity associated with each fossil fuel energy source.

Table 9 : Existing Capacity of Nonutilities by Prime Mover (1995)

Prime Mover	Generating Capacity (megawatts)	Percent of Total U.S. Capacity
Steam Turbines	28,192	42
Combined-Cycle	17,417	27
Gas Turbines	12,081	18
Internal Combustion	2,018	3
Hydraulic Turbines	3,410	5
Others*	3,297	5
Total	**66,415**	**100**

* Includes nuclear generators.

Source: *1995 Capacity and Generation of Nonutility Sources of Energy.* Edison Electric Institute, Washington, DC. November 1996.

Table 10: Nonutility Capacity by Fossil Fuel Energy Source (1995)

Fossil Fuel	Generating Capacity (megawatts)	Percent of Total Fossil Fuel Nonutility Capacity
Gas	33,221	73
Coal	10,324	23
Petroleum	1,657	4
Total	**45,202**	**100**

Source: *1995 Capacity and Generation of Nonutility Sources of Energy.* Edison Electric Institute, Washington. DC. November 1996.

The majority of the nonutility power producers use fossil fuels to generate electricity. Fossil fuels accounted for more than 287 million megawatthours, which was 72 percent of the total electricity produced by nonutilities in 1995.[8]

Gas was the fossil fuel used to generate the most electricity in the nonutility industry, providing a total of 213 million megawatthours of electricity in 1995. Coal was used to produce 70 million megawatthours of electricity, and petroleum was used to produce 4 million megawatthours of electricity. Table 11 provides 1995 nonutility generation by power producer class and energy source.

Table 11: 1995 Nonutility Net Generation by Primary Fossil Fuel Energy Source and Type of Producer (thousand megawatthours)

Energy Source	Cogenerators	Small Power Producers	Other Nonutility Power Producers	Total U.S. Nonutility Generation
Gas	200,080	0	13,357	213,437
Coal	63,440	0	6,740	70,180
Petroleum	3,957	0	121	4,079
Total	**267,477**	**0**	**20,218**	**287,696**

Source: *1995 Capacity and Generation of Nonutility Sources of Energy.* Edison Electric Institute, Washington, DC. November 1996.

II.B.5 Economic Trends

Change in Structure of the Utility Electric Power Industry

Utility electric power generation is one of the largest industries that remains regulated in the United States. Change is rapidly occurring in this industry due to the issuance by the FERC of Orders 888 and 889 (dated April 24, 1996), which encourage wholesale competition. Order 888 deals with issues of open access to transmission networks and stranded costs; Order 889 requires utilities to establish systems to share information on the availability of transmission capacity. To date, many States have initiated activities related to retail competition, and legislative proposals have been introduced into the U.S. Congress on restructuring the electric power industry.

With a competitive industry structure eminent, investor-owned utilities have been downsizing staff and reorganizing their company structures to lower costs. They have lowered costs by taking advantage of lower fuel prices and modifying fuel acquisition procedures. This has resulted in lower operation and maintenance costs. Some large investor-owned utilities have begun to expand their business investments into such areas as energy service companies; oil and gas exploration, development, and production; foreign ventures; and telecommunications. Numerous utilities are planning to improve their position in a competitive market through mergers and acquisitions. In 1995, 13 investor-owned utilities merged or had mergers pending.[9]

Publicly owned and cooperative utilities are expected to be affected by the posturing of the investor-owned companies. Although they can sell electricity at a competitive price, increased competition from investor-owned utilities and electricity marketing companies may require them to lower costs.

Many have already begun to reduce staff and engage in other cost-cutting measures. Mergers are also expected to occur among public utilities, however, not at the same rate as the investor-owned.

Stranded costs are a major concern for this industry as they move to a competitive market. Stranded costs are costs that have been incurred by the utilities to serve their consumers but cannot be recovered if the consumers choose other electricity suppliers. Estimates of stranded costs have been from $10 to $500 billion. Currently, utilities are looking for ways to mitigate stranded costs, and regulators are looking at alternatives for recovering these costs.[10]

The structure of the electric power industry is undergoing other changes. In the past, the electric power industry has been dominated by utilities, especially regulated investor-owned utilities. It is expected that utility generators will continue to dominate capacity in the United States, increasing from 703 gigawatts in 1995 to 724.4 gigawatts in 2015. In addition, nonutilities will continue to increase their role in the industry. Recent legislation has had an effect. For example, PURPA in 1978 has allowed QF status, and the Energy Policy Act of 1992 (EPACT) has removed constraints on utility ownership of significant shares of nonutility producers. In 10 years (1985-1995), the nonutility role in U.S. electric power industry has grown from 4 percent to 11 percent of the total generation.[11]

With the advent of a more competitive market, a new type of firm called "power marketers" has arisen in the electric power generation industry. Power marketers buy electric energy and transmission and other services from utilities, or other suppliers, and resell the products for profit. This practice started in the late 1980s, and growth in this market has increased competition in the wholesale market. Nine wholesale marketers existed in 1992; 180 existed by the end of 1995. The growth and success of power marketers signal a potential for fundamental change in the wholesale electricity business.

Projected Growth in the Power Generation Industry

Demands for electricity have slowed in recent years due to several factors. These factors include market saturation of electric appliances, improvements in equipment efficiency, utility investments in demand-side management programs, and legislation establishing more stringent equipment efficiency standards. In the 1960s, electricity demand grew by more than 7 percent a year. By the 1980s, this growth had slowed to only 1 percent per year. A further decline in growth is expected into the next century.[12]

Despite the slower demand growth, 319 gigawatts of new generating capacity are expected to be needed by 2015. This need is both a result of the demand and because of the amount of capacity that is expected to be retired. In particular, approximately 38 percent of the existing nuclear capacity is expected to be retired, in addition to 16 percent of the existing fossil-fueled steam turbine capacity. Of the new capacity needed, 81 percent is projected to be combined-cycle or combustion turbine technology expected to be fueled with natural gas or both oil and gas. Both of these technologies supply peak and intermediate capacity, but combined-cycle units can also be used to meet baseload requirements.

Before building new capacity, many utilities are exploring other alternatives to meet the growth demand. Some of these alternatives are life extension and repowering, power imports, demand-side management programs, and purchase from cogenerators. Even with these alternatives, a projected 1,063 new plants (assuming approximately 300 megawatts capacity per plant) will be needed by 2015 to meet the growing demand and to offset the retirements.[13]

[This page intentionally left blank.]

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the fossil fuel electric power generation industry, including the materials and equipment used and the processes employed. The section is designed for those interested in gaining a general understanding of the industry and for those interested in the interrelationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Section IX lists available resource materials and contacts.

This section describes commonly used production processes, associated raw materials, the by-products produced or released, and the materials either recycled or transferred offsite. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A Industrial Processes in the Fossil Fuel Electric Generation Industry

The majority of the electricity generated in the United States today is produced by facilities that employ steam turbine systems.[14] Other fossil fuel prime movers commonly used include gas turbines and internal combustion engines. Still other power generation systems employ a combination of the above, such as combined-cycle and cogeneration systems. The numbers of these systems being built are increasing as a result of the demands placed on the industry to provide economic and efficient systems.

The type of system employed at a facility is chosen based on the loads, the availability of fuels, and the energy requirements of the electric power generation facility. At facilities employing these systems, other ancillary processes must be performed to support the generation of electricity. These ancillary processes may include such supporting operations as coal processing and pollution control, for example. The following subsections describe each system and then discuss ancillary processes at the facility.

III.A.1 Steam Turbine Generation

The process of generating electricity from steam comprises four parts: a heating subsystem (fuel to produce the steam), a steam subsystem (boiler and steam delivery system), a steam turbine, and a condenser (for condensation of used steam). Heat for the system is usually provided by the combustion of coal, natural gas, or oil. The fuel is pumped into the boiler's furnace. The boilers generate steam in the pressurized vessel in small boilers or in the water-wall tube system in modern utility and industrial boilers. Additional elements within or associated with the boiler, such as the superheater, reheater, economizer and air heaters, improve the boiler's efficiency.

Wastes from the combustion process include exhaust gases and, when coal or oil is used as the boiler fuel, ash. These wastes are typically controlled to reduce the levels of pollutants exiting the exhaust stack. Bottom ash, another byproduct of combustion, also is discharged from the furnace.

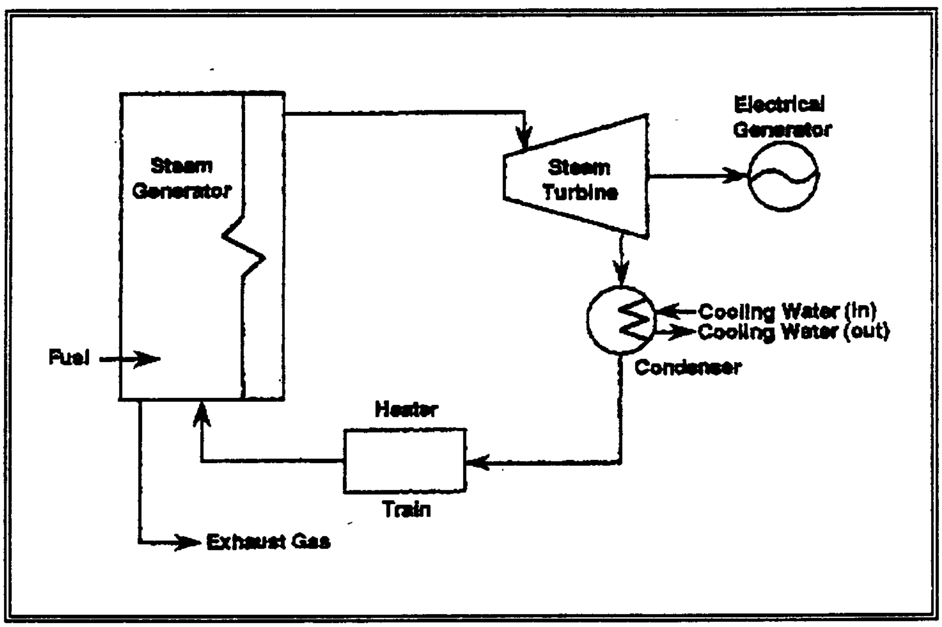
High temperature, high pressure steam is generated in the boiler and then enters the steam turbine. At the other end of the steam turbine is the condenser, which is maintained at a low temperature and pressure. Steam rushing from the high pressure boiler to the low pressure condenser drives the turbine blades, which powers the electric generator. Steam expands as it works; hence, the turbine is wider at the exit end of the steam. The theoretical thermal efficiency of the unit is dependent on the high pressure and temperature in the boiler and the low temperature and pressure in condenser. Steam turbines typically have a thermal efficiency of about 35 percent, meaning that 35 percent of the heat of combustion is transformed into electricity. The remaining 65 percent of the heat either goes up the stack (typically 10 percent) or is discharged with the condenser cooling water (typically 55 percent).

Low pressure steam exiting the turbine enters the condenser shell and is condensed on the condenser tubes. The condenser tubes are maintained at a low temperature by the flow of cooling water. The condenser is necessary for efficient operation by providing a low pressure sink for the exhausted steam. As the steam is cooled to condensate, the condensate is transported by the boiler feedwater system back to the boiler, where it is used again. Being a low-volume incompressible liquid, the condensate water can be efficiently pumped back into the high pressure boiler.

A constant flow of low-temperature cooling water in the condenser tubes is required to keep the condenser shell (steam side) at proper pressure and to ensure efficient electricity generation. Through the condensing process, the cooling water is warmed. If the cooling system is an open or a once-through system, this warm water is released back to the source water body. In a closed system, the warm water is cooled by recirculation through cooling towers, lakes, or ponds, where the heat is released into the air through evaporation and/or sensible heat transfer. If a recirculating cooling system is used, only a small amount of make-up water is required to offset the cooling tower blowdown which must be discharged periodically to control the build-up of solids. Compared to a once-through system, a recirculated system uses about one twentieth the water.[15] Figure 6 presents a typical steam generation process.

There are several types of coal-fired steam generators. A description of each follows. The classification of these generators is based on the characteristics of the coal fed to the burners and the mode of burning the coal. Coal-fired steam generation systems are designed to use pulverized coal or crushed coal. Before the coal is introduced to the burners, it must be processed, as discussed in Section III.A.6.

Figure 6: Steam Turbine Generation



Stoker-Fired Furnace

Stoker-fired furnaces are designed to feed coal to the combustion zone on a traveling grate. Stokers can be divided into three general groups, depending on how the coal reaches the grate of the stoker for burning. The three general types of stokers are (1) underfeed, (2) overfeed, and (3) spreader configurations. Table 12 presents the general characteristics of these three general types of stokers. Figure 7 presents a schematic of a stoker coal feeder.

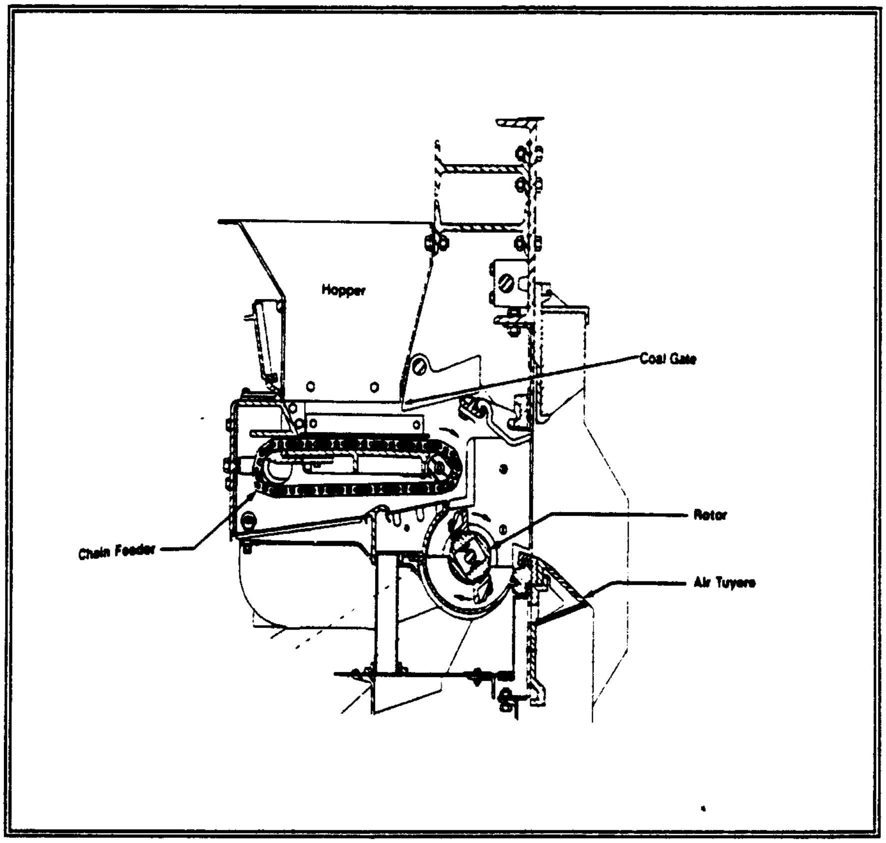
Table 12: Characteristics of Various Types of Stokers

Stoker Type and Subclass	Burning Rate * (BTU/hr/ft²)	Characteristics
Spreader		
Stationary	450,000	Capable of burning a wide range of coals, best in handling fluctuating loads, high fly ash carry over, low load smoke.
Traveling grate	750,000	
Vibrating grate	400,000	
Overfeed		
Chain grate and traveling grate	600,000	Low maintenance but difficult in burning caking coals.
Vibrating grate	400,000	Low maintenance but difficult in burning weakly caking coals, smokeless operation.
Underfeed		
Single or double retort	400,000	Capable of burning caking coals and a wide range of coals, high maintenance, low fly ash carry over, suitable for continuous load operation.
Multiple retort		

* Maximum amount of British thermal units per hour per square foot of grate in the stoker.

Source: *Coal Handbook*, Robert Meyers (Ed.). Marcel Dekker, Inc. New York, NY, 1981 as referenced in *Wastes from the Combustion of Coal by Electric Utility Power Plants*. Report to Congress. US. Environmental Protection Agency, Office of Solid Waste. Washington, DC. February 1988. EPA/530-SW-88-002.

Figure 7: Stoker Coal Feeder

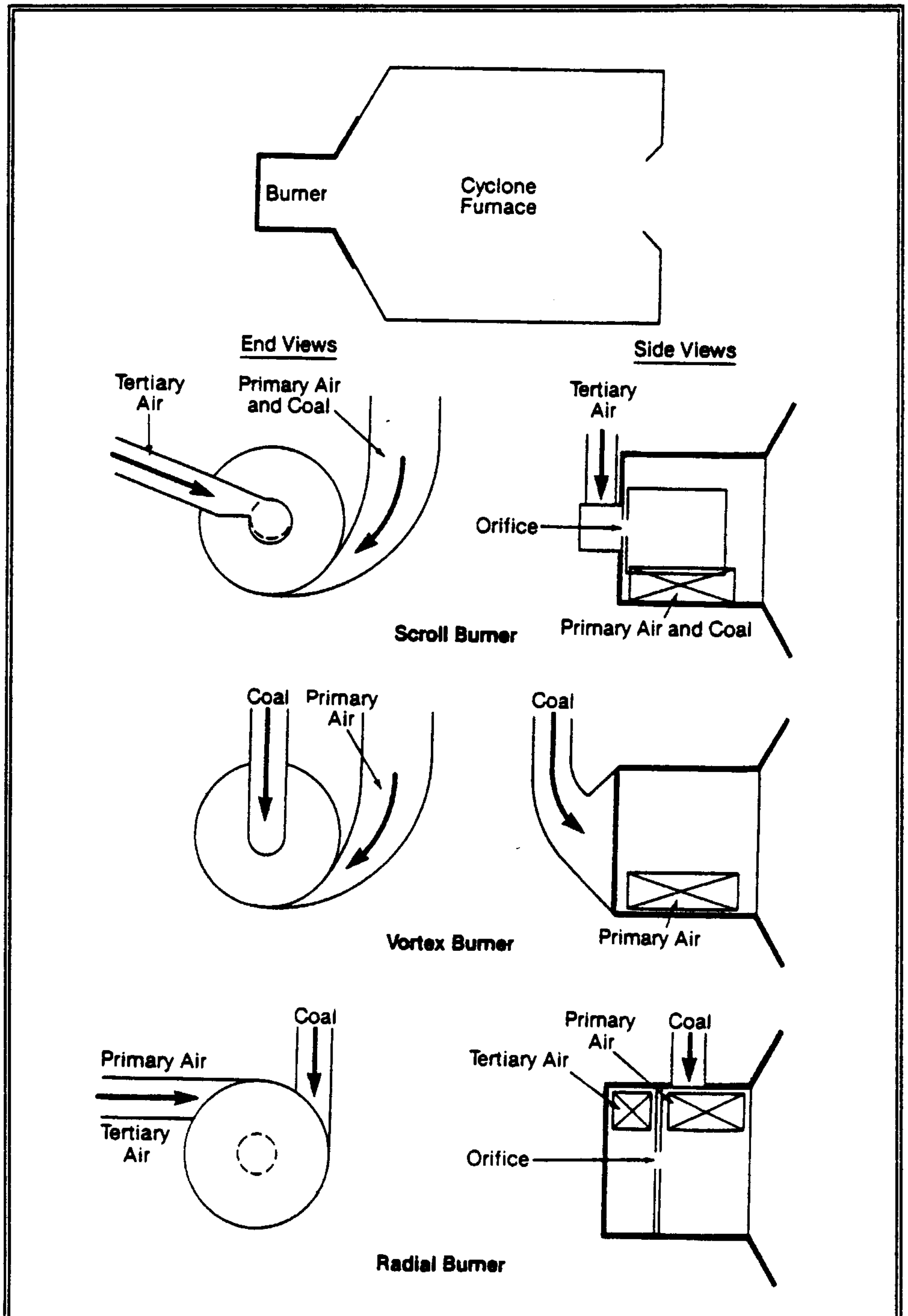


Source: *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. ed. McGraw-Hill, Inc. New York NY. 1989. Reproduced with permission of the McGraw-Hill Companies.

In a cyclone-fired furnace, fuel is fired under intense heat and air is injected tangentially to create a swirling motion as shown in Figure 8. The resulting hot gases exit through the cyclone bore into the cyclone in the furnace. Ash becomes a molten slag that is collected below the furnace. Coal is the primary cyclone fuel, but oil and gas are used as startup, auxiliary, and main fuels.

R0075132

Figure 8: Typical Cyclone Coal Burners

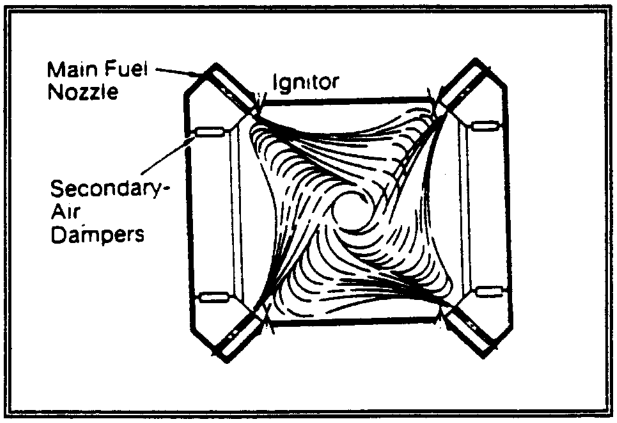


Source: *Steam, Its Generation and Use*; 40th Edition. Stultz and Kitto, eds. Babcock and Wilcox, Barbeton, OH. 1992. Reproduced with permission from the Babcock and Wilcox Co.

Tangential-Fired Furnace

In a tangential-fired furnace, both air and fuel are projected from the corners of the furnace along lines tangent to a vertical cylinder at the center. A rotating motion is created, allowing a high degree of mixing. This system provides great flexibility for multiple fuel firing (see Figure 9).[16]

Figure 9: Tangential Firing Pattern



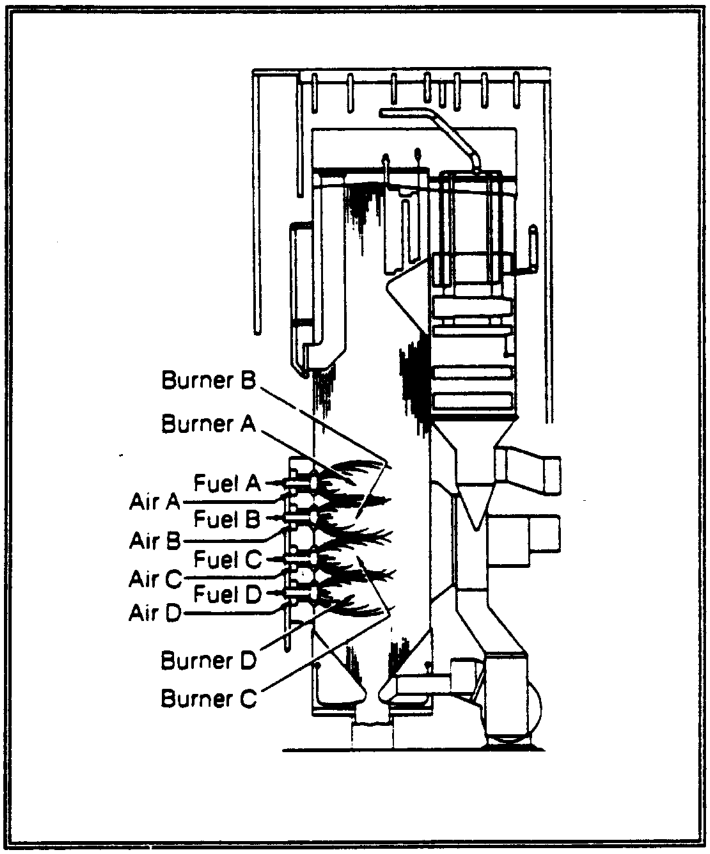
Source: *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. ed. McGraw-Hill, Inc. New York, NY. 1989. Reproduced with permission of the McGraw-Hill Companies.

Horizontal or Wall-Fired Furnace

In horizontal or wall-fired systems, pulverized coal and primary air are introduced tangentially to the coal nozzle. The degree of air swirl and the contour of the burner throat establish a recirculation pattern extending several throat diameters into the furnace. The hot products of combustion are directed back toward the nozzle to provide the ignition energy necessary for stable combustion. In this system, burners are located in rows on the front wall (see Figure 10) or both front and rear walls.[17]

R0075134

Figure 10: Flow Pattern of Horizontal Firing



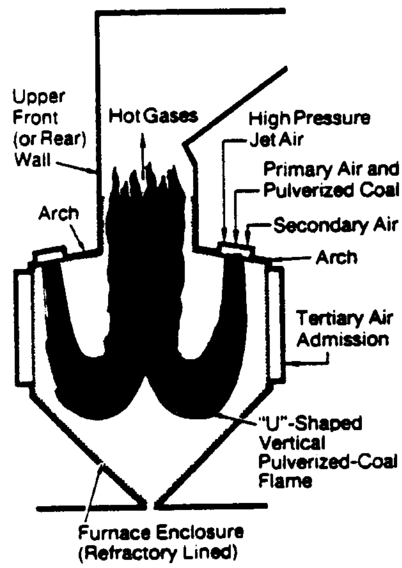
Source: *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. ed. McGraw-Hill, Inc. New York, NY. 1989. Reproduced with permission of the McGraw-Hill Companies.

Arch-Fired Systems

Vertical-fired systems are used to fire solid fuels that are difficult to ignite, such as coals with moisture and ash-free volatile matter of less than 13 percent. In this system, the pulverized coal is discharged through a nozzle surrounded by heated combustion air. High-pressure jets are used to prevent fuel-air streams from short circuiting. The firing system produces a looping flame with hot gases discharging at the center (see Figure 11).[18]

R0075135

Figure 11: Flow Pattern of Arch Firing



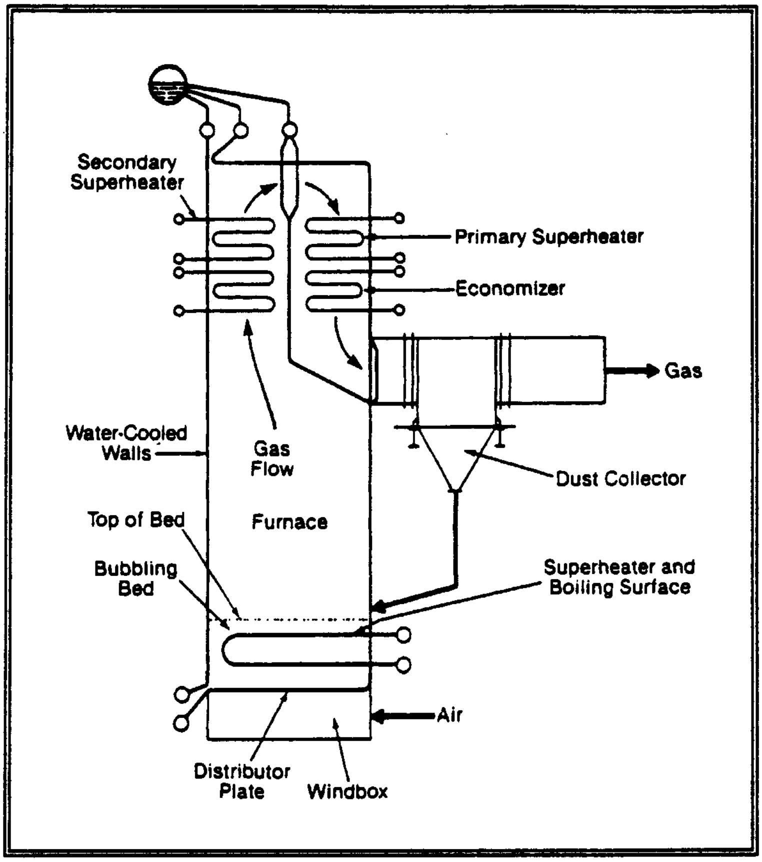
Source: *Standard Handbook of Power Plant Engineering.* Elliot, Thomas C. ed. McGraw-Hill, Inc. New York, NY. 1989. Reproduced with permission of the McGraw-Hill Companies.

Fluidized-Bed Combustors

In fluidized-bed combustors, fuel materials are forced by gas into a state of buoyancy. The gas cushion between the solids allows the particles to move freely, thus flowing like a liquid. By using this technology, SO_2 and NO_X emissions are reduced because an SO_2 sorbent, such as limestone, can be used efficiently. Also, because the operating temperature is low, the amount of NO_X gases formed is lower than those produced using conventional technology.

Fluidized-bed combustors are divided into two categories: circulating fluidized-beds and bubbling fluidized-beds (see Figure 12). Fluidized-bed combustors can operate at atmospheric pressure or in a pressurized chamber. In the pressurized chamber, operating pressures can be 10 to 20 times the atmospheric pressure. Pressurized fluidized-bed furnaces provide significant gain in overall thermal efficiency over atmospheric fluidized-bed furnances. [19]

Figure 12: Typical Bubbling Fluidized-Bed Boiler



Source: Adapted from *Steam, Its Generation and Use*; 40th Edition. Stultz and Kitto, eds. Babcock and Wilcox, Barbeton, OH. 1992. Reproduced with permission from the Babcock and Will Cox. Co.

Fluidized-bed combustion allows for the use of high sulfur coals, high fouling and slagging fuels, and low British Thermal Unit (BTU) fuels. High ash coals burned in fluidized-beds require less preparation than in pulverized coal combustors. Additionally, fluidized-bed combustors require less maintenance than pulverized coal combustors.

III.A.2 Internal Combustion Generation

Internal combustion generating units, also known as diesel engines, have one or more cylinders in which fuel combustion occurs. Internal combustion generating units convert the chemical energy of fuels into mechanical energy in a design similar to an automobile engine. Attached to the shaft of the generator, the engine provides the mechanical energy to drive the generator to produce electricity. Internal combustion generating units for power plants are typically designed to operate on either four- or two-stroke cycles.

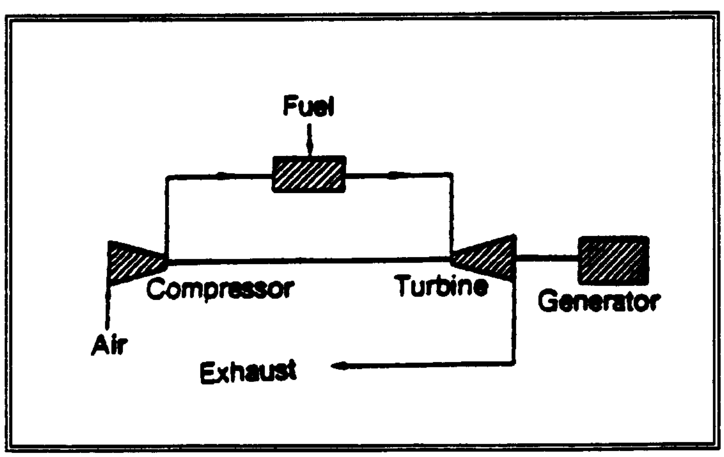
Internal combustion generators are small and range in capacity from 2 to 6 megawatts. They are more efficient than gas turbines.[20] In addition, capital costs are low, they are easily transported, and they can generate electricity almost immediately upon startup. For this reason, internal combustion generators are often used for small loads and for emergency power.[21]

III.A.3 Gas Turbine Generation

Gas turbine systems operate in a manner similar to steam turbine systems except that combustion gases are used to turn the turbine blades instead of steam. In addition to the electric generator, the turbine also drives a rotating compressor to pressurize the air, which is then mixed with either gas or liquid fuel in a combustion chamber. The greater the compression, the higher the temperature and the efficiency that can be achieved in a gas turbine. Exhaust gases are emitted to the atmosphere from the turbine. Unlike a steam turbine system, gas turbine systems do not have boilers or a steam supply, condensers, or a waste heat disposal system. Therefore, capital costs are much lower for a gas turbine system than for a steam system.

In electrical power applications, gas turbines are typically used for peaking duty, where rapid startup and short runs are needed. Most installed simple gas turbines with no controls have only a 20- to 30-percent efficiency. Figure 13 presents a schematic of a simple gas turbine system.

Figure 13: Simple Gas Turbine Cycle



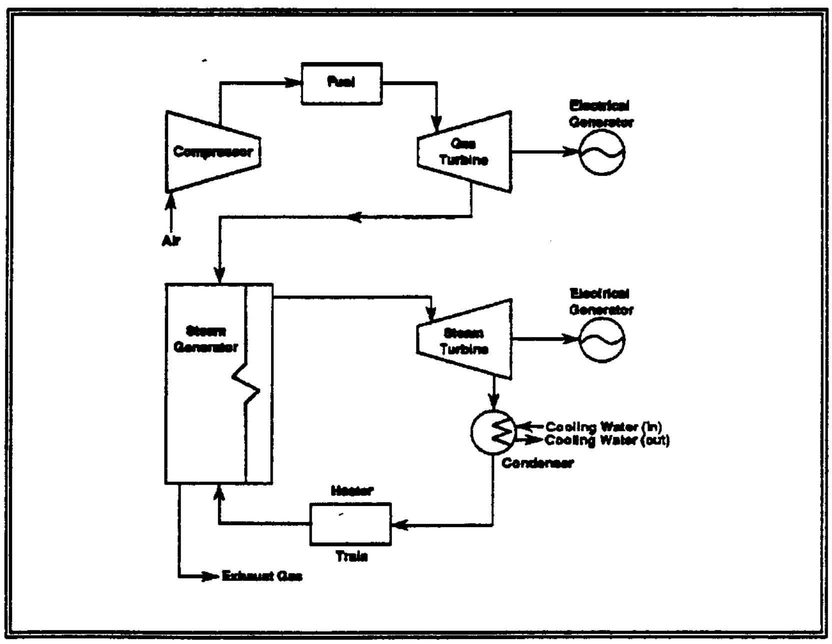
Source: *Standard Handbook of Power Plant Engineering.* Elliot, Thomas C. ed. McGraw-Hill, Inc. New York, N.Y. 1989.

R0075138

III.A.4 Combined-Cycle Generation

Combined-cycle generation is a configuration using both gas turbines and steam generators. In a combined-cycle gas turbine (CCGT), the hot exhaust gases of a gas turbine are used to provide all, or a portion of, the heat source for the boiler, which produces steam for the steam generator turbine. This combination increases the thermal efficiency over a coal- or oil- fueled steam generator. The system has an efficiency of about 54 percent, and the fuel consumption is approximately 25 percent lower. Combined-cycle systems may have multiple gas turbines driving one steam turbine (see Figure 14).[22]

Figure 14: Combined Cycle with Heat Recovery



There are four major classifications of combined-cycle facilities:

- **Gas Turbine Plus Unfired Steam Generator**: A steam generator is installed at the discharge of a gas turbine to recover the heat in the gas turbine exhaust so as to create steam in the steam generator. The fuel is fired only in the gas turbine.

- **Gas Turbine Plus Supplementary-Fired Steam Generator**: A portion of the oxygen in the gas turbine exhaust is used to support further combustion in a supplementary firing system in the connecting duct between the gas turbine and the steam generator.

- **Gas Turbine Plus Furnace-Fired Steam Generator**: This generator is the same as the gas turbine plus supplementary-fired steam generator, except that essentially all of the oxygen from the gas turbine exhaust is used to support further combustion.

- **Supercharged Furnace-Fired Steam Generator Plus Gas Turbine**: A steam generator is placed between the air compressor and the gas turbine. The air compressor is used to pressurize the boiler where the fuel is fired. The products of combustion that have been cooled within the boiler are then discharged through a gas turbine.

In addition, integrated coal gasification combined-cycle (IGCC) units are combined systems that are in the demonstration stage, but are expected be in commercial operation by the year 2000. In an IGCC system, coal gas is manufactured and cleaned in a "gasifier" under pressure, thereby reducing emissions and particulates. The coal gas then is combusted in a CCGT generation system.

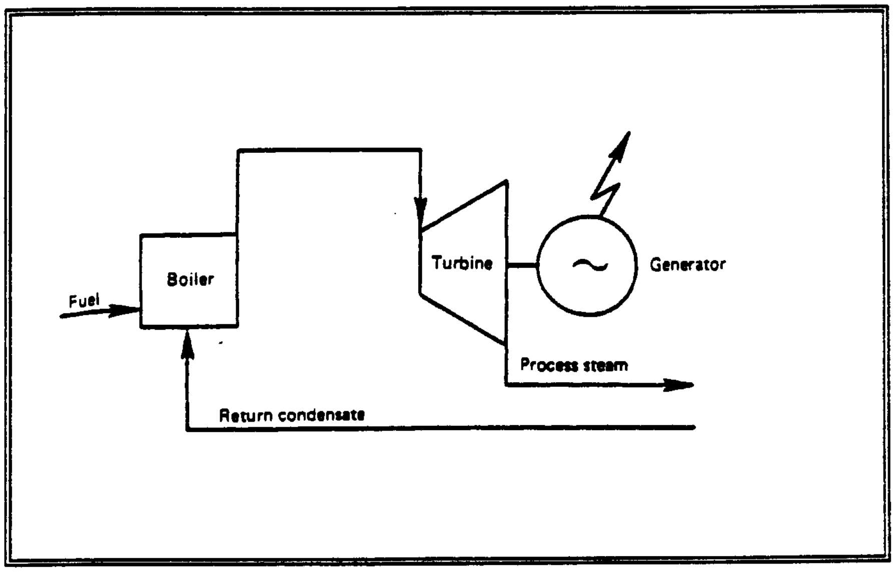
III.A.5 Cogeneration

Cogeneration is the merging of a system designed to produce electric power and a system used for producing industrial heat and steam. Cogeneration accounted for 75 percent of all nonutility power generation in 1995.[23] This system is a more efficient way of using energy inputs and allows the recovery of otherwise wasted thermal energy for use in an industrial process. Cogeneration technologies are classified as "topping cycle" and "bottoming cycle" systems, depending on whether electrical (topping cycle) or thermal (bottoming cycle) energy is derived first.

Most cogeneration systems use a topping cycle. This is shown as a steam turbine topping system in Figure 15. The process steam shown in Figure 15 is condensed as it delivers heat to an industrial process, and the resulting return condensate is returned back to the boiler as shown.

Facilities that cogenerate may be eligible for QF status under PURPA. To qualify, the facility must produce electric energy and "another form of useful thermal energy through sequential use of energy," and meet certain ownership, operating, and efficiency criteria established by FERC (See 18 CFR Part 292). In a topping cycle system, the fuel is used to generate power with a steam boiler or gas turbine cycle combustor. The waste heat from the power generation process is then used in an industrial process.[24]

Figure 15: Cogeneration Plant Schematic



Source: *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. ed. McGraw-Hill, Inc. New York, NY. 1989. Reproduced with permission of the McGraw-Hill Companies.

III.A.6 Supporting Operations

Many operations associated with fossil fuel electric power generation facilities are not directly involved in the production of electricity but serve in a supporting role. This section discusses some of the major supporting processes.

Coal Processing

Fifty-seven percent of coal used in power plants is transported from mines by rail.[25] Coal is also transported by truck and barge. Once coal arrives at the plant, it is unloaded to live storage, dead storage, or directly to the stoker or hopper. Live storage is an enclosed silo or bunker next to conveyors leading to the pulverizer. Dead storage is exposed outdoors and is the backup supply. Coal unloading devices depend on the size and type of plant. Coal arriving by rail may be unloaded directly into the storage area or to conveyors leading directly to generation units. Coal arriving by barge is unloaded by buckets, which are part of coal towers or unloading bridges.[26] Coal shipped by truck generally needs little equipment for unloading.

Precautions must be taken in the transportation and storage of coal. In transporting coal during warmer months and in dry climates, dust suppression may be necessary. Dust suppression is typically accomplished through the use of water, oil, or calcium chloride ($CaCl_2$). In winter months, antifreeze chemicals are applied to the coal. Because coal oxidizes easily in open air, it should be stored in layered piles to minimize air flow. Hot areas should be removed from the pile to prevent fire; water should not be added to reduce the heat, since the water increases the air flow and, therefore, would increase the oxidation of the coal.

Coal may be cleaned and prepared before being either crushed or pulverized. Impurities in coal, such as ash, metals, silica, and sulfur, can cause boiler fouling and slagging. Coal cleaning can be used to reduce sulfur in the coal to meet sulfur dioxide (SO_2) emissions regulations. Cleaning the coal is a costly process that increases its fuel efficiency, yet reduces the size of the particles. Coal cleaning is typically performed at the mine by using gravity concentration, flotation, or dewatering methods. Some smaller stoker plants purchase pre-cleaned, pre-crushed coal.[27]

Coal is transported from the coal bunker or silo to be crushed, ground, and dried further before it is fired in the burner or combustion system. Many mechanisms can be used to grind the coal and prepare it for firing. Pulverizers, cyclones, and stokers are all used to grind and dry the coal. Increasing the coal's particle surface area and decreasing its moisture content greatly increases its heating capacity. Once prepared, the coal is transported within the system to the combustion system, or boiler. Devices at the bottom of the boilers catch ash and/or slag.

Air Pollution Control Processes

Air pollution control devices found in fossil fuel-fired systems (particularly steam electric power facilities) include particulate removal equipment, sulfur oxide (SO_X) removal equipment, and nitrogen oxide (NO_X) removal equipment. Particulate removal equipment includes electrostatic precipitators, fabric filters, or mechanical particulate collectors, such as cyclones. SO_X removal equipment includes sorbent injection technologies and wet and dry scrubbers. Both types of scrubbers result in the formation of calcium sulfate and sulfite as waste products. NO_X emission control systems include low NO_X burners and selective catalytic or non-catalytic reduction technologies. The selective catalytic and non-catalytic reduction technologies convert oxides of nitrogen into nitrogen gas and water.

Other Processes to Mitigate Environmental Impacts

Control technologies are used at many utility electric power generation facilities to mitigate the environmental impacts of cooling water intake structures. These technologies may include intake screening systems, passive intake system (physical exclusion devices), or fish diversion and avoidance systems. Technologies used to mitigate thermal pollution include cooling towers, cooling ponds or lakes, and sprinklers. Other control technologies may include recycling and reuse equipment for metals recovery; evaporators; and physical, chemical, and biological wastewater treatment.

III.B Raw Material Inputs and Pollution Outputs

The primary raw material used in fossil fuel electric power generation is the fossil fuel needed as the energy source to drive the prime mover (i.e., turbine). Fossil fuels employed in the United States predominantly include coal, petroleum, and gas. Other inputs include water (for cooling and steam generation) and chemicals used for equipment cleaning and maintenance. Pollution outputs include solid waste pollution, wastewater pollution, air pollution, and thermal pollution. The following subsection discusses the major sources of raw materials and the sources of emissions associated with the power generation industry.

III.B.1 Fossil Fuels and Other Raw Material Inputs

The major types of fossil fuels used for electricity generation in the United States are coal, petroleum, gas. Other fossil fuels used include petroleum coke, refinery gas, coke oven gas, blast furnace gas, and liquefied petroleum gas. These latter fuels are used much less frequently and, therefore, will not be discussed in this notebook.

Coal

Coal is the most abundant fossil fuel in the United States and the most frequently used energy source for U.S. electricity generation. More than one-half of all electricity generated by utilities comes from coal-fired facilities.[28] Although the use of coal has decreased since the 1970s, some areas of the country use coal almost exclusively.

Coals used for electric power generation are very heterogeneous and vary in content, depending on the location of the mine. The major chemical makeup, which includes carbon, hydrogen, and oxygen, also contains impurities, such as minerals and sulfur. These impurities are a major concern because they contribute to the pollutants produced during combustion of the coal.

Of all the fossil fuel used for electricity generation, coal requires the most extensive processing, handling, storage, and loading and unloading facilities. Coal firing requires the use of crushers, pulverizers, ash handling equipment, dust control, emissions control equipment, and soot blowers.

Petroleum

Petroleum, or crude oil, is the source of various fuel oils used as the energy source for power generation. As an energy source, petroleum accounts for less than five percent of all electricity receipts in the United States. However, numerous utilities in the New England States, New York, Florida, and Hawaii still rely on petroleum as an energy source.[29]

Most petroleum used for power generation is refined prior to use. Typical fuel oils include fuel oil numbers 4, 5, and 6 (heavy oil) and constitute the majority of all petroleum receipts at electric utilities. Smaller amounts of fuel oil number 2 (light oil) are used typically for startup and flame stabilization of the boilers.[30] Other less frequently used sources include topped crude, kerosene, and jet fuel.

Fuel oils used for electricity generation require special handling, storage, and loading and unloading facilities. Oil requires ash handling equipment, dust control, emissions control equipment, soot blowers, and, in some instances, warming and heating facilities.

Gas

Gas is used less than coal as a primary fuel source at power generation utilities. Gas is widely used for industrial electric power generation, however. Gas is used in those areas of the United States where it is readily accessible or in States in which environmental laws for air emissions are stringent (e.g., California). Many of the facilities that use gas also use petroleum in dual-fired generating units. The use of one fuel over the other is based on economics.

Natural gas must be treated to produce commercial fuel. Natural gas comprises primarily methane and ethane. Natural gas suitable for use as a fuel in power generation facilities must be at least 70-percent methane, 60-percent propane, or 25-percent hydrogen. The fuel may come in either a gaseous or liquid form.[31]

Gas has one advantage over other fuels in that it is a cleaner burning fuel. Therefore, some electric utilities use gas in order to comply with environmental regulations. Gas used for generating electricity requires relatively little special handling (piping) and may or may not require storage facilities.

Other Inputs

In addition to fossil fuels, electric power generation requires other material inputs. These inputs include (1) water for steam condensation and equipment cooling, (2) lime or limestone, as a sorbent for pollution control equipment, (3) chlorine and/or biocides to prevent biofouling of steam condensers and cooling towers, (4) chemical solvents, oils, and lubricants for equipment cleaning and maintenance.

III.B.2 Pollutant Outputs

Pollutants are generated as byproducts from the burning of fossil fuels to generate electricity. The combustion process releases highly regulated pollutants, such as NO_X, carbon monoxide (CO), particulate matter (PM), SO_2, volatile organic compounds (VOCs), organic hydrocarbons, and trace metals, into the air. Combustion waste, the majority of which is ash waste, is created during combustion processes using coal or oil for fuel. Non-combustion wastes, such as cooling, process, and storm waters, that are discharged from fossil fuel electric power generation facilities have the potential to release pollutants (e.g., chlorine, heavy metals, and thermal pollution) into surface waters. The following discussion highlights each of the waste streams created during the generation of fossil fuel electric power.

Air Emissions

Air emissions from the stack gases from coal- and oil-fired boilers include four of six criteria pollutants regulated through the National Ambient Air Quality Standards (NAAQS) under the Clean Air Act (CAA) as amended: NO_X, CO, SO_2, and PM. Amounts of SO_2 emitted depend largely on the amount of sulfur present in the coal or oil and the method used to generate steam.

Other emissions regulated by the CAA commonly contained in emission gases are total organic carbon (TOC) as methane, non-methane hydrocarbons (NMHC), and VOCs. Traces of lead, another criteria pollutant, and other metals and minerals are also found. These metals are present in the coal and oil. Sulfur is also found in these fuels (more in coal than in oil), and fly ash is the product of sulfur and other mineral materials that do not combust.

Fugitive dust from coal piles and fuel handling equipment is another source of particulates. In addition, fugitive emissions of VOCs can arise from coal

R0075145

piles during low temperature devolatilization. Thermal rise plumes are also discharged from cooling towers. These plumes contain such pollutants as heat and some trace materials in the water vapor.

Compared to a fossil-fueled steam turbine generating system with no air pollution controls, a gas-fired power generation system with no controls emits less tonnage of NO_X and SO_2 and trace amounts of TOC, particulate matter, and CO.

Combined-cycle gas turbines have virtually no SO_2 emissions because of the purity of natural gas. Because oil and coal are not used, solid waste is eliminated, and CO_2, NO_X, and thermal pollution are cut by 60 percent.

Cogeneration is considered a pollution prevention technology. Other benefits of cogeneration are reduced fuel consumption and lower air emissions. Because of their smaller size, however, cogeneration systems in the United States tend to have lower stack heights. Therefore, air emissions to the immediate atmosphere contribute to increased local pollution.

Combustion Wastes

Two principal wastes are associated with the combustion of fossil fuels: ash waste and flue gas desulfurization (FGD) wastes. The quantities of these wastes generated depend upon the fossil fuel burned.

Ash waste -Two types of ash are generated during combustion of fossil fuels: bottom ash and fly ash. Ash that collects at the bottom of the boiler is called bottom ash and/or slag. Fly ash is a finer ash material that is borne by the flue gas from the furnace to the end of the boiler. Bottom ashes are collected and discharged from the boiler, economizer, air heaters, electrostatic precipitator, and fabric filters. Fly ash is collected in the economizer and air heaters or is collected by the particulate control equipment. Coal-fired facilities generate the largest quantity of ash; gas facilities generate so little that separate ash management facilities are not necessary. Fly and bottom ash may be managed separately or together in landfills or in wet surface impoundments.

Ashes differ in characteristics depending upon the content of the fuel burned. For coal, the chemical composition of ash is a function of the type of coal that is burned, the extent to which the coal is prepared before it is burned, and the operating conditions of the boiler. These factors are very plant- and coal-specific. Generally, however, more than 95 percent of ash is made up of silicon, aluminum, iron, and calcium in their oxide forms, with magnesium, potassium, sodium, and titanium representing the remaining major constituents. Ash may also contain a wide range of trace constituents in highly variable concentrations. Potential trace constituents include antimony, arsenic, barium, cadmium, chromium, lead, mercury, selenium, strontium, zinc, and other metals.

Flue gas desulfurization waste - If coal or oil is the fuel source, the FGD control technologies result in the generation of solid wastes. Wet lime/limestone scrubbers produce a slurry of ash, unreacted lime, calcium sulfate, and calcium sulfite. Dry scrubber systems produce a mixture of unreacted sorbent (e.g., lime, limestone, sodium carbonates, calcium carbonates), sulfur salts, and fly ash. Sludges are typically stabilized with fly ash. Sludges produced in a wet scrubber may be disposed of in impoundments or below-grade landfills, or they may be stabilized and disposed of in landfills. Dry scrubber sludges may be managed dry or wet.

Non-Combustion Wastes

Non-combustion wastes can be categorized into contact and noncontact wastes. Contact wastes come in contact with combustion wastes and, therefore, contain the same constituents as the combustion wastes. In many cases, these contact wastes are managed with the combustion wastes. Non-contact wastes do not come in contact with ashes or FGD wastes and may be managed separately. Table 13 summarizes the typical waste streams, potential pollutants, and ways of managing these pollutants. Figure 16 shows where the waste streams are generated at a typical steam electric power plant.

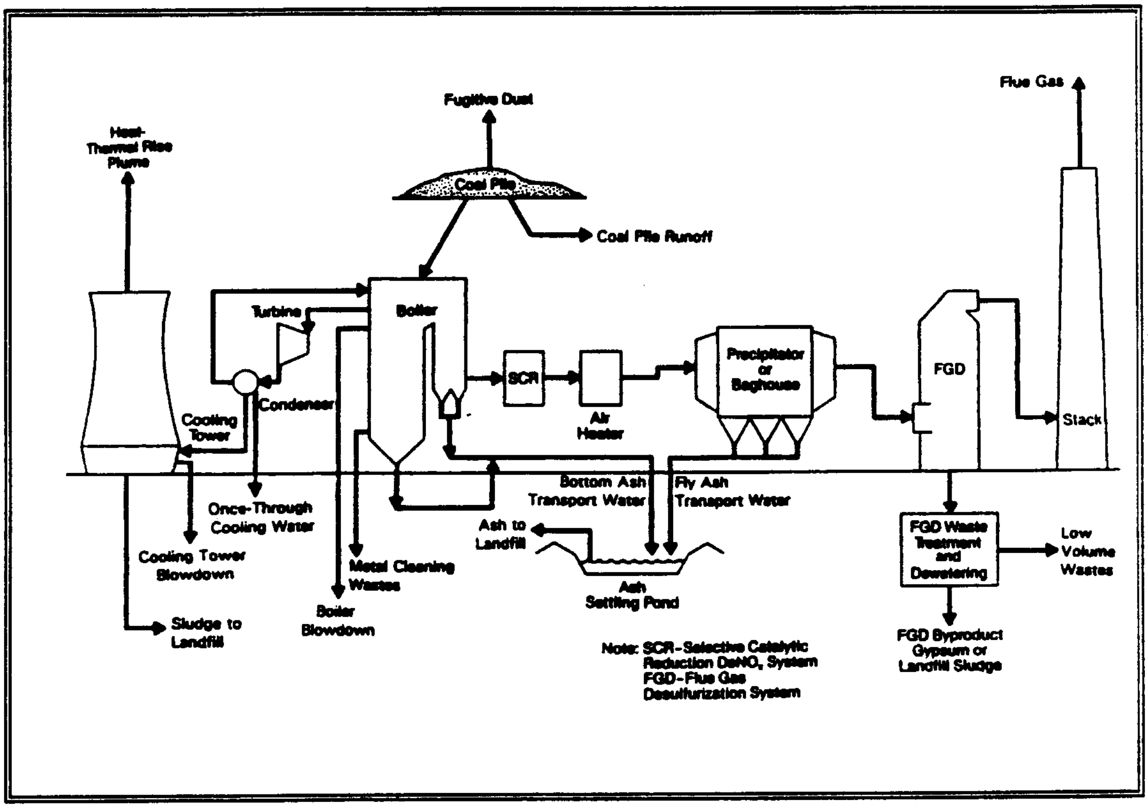
Table 13: Summary of Typical Waste Streams and Pollutants Generated at Fossil Fuel Electric Power Generation Facilities Based on Fuel Type

Fuel Type	Wastes/Pollutant	Air Emissions	Combustion Wastes	Non-Combustion Wastes
Coal	Process wastes	Flue gas and heat - thermal rise plume.	Bottom ash, fly ash, and FGD wastes desulfurization, and fly ash.	*Contact*†: ash transport, gas-side boiler cleaning,* FGD blowdown, coal pile runoff, pyrite waste, floor drains. *Noncontact:* once-through cooling water,* cooling system blowdown,* boiler blowdown,* water-side boiler cleaning,* demineralizer regenerent.*
	Pollutants	SO_2, NO_X, CO_2, CO (more from small boilers), VOCs, TOC, PM, metals, sulfur.	Heavy metals, ferrous sulfate, sulfuric acid, sulfate, $CaSO_3$, and CaO.	Chlorine, organic chemicals, metals, pH, TSS, TDSS, ferrous sulfate, sulfuric acid, metals, pyrite.
Oil	Process wastes	Flue gas and heat - thermal rise plume.	Bottom ash and fly ash.	*Contact*†: ash transport, gas-side boiler cleaning,* FGD blowdown, floor drains. *Noncontact:* once-through cooling water,* cooling system blowdown,* boiler blowdown,* water-side boiler cleaning,* demineralizer regenerent.*
	Pollutants	Low SO_2, NO_X (as NO_X particulate), CO_2, sulfur, and PM compared to coal. Metals and TOC.	VOCs and heavy metals.	Chlorine, organic chemicals, metals, pH, TSS, TDSS, ferrous sulfate, sulfuric acid, metals.
Gas	Process wastes	Flue gas.	None.	*Contact*†: infrequent gas-side boiler cleaning,* floor drains. *Noncontact:* once-through cooling water,* cooling system blowdown,* boiler blowdown,* water-side boiler cleaning,* demineralizer regenerent.*
	Pollutants	Low No_X, and SO_2 compared to oil and coal. Thermal pollution is 60% less than coal.	None.	Chlorine, organic chemicals, metals, pH, TSS, TDSS, metals.

*** Waste streams at facilities with steam turbines. † In contact with combustion wastes.**

R0075148

Figure 16: Waste Streams Generated at a Typical Fossil Fuel Electric Power Generation Plant



Source: Adapted from Steam, Its Generation and Use, 40th Edition. Stultz and Kitto, eds. Babcock and Wilcox, Barbeton, OH. 1992. Reproduced with permission from the Babcock and Wilcox Co.

Contact, Non-Combustion Wastes

Metal and boiler cleaning waste (gas-side) - Gas-side metal and boiler cleaning wastes are produced during maintenance of the gas-side of the boiler, including the air preheater, economizer, superheater, stack, and ancillary equipment. Residues from coal combustion (soot and fly ash) build up on the surfaces of the equipment and must be removed periodically. This buildup is typically removed with plain, pressurized water containing no chemical additives. Wastewaters are sometimes neutralized and metals precipitated. At coal plants, the wastewater is most often put into the ash ponds without treatment.

Ash transport wastewater - Ash produced from the combustion of coal or oil is typically collected in a sluice water that is then sent to settling ponds for disposal. The ash settling pond discharge may contain dissolved and suspended solids, heavy metals (nickel, iron, vanadium), organometalic compounds, and magnesium compounds when magnesium oxides are used for corrosion control.

Flue gas desulfurization blowdown - Blowdown from FGD systems is discharged when the recycled liquor begins to build up chlorine. The discharge contains calcium sulfate, calcium chloride, and sodium chloride. Depending upon fly ash carryover, the wastewater may contain metal ions.

Coal pile runoff - Open storage of coal allows contact with rain and/or other precipitation. These storm waters react with the minerals in the coal to produce a leachate contaminated with ferrous sulfate and sulfuric acid. The low pH of the leachate reacts with the coal, thereby accelerating dissolution of metals in the coal.

Pyrite waste - Coal mills or pulverizers reduce the size of the feed coal going into the boiler. During this process, various impurities, such as hard coal, rocks, and pyrites (an iron-based mineral), are mechanically separated from the feed stream. This solid waste is typically collected and fed into the bottom ash transport system and eventually co-disposed with the ash in either a landfill or an impoundment.

Floor drains - Floor and yard drains collect rainfall, seepage, leakage wastewaters from small equipment cleaning operations, process spills, and leaks. As a result, the pollutants found in the wastewaters are variable. The waste streams may contain coal dust, oil, and detergents.

Noncontact, Non-combustion Wastes

Once-through cooling water - When a steam turbine is used to drive the electric generator the process is called "steam electric." Steam electric units require large amounts of cooling water for steam condensation and efficient thermal operation. The cooling water flow rate through the condenser is by far the largest process water flow, normally equating to about 98 percent of the total process water flow for the entire unit. In a once-through cooling water system, water is usually taken into the plant from surface waters, but sometimes ground waters or municipal supplies are used. The water is passed through the condenser where it absorbs heat and is then discharged to a receiving water. Chlorine, which is added intermittently to the cooling water to control biofouling, is a pollutant of concern in cooling water discharge. Heat is also a concern.

Cooling tower blowdown - Cooling water is recirculated when the water supply is inadequate to sustain a once-through system or when thermal discharges are regulated or undesirable. In a system that recirculates cooling water, heat from the water is transferred to the atmosphere via cooling towers, cooling ponds, or spray facilities. The recirculated water eventually builds up dissolved solids and suspended matter. Cooling tower blowdown (a percentage of the recirculated water) is discharged regularly and additional fresh makeup water is treated and added into the recirculating system to relieve this buildup of solids. Pollutants of concern in cooling tower blowdown discharges include chlorine, organic chemicals, and trace metals from biofouling and corrosion control.

Boiler blowdown - Water to make steam may be recirculated and eventually build up impurities in the boiler. This water is periodically purged from the system. Boiler blowdown is typically alkaline, is low in total dissolved solids, and contains chemical additives used to control scale and corrosion. Blowdown also contains trace amounts of copper, iron, and nickel.

Metal and boiler cleaning waste (water-side) - Metal cleaning wastes are produced during cleaning of the boiler tubes, superheater, and condenser located on the water-side or steam-side of the boiler. Scale and corrosion products build up in the boiler and must be removed with chemical cleaning using an acid or alkaline solution. The composition of the waste solvents depends on the construction material of the feedwater system, but largely consists of iron with lesser amounts of copper, nickel, zinc, chromium, calcium, and magnesium. Spent solvents may be treated in numerous ways: (1) neutralization and then discharge, (2) evaporation in other operating boilers onsite, (3) dedicated holding ponds, (4) mixing with rinsate and sending to ash impoundments, or (5) disposal offsite.

Demineralizer Regenerant - Boiler systems may require treatment of boiler makeup water prior to use. Ion exchange resins used in the treatment of the water accumulate cations and anions removed from the raw water. These resins are regenerated using a strong acid, such as sulfuric acid, or a strong base, such as sodium hydroxide. Regenerant wastes contain dissolved ions removed from the raw wastewater and excess acid or base. Often, the waste is directed into the ash impoundment for disposal or to a settling pond with other liquid wastes prior to discharge.

IV. WASTE RELEASE PROFILE

This section provides estimates and reported quantities of wastes released from the fossil fuel electric power generation industry. Currently, this information is not available from the Toxics Release Inventory (TRI) under the Emergency Planning and Community Right-to-Know Act (EPCRA). However, regulations promulgated on May 1, 1997, would require facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce to begin reporting in 1999 (for the period from January 1 to December 31, 1998). Because TRI reporting is not currently required, other sources of waste release data have been identified for this profile.

This section comprises three subsections. The first section provides available data on releases of solid wastes from fossil fuel electric power generation facilities. The second section provides available data on releases to surface waters. A third section provides available data on releases of criteria pollutants and hazardous pollutants to the air.

IV.A Available Solid Waste Release Data for the Fossil Fuel Electric Power Generation Industry

As described previously, the primary solid waste releases from coal- and oil-fired steam electric facilities are fly ash and bottom ash produced during the combustion process. An increasing number of facilities must condition flue gases to remove sulfur compounds, which results in the generation of another solid waste typically referred to as FGD sludge. The following tables present aggregated ash and FGD sludge generation estimates for utility and nonutility steam electric facilities.

Table 14 presents the estimated quantity of fly and bottom ash (combined) for utility boilers in 1994. Coal ash figures have been derived from 1994 DOE, EIA Form EIA-767 utility survey responses. These responses are compiled by the Edison Electric Institute (EEI) in their *Power Statistics Database*.[32] The oil ash figures were developed by the Electric Power Research Institute (EPRI) based on utility-provided estimates, as well as extrapolations based on oil consumption and particulate collection efficiencies for individual plants. Gas-fired facilities are not presented in the table because gas combustion does not generate measurable quantities of particulate ash. In general, coal-fired utilities produce ash at approximately 10 percent of the fuel consumption rate. This high rate of production confirms that ash management can represent an important operational consideration at coal plants. In contrast, oil-fired utilities produce much less than 0.1 percent of the total ash produced by the coal-fired facilities. This figure reflects the low ash content of oil compared with coal, the typically lower requirements for particulate collection devices at coal-fired facilities, the small average particle size of oil ash, and the small contribution that oil currently makes to total U.S. electricity generation.

Table 14: Generation and Disposition of Utility Fly and Bottom Ash, 1994 (thousand short tons)

Fuel Type	Number of Plants	Quantity Sold	Quantity Removed by Contractor	Quantity Landfilled	Quantity Ponded	Quantity Used Onsite, Given Away, or Disposed of in Other Ways	Total Quantity Collected for the Record Year (1994)
Coal*	404	12,122	8,762	24,849	19,929	4,014	69,676
Coal/Gas	32	830	546	636	133	83	2,228
Coal/Nuclear	2	279	0	0	26	29	334
Coal/Oil	26	368	401	303	470	180	1,722
Coal/Oil/Gas	2	1	41	45	0	0	87
Coal/Wood	1	0	0	0	0	0	0
Subtotal Coal	**467**	**13,600**	**9,750**	**25,833**	**20,558**	**4,306**	**74,047**
Oil**	73	n/a	n/a	n/a	n/a	n/a	23
Totals	**540**	**13,600**	**9,750**	**25,833**	**20,558**	**4,306**	**74,070**

* Coal ash values provided in EEI *Power Statistics Database (1994 Data).* Prepared by Utility Data Institute, McGraw-Hill, Washington, DC. 1995. Plants include only those reporting coal as primary or secondary fuel. Includes 88 facilities reporting zero waste generation: 26 facilities reported zero fuel consumption and 62 facilities did not exceed the capacity and/or ash generation reporting thresholds for the DOE EIA 767 Survey.

** Oil ash values are for 1995. Source: *Oil Combustion By-Products -- Chemical Characteristics and Management Practices: Draft Report.* Electric Power Research Institute, Palo Alto, California. March 1997.

Table 14 also indicates the range of management options employed by utilities in managing coal ash. While the figure varies considerable between operators and sites, roughly one-third of all U.S. utility coal ash finds its way to some type of beneficial use project. Of the material remaining in traditional disposal environments, the majority is managed in onsite impoundments or landfills. These units vary in size, design, and environmental controls, depending on the age, the State, and the operator.

Table 15 presents similar findings for utility FGD sludge generation and management. Again, the data reflect utility responses to the Form EIA-767, as compiled by EEI in the *Power Statistics Database*. Note that there are no oil-fired utility boilers equipped with FGD scrubbers. The quantity of FGD

R0075153

sludge generated at a given plant is a function of the sulfur content of the coal consumed, the total quantity of coal consumed, the type of scrubber

Table 15: Generation and Disposition of Utility FGD Sludge, 1994 (thousand short tons)

Fuel Type	Number of Plants	Quantity Sold	Quantity Removed by Contractor	Quantity Landfilled	Quantity Ponded	Quantity used onsite, given away, or disposed of in other ways	Total Quantity Collected for the record year (1994)
Coal	71	118	759	8,286	4,082	708	13,953
Coal/Gas	4	106	6	479	0	5	596
Coal/Nuclear	0	0	0	0	0	0	0
Coal/Oil	2	18	5	55	0	0	78
Coal/Oil/Gas	1	0	0	33	0	0	33
Coal/Wood	0	0	0	0	0	0	0
Totals	**78**	**242**	**770**	**8,853**	**4,082**	**713**	**14,660**

Source: EEI *Power Statistics Database (1994 Data)*. Prepared by Utility Data Institute, McGraw-Hill. Washington, DC. 1995.

employed, the efficiency of reaction of the scrubber, and other factors. The majority of FGD sludge is managed in onsite landfills or impoundments.

Table 16 presents an estimate of the 1990 coal ash generation by nonutility fossil fuel combustors, broken out by major industrial category. Based on EPA Office of Air and Radiation's 1990 *Particulate Inventory Database (Version 3)*, the ash figures are derived from the estimated 1990 coal consumption and coal ash content for the boiler population. The table includes all coal combustors permitted as major sources of criteria pollutants under the CAA and, therefore, includes many combustors that do not produce electricity. The electric generators, however, may be expected to represent the largest of the nonutility combustors and the greatest portion of the fuel usage by that population, such that the estimates shown provide at least a fair picture of the ability of the population to generate ash.

Compared with the utility coal ash estimates presented above, the nonutility universe represents only roughly 5 percent of the total U.S. ash generation. This fact reflects the generally small boiler size and the small aggregate coal consumption represented by nonutility combustors. Two industry categories, paper and chemicals manufacturing, represent 50 percent of all nonutility coal consumption, with only five industry categories accounting for more than 80 percent of all nonutility coal consumption.

Table 16: Estimated Nonutility Generation of Coal Ash, 1990

Standard Industrial Classification	Number of Facilities	Number of Boilers	Total Capacity (MMBTU)	Estimated Ash Generation (1,000 tons)
2600-2699, Paper and Allied Products	139	243	61,348	1,189
2800-2899, Chemicals and Allied Products	116	276	54,031	1,025
3300-3399, Primary Metals Industries	45	85	20,344	500
2000-2099, Food and Kindred Products	94	151	21,391	402
4900-4999, Electric, Gas, and Sanitary Services	29	83	30,234	392
3700-3799, Transportation Equipment	57	162	14,581	125
2200-2299, Textile Mill Products	58	101	7,272	107
1400-1499, Mining and Quarrying of Non-Metallic Minerals, Except Fuels	7	15	6,620	76
3800-3899, Measuring, Analyzing, and Controlling Instruments	1	3	1,976	66
3000-3099, Rubber and Miscellaneous Plastic Products	20	37	3,779	63
TOTALS (Top Ten Ash Producing SIC Categories)	**566**	**1,156**	**221,576**	**3,945**
Percentage of Total Universe	76	79	89	93
TOTALS (Complete Nonutility universe)	**749**	**1,467**	**249,437**	**4,263**

Source: *Nonutility Fossil Fuel Combustion: Sources and Volumes - Revised Draft Report.* Prepared for U.S.EPA, Office of Solid Waste by Science Applications International Corporation, McLean, VA. December 1996.

As discussed previously, steam electric facilities may generate a variety of other solid wastes. These may include boiler and cooling water treatment wastes, coal mill rejects, boiler cleaning wastes, and a variety of smaller waste streams incidental to power generation of ancillary activities. At coal plants, these waste streams typically are small compared with ash and sludge generation. At oil- and gas-fired plants, they may represent the largest solid wastes present at the site. Unfortunately, available data sources do not provide credible estimates of the total quantity of these materials generated at utility and nonutility steam electric sites.

IV.B Available Water Release Information for the Fossil Fuel Electric Power Generation Industry

The EPA Office of Water, Office of Science and Technology, Engineering and Analysis Division, has collected water release data in evaluating the need for revisions to the 1982 Effluent Limitations Guidelines and Standards for the Steam Electric Point Source Category. The EPA has identified 53 chemicals (29 priority and 24 nonconventional) as pollutants of interest in wastewaters discharged from steam electric power generation facilities. These pollutants were identified in the EPA Permit Compliance System (PCS) database. The PCS is a computerized information management system maintained by the EPA Office of Enforcement. The PCS contains data on permit conditions, monitoring, compliance, and enforcement data for facilities regulated by the National Pollutant Discharge Elimination System (NPDES) Program. The information contained in the database is generally limited to only those facilities that have been classified as "major" by EPA based on factors such as effluent design flow and physical, chemical, and locational characteristics of the discharge. Information on facilities designated as "minor" is not required to be entered into the PCS database.

The data collected included 1992 records of pollutant releases from facilities with primary SIC codes 4911 and 4931. Approximately 512 facilities were identified in PCS as "major" steam electric facilities. Please note that facilities that use nuclear energy to drive steam turbines are also covered in the universe evaluated under this study. An option in the PCS system called Effluent Data Statistics (EDS) was used to generate the annual loading values. For the purposes of the effluent guideline study, the EDS-derived data were subjected to numerous refinements in an attempt to overcome limitations in the database. These refinements included review of the data by monitored facilities, as arranged by the Utility Water Act Group (UWAG) and the EEI. The industry still contends, however, that the loadings of pollutants in these data are over estimated.[33] Therefore actual loadings cannot be provided in this Sector Notebook.

Table 17 provides a list of the pollutants found in the 1992 PCS data for steam electric effluents.

Table 17: List of Pollutants Reported in 1992 PCS Data from Steam Electric Facilities*

Priority Pollutant	Pollutant	Priority Pollutant	Pollutant
	Iron	X	Trichloromethane
	Chlorine	X	Beryllium
	Aluminum		Ethylene glycol
	Boron		Nitrosomorpholine, N-
	Fluoride	X	Mercury
	Boric Acid	X	Pentachlorophenol
X	Zinc	X	Silver
	Barium	X	Thallium
	Magnesium	X	Antimony
X	Copper		Molybdenum
	Ammonia		Benzonitrile
	Iron Sulfate		Titanium
	Manganese		Polychlorinated biphenyls, NOS
X	Chromium, trivalent	X	Dichloromethane
X	Nickel	X	Tetrachloroethane
X	Lead		Dibenzofuran
X	Arsenic	X	Toluene
X	Chromium		Xylene
X	Selenium		Lithium
	Bromine	X	Benzene
	Hydrogen Sulfide	X	Ethylbenzene
X	Chromium, hexavalent	X	Phenanthrene
X	Cadmium	X	Pyrene
	Vanadium	X	PCB-1254
X	Cyanide	X	PCB-1260
X	Phenol	X	Chlorophenol, 2-
	Hydrazine		

* Based on estimated data supplied by members (representing 80 facilities) of the electric utility industry.

Source: *Preliminary Data Summary for the Steam Electric Point Source Category*. U.S. Environmental Protection Agency, Office of Water, Washington, D. C. July 1996. (EPA-921-R-96-010).

IV.C Available Air Emissions Data for the Fossil Fuel Electric Power Generation Industry

Three existing sources of data for estimating the releases to the air from the fossil fuel electric power generation industry were identified. The following sections discuss the available data and associated limitations.

IV.C.1 Annual Emissions Estimated by the Department of Energy, Energy Information Administration

Emissions data for traditional utility steam electric facilities that generate 10 or more megawatts electricity using fossil fuels are derived or obtained directly from information collected in an annual survey by the DOE EIA. This survey (Form EIA-767) is a restricted-universe census used to collect boiler-specific data from almost 900 electric utility power plants. The emissions are calculated based on fuel consumption data and using emission factors from the EPA report AP-42, *Compilation of Air Pollutant Emission Factors* and reduction factors for control equipment, where applicable. The CO_2 emissions are estimated using additional information about fuel quality. Table 18 provides the estimated 1995 emissions for utility fossil fuel steam electric generating units that generate 10 or more megawatts electricity.

Table 18: Estimated 1995 Emissions From Fossil Fuel Steam Electric Generating Units at Electric Utilities by Fuel Type (thousand short tons)

Fuel	Net Generation (thousand megawatts)	SO_2	NO_X	CO_2
Coal	1,652,914	11,248	6,508	1,752,527
Gas	307,306	1	533	161,969
Petroleum	60,844	321	92	50,878

Source: *Electric Power Annual 1995, Volume 2.* Energy Information Administration, Department of Energy, Washington, DC. DOE/EIA-0348(95)/2. December 1996.

As indicated in the table, the majority of the emissions from utility fossil fuel steam electric generating units come from coal-burning facilities. This is due in part because there is more coal-fired capacity than other fossil-fueled capacity in use. SO_2 emissions are higher in coal-burning facilities due to the higher sulfur content in coals than in other fuels. The average sulfur content in coals ranges from 0.3 percent in the West to approximately 2.5 percent in the East. Petroleum burned at utility power plants ranges from almost no sulfur to about 3.5 percent. The amount of sulfur contained in natural gas is relatively small.

The Form EIA-767 does not collect data for facilities employing internal combustion engines, gas turbines, or combined-cycle systems or steam electric plants generating less than 10 megawatts electricity. The EIA conducted a study in 1991 to estimate air emissions from these generating units, using a methodology similar to that used on the larger steam electric facilities. The study indicated that emissions of SO_2, NO_X, and CO_2 are less than 0.1, 1.2, and 1.1 percent, respectively, of total utility air emissions.[34]

The EIA collects similar fuel consumption and quality information for nonutility power producers. However, EIA provides only aggregate statistics on estimated emissions for all fuels (fossil and renewable energy sources) and does not separate out emissions for fossil-fueled facilities. These statistics are not provided in this document since the capacity of nonutility generation using nonrenewable energy sources is large.

IV.C.2 AIRS Database Annual Estimated Releases for the Electric Power Generation Industry

The Aerometric Information Retrieval System (AIRS) is an air pollution data delivery system managed by the Technical Support Division in EPA's Office of Air Quality Planning and Standards (OAQPS), located in Research Triangle Park, North Carolina. The AIRS is a national repository of data related to air pollution monitoring and control. It contains a wide range of information related to stationary sources of air pollution, including the emission of a number of air pollutants that may be of concern within a particular industry. States are the primary suppliers of data to AIRS. Data are used to support monitoring, planning, tracking, and enforcement related to implementation by EPA staff, the scientific community, other countries, and the general public. The following criteria pollutant emissions and estimated TRI pollutant release data for the fossil fuel electric power generation industry were extracted from this database.

AIRS Estimated Criteria Pollutant Emissions

The AIRS database contains data on criteria pollutants: CO, NO_X, particulate matter (PM) of 10 microns or less (PM10), total particulate emissions (PT), SO_2, and VOCs. Criteria pollutant releases for the fossil fuel electric power generation industry were accessed using SIC codes 4911 and 4931. It should be noted that accessing the data using SIC codes does not allow the segregation of emissions for facilities that use fossil fuels from facilities that use nuclear, renewable, or a combination of fuels. Therefore, the annual emissions taken from the AIRS database will overestimate the emissions from the fossil fuel subsector of the power generation industry. Table 19 presents the criteria pollutant data available for this industry. Pollutant releases for other industries are also included in the table.

Table 19: Annual Air Pollutant Releases (tons/year)

Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
Metal Mining	4,670	39,849	63,541	173,566	17,690	915
Nonmetal Mining	25,922	22,881	40,199	128,661	18,000	4,002
Lumber and Wood Production	122,061	38,042	20,456	64,650	9,401	55,983
Furniture and Fixtures	2,754	1,872	2,502	4,827	1,538	67,604
Pulp and Paper	566,883	358,675	35,030	111,210	493,313	127,809
Printing	8,755	3,542	405	1,198	1,684	103,018
Inorganic Chemicals	153,294	106,522	6,703	34,664	194,153	65,427
Organic Chemicals	112,410	187,400	14,596	16,053	176,115	180,350
Petroleum Refining	734,630	355,852	27,497	36,141	619,775	313,982
Rubber and Misc. Plastics	2,200	9,955	2,618	5,182	21,720	132,945
Stone, Clay and Concrete	105,059	340,639	192,962	662,233	308,534	34,337
Iron and Steel	1,386,461	153,607	83,938	87,939	232,347	83,882
Nonferrous Metals	214,243	31,136	10,403	24,654	253,538	11,058
Fabricated Metals	4,925	11,104	1,019	2,790	3,169	86,472
Electronics and Computers	356	1,501	224	385	741	4,866
Motor Vehicles, Bodies, Parts and Accessories	15,109	27,355	1,048	3,699	20,378	96,338
Dry Cleaning	102	184	3	27	155	7,441
Transportation	128,625	550,551	2,569	5,489	8,417	104,824
Metal Casting	116,538	11,911	10,995	20,973	6,513	19,031
Pharmaceuticals	6,586	19,088	1,576	4,425	21,311	37,214
Plastic Resins and Synthetic Fibers	16,388	41,771	2,218	7,546	67,546	74,138
Textiles	8,177	34,523	2,028	9,479	43,050	27,768
Fossil Fuel ElectricPower Generation	366,208	5,986,757	140,760	464,542	13,827,511	57,384
Ship Building and Repair	105	862	638	943	3,051	3,967

Source: U.S. EPA Office of Air and Radiation, AIRS Database, 1997.

AIRS Estimated TRI Pollutant Emissions

Data were collected from the AIRS database by the EPA Office of Pollution Prevention and Toxics, Environmental Assistance Division, Toxics Release Inventory Branch in support of the TRI expansion project discussed previously. The data set that was downloaded included the most recent data available for each facility up to and including 1995 data. The data presented in Table 20 are estimates of TRI releases based on air releases reported in the AIRS Facility Subsystem (AFS) from facilities within SIC codes 4911 and 4931. The data contain quantities of directly reported TRI chemicals, as well as quantities of additional TRI chemicals extrapolated from reported releases of PM and VOCs. The PM and VOC releases were matched with chemical profiles contained in the SPECIATE database (Version 1.5). The SPECIATE is a computerized format of the EPA Air Emissions Species Manual and is available for download from the Clearing House of Inventory and Emissions Factors (CHIEFs). The data presented are based only on apportionment of "original" species profiles in the SPECIATE database -- those species profiles that were developed specifically for the source of the release where it has been applied. Despite the use of only the highest quality profiles in the SPECIATE database, these data should only be used as a preliminary indication of potential releases and not as actual air releases. These data have been provided for illustrative purposes only and should not be used in comparisons with other release data.

IV.C.3 Hazardous Air Pollutant Emissions Estimates for Fossil Fuel Electric Utility Steam Generating Units

Estimates of hazardous air pollutant (HAP) emissions from fossil fuel electric utility steam generating units have been developed by OAQPS and are reported in a report entitled, *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Interim Final Report* (Volumes 1-3).[35] These estimates are based on emissions test data from 52 units obtained from extensive emission tests by the EPRI, DOE, the Northern States Power Company, and EPA. The testing program covered a wide range of facility types with a variety of control scenarios. Therefore, the data are considered to be generally representative of fossil fuel utility steam electric generating units as a whole. This study estimated the average annual emissions for each of 684 power plants. A total of 67 HAPs were identified in the emission testing program as potentially being emitted from these facilities.

It should be noted that the report states that because of the small sample sizes for specific boiler types and control scenarios, there are uncertainties in the data. Therefore, the data for individual plants may either underestimate or overestimate the actual emissions. According to the report, the average annual emissions estimates will be roughly within a factor of plus or minus three of the actual annual emissions. However, it is recognized that the analysis had numerous limitations, such as not including data on potential upsets or unusual operating conditions, and it is possible that the range of uncertainty is greater. Tables 21, 22, and 23 present data on estimated inorganic HAPs from coal-fired, oil-fired, and gas-fired utility steam electric facilities. Tables 24, 25, and 26 present data on estimated organic HAPs from coal-fired, oil-fired, and gas-fired utility steam electric facilities.

Table 20: Estimated Releases of TRI Chemicals *		
CAS NO.	Chemical Name	Total Releases (pounds per year)
71556	1,1,1-Trichloroethane (Methyl chloroform)	52,923,638
79005	1,1,2-Trichloroethane	422,954
95636	1,2,4-Trimethylbenzene	264,682
106934	1,2-Dibromoethane (Ethylene dibromide)	1,820,797
95501	1,2-Dichlorobenzene	22,292
107062	1,2-Dichloroethane (Ethylene dichloride)	35,222,942
106990	1,3-Butadiene	7,443,883
541731	1,3-Dichlorobenzene	672
106467	1,4-Dichlorobenzene	378,018
112345	2-(2-Butoxyethoxy)ethanol	103,100
124174	2-(2-Butoxyethoxy)ethanol acetate	0
111900	2-(2-Ethoxyethoxy)ethanol	885,978
111773	2-(2-Methoxyethoxy)ethanol	0
111762	2-Butoxyethanol	21,929,191
110805	2-Ethoxyethanol	998,125
111159	2-Ethoxyethyl acetate	111,202
109864	2-Methoxyethanol	60
90437	2-Phenylphenol	8,507
101779	4,4'-Methylenedianiline	43
75070	Acetaldehyde	2,010,699
107028	Acrolein	1,528,324
79107	Acrylic acid	3,657
107131	Acrylonitrile	783,041
7429905	Aluminum (fume or dust)	75,792,629
7664417	Ammonia	43,518,590
62533	Aniline	311,982
120127	Anthracene	139,265
7440360	Antimony	1,789,097
7440382	Arsenic	9,329,119
1332214	Asbestos (friable)	8,123
7440393	Barium	1,435,995
56553	Benz(a)anthracene	1,839
71432	Benzene	149,967,605
218019	Benzo(a)phenanthrene	1,609
50328	Benzo(a)pyrene	1,381
100447	Benzyl chloride	0
7440417	Beryllium	10,997
92524	Biphenyl	85,493
7726956	Bromine	949,230
141322	Butyl acrylate	11,240
123728	Butylaldehyde	110,921
7440439	Cadmium	13,733,816

R0075163

Table 20 (continued): Estimated Releases of TRI Chemicals*		
CAS NO.	Chemical Name	Total Releases (Pounds per Year)
75150	Carbon disulfide	27,330,674
56235	Carbon tetrachloride	81,376
7782505	Chlorine	71,501,754
108907	Chlorobenzene	171,894
75456	Chlorodifluoromethane (HCFC-22)	162,070
75003	Chloroethane (Ethyl chloride)	31,182,710
67663	Chloroform	13,340
74873	Chloromethane (Methyl chloride)	178,484
126998	Chloroprene	57,294
75729	Chlorotrifluoromethane (CFC-13)	9,053
7440473	Chromium	2,632,999
7440484	Cobalt	211,262
7440508	Copper	3,058,579
8001589	Creosote	0
1319773	Cresol (mixed isomers)	239,994
98828	Cumene	725,684
110827	Cyclohexane	96,418,561
108930	Cyclohexanol	6,031
84742	Dibutyl phthalate	1,248,555
75718	Dichlorodifluoromethane (CFC-12)	97,414
75092	Dichloromethane (Methylene chloride)	1,414,455,336
76142	Dichlorotetrafluoroethane (CFC-114)	5,847
131113	Dimethyl phthalate	669,536
106898	Epichlorohydrin	66,000
140885	Ethyl acrylate	117,509
100414	Ethylbenzene	68,347,539
74851	Ethylene	53,298,159
107211	Ethylene glycol	76,627
75218	Ethylene oxide	541,571
7782414	Fluorine	6,068,173
50000	Formaldehyde	61,211,875
64186	Formic acid	467,279
76131	Freon 113 [Ethane, 1,1,2-trichloro-1,2,2,-trifluoro-]	7,587,241
7647010	Hydrochloric acid	5,809,931
78842	Isobutyraldehyde	109,758
67630	Isopropyl alcohol (mfg-strong acid process)	32,059,970
7439921	Lead	72,091,837
108383	m-Xylene	32,874,142
108316	Maleic anhydride	324,171
7439965	Manganese	2,969,118
7439976	Mercury	394,924
67561	Methanol	44,028,966

Table 20 (continued): Estimated Releases of TRI Chemicals*

CAS NO.	Chemical Name	Total Releases (Pounds per Year)
96333	Methyl acrylate	0
78933	Methyl ethyl ketone	91,926,327
108101	Methyl isobutyl ketone	20,020,683
80626	Methyl methacrylate	16,208
74953	Methylene bromide	52,241
101688	Methylenebis(phenylisocyanate) (MBI)	130
101688	Methylenebis(phenylisocyanate) (MDI)	130
76153	Monochloropentafluoroethane (CFC-115)	6,199
68122	N,N-Dimethylformamide	2,700,310
71363	n-Butyl alcohol	12,653,277
110543	n-Hexane	107,548,181
91203	Naphthalene	434,275
7440020	Nickel	7,884,920
7697372	Nitric acid	214,564
98953	Nitrobenzene	0
95476	o-Xylene	41.115,640
106423	p-Xylene	2,327,391
85018	Phenanthrene	84,032
108952	Phenol	15,017,545
7723140	Phosphorus (yellow or white)	7,980,941
85449	Phthalic anhydride	2,491,887
123386	Propionaldehyde	49,400
115071	Propylene (Propene)	45,955,707
75569	Propylene oxide	183,593
78922	sec-Butyl alcohol	990,420
7782492	Selenium	173,886
7440224	Silver	289,686
100425	Styrene	28,155,503
7664939	Sulfuric acid	1,320,503
75650	Tert-Butyl alcohol	4,660
127184	Tetrachloroethylene (Perchloroethylene)	14,623,885
7440280	Thallium	<1
108883	Toluene	421,985,085
79016	Trichloroethylene	27,838,379
75694	Trichlorofluoromethane (CFC-11)	1,315,878
7440622	Vanadium (fume or dust)	7,256,367
108054	Vinyl acetate	1,011,166
75014	Vinyl chloride	10,200,715
1330207	Xylene (mixed isomers)	191,013,108
7440666	Zinc (fume or dust)	20,353,738

* Data in this table should not be used for comparison with other environmental data from other sources. It is only provided for illustrative purposes. Please note the limitations of the data explained in the text.

Table 21: Median Emission Factors Determined From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Inorganic HAPs From Coal-Fired Units *

Coal-Fired Units: Inorganic HAPs	Number of Stack Factors: PM Control **	Median Stack Factor: PM Control (lb/trillion Btu)***	Number of Stack Factors: PM and SO_2 Control**	Median Stack Factor: PM and SO_2 Control (lb/trillion Btu)**	Estimated Total 1990 Emissions (tons)	Estimated Total 2010 Emissions (tons)
Antimony	7	1.4	4	0.13	11	14
Arsenic	21	2.9	8	0.9	54	62
Beryllium	12	0.45	5	0.14	6.6	7.6
Hydrogen Chloride	15	21,000	9	1,290	137,000	150,000
Hydrogen Cyanide (HCN) †	All HCN factors were combined	Number of Factors: 5	Median Factor: 28 lb/trillion Btu		240	320
Hydrogen Fluoride	14	4,200	6	106	19,500	25,600
Cadmium	18	0.72	9	1	1.9	2.3
Chromium	22	8.4	10	4	70	83
Cobalt	10	2.7	6	1	21	27
Lead	21	4.8	9	5.8	72	83
Manganese	21	15	9	15	180	232
Mercury	20	3.9	10	3.4	51	65
Nickel	21	8.3	10	5.2	48	57
Phosphorous (P)††	All P Factors were Combined	Number of Factors: 10	Median Factor 31 lb/trillion Btu		270	350
Selenium	19	62	9	8	190	230

* Compounds are listed in the following sequence: inorganic, organic, and dioxin/furan/polycyclic aromatic hydrocarbons (PAHs). Median emission factors were determined from organic HAP concentrations at the stack, control device outlet, or boiler outlet when at least one of typically three measured flue gas concentrations was detected.
** Stack factors for inorganic HAPs were taken from test reports when at least one of typically three measured flue gas concentrations was detected. These factors were not used to develop the estimated emissions.
*** Since the inorganic emissions were not directly estimated from stack factors, total emissions of inorganic HAPs projected with the computer program and from median stack factors will vary.
† Nationwide hydrogen cyanide emissions were detected from stack emission factors and not from emission median factors.
†† Nationwide phosphorous emissions were detected from stack emission factors and not from emission median factors.

Source: *Study of Hazardous Air Pollutant Emission from Electric Utility Steam Generating Units--Interim Final Report, Volumes 1-3.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. EPA-453/R-96-013b. October 1996.

Table 22: Median Emission Factors Determined From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Inorganic HAPs From Oil-Fired Units *

Oil-Fired Units: Inorganic HAPs	Number of Stack Factors: PM Control **	Median Stack Factor: PM Control (lb/trillion Btu)***	Number of Stack Factors: No PM Control **	Median Stack Factor: No PM Control (lb/trillion Btu) ***	Estimated Total 1990 Emissions (tons)	Estimated Total 2010 Emissions (tons)
Arsenic	2	0.32	8	5.3	5	2.5
Beryllium	2	0.33	4	0.21	0.45	0.23
Cadmium	1	0.32	9	1.6	1.7	0.87
Chromium	4	3.7	8	5.7	4.7	2.4
Cobalt	2	6.1	3	27	20.3	10.3
Hydrogen Chloride	4	2900	2	2300	2870	1456
Hydrogen Fluoride	3	230	2	140	144	73
Lead	3	2.6	8	9	10.6	5.3
Manganese	3	15	9	16	9.5	4.8
Mercury	3	0.24	3	0.48	0.25	0.13
Nickel	4	180	9	410	389	197
Phosphorous (P)†	All P Factors were Combined	Number of Factors: 3	Median Factor 110 lb/trillion Btu		68	34
Selenium	1	1.4	8	3.8	1.7	0.84

* Compounds are listed in the following sequence: inorganic, organic, and dioxin/furan/polycyclic aromatic hydrocarbons (PAHs). Median emission factors were determined from organic HAP concentrations at the stack, control device outlet, or boiler outlet when at least one of typically three measured flue gas concentrations was detected.

** Stack factors for inorganic HAPs were taken from test reports when at least one of typically three measured flue gas concentrations was detected. These factors were not used to develop the estimated emissions.

*** Since the inorganic emissions were not directly estimated from stack factors, total emissions of inorganic HAPs projected with the computer program and from median stack factors will vary.

† Nationwide phosphorous emissions were detected from stack emission factors and not from emission median factors.

Source: *Study of Hazardous Air Pollutant Emission from Electric Utility Steam Generating Units--Interim Final Report Volumes 1-3.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. EPA-453/R-96-013b. October 1996.

Table 23: Median Emission Factors Determined From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Inorganic HAPs From Gas-Fired Units [*]

Gas-Fired Units: Inorganic HAPs	Number of Stack Factors: No PM Control	Median Stack Factor: No PM Control (lb/trillion Btu)	Estimated Total 1990 Emissions (tons)	Estimated Total 2010 Emissions (tons)
Arsenic	2	0.14	0.16	0.25
Cadmium	1	0.044	0.054	0.086
Chromium	2	0.96	1.2	1.9
Cobalt	1	0.12	0.14	0.23
Lead	2	0.37	0.44	0.68
Manganese	2	0.3	0.37	0.59
Mercury	2	<0.38	0.0016	0.0024
Nickel	2	2.3	2.3	3.5
Phosphorous	1	2.2	1.3	2

[*] Compounds are listed in the following sequence: inorganic, organic, and dioxin/furan/polycyclic aromatic hydrocarbons (PAHs). Median emission factors were determined from organic HAP concentrations at the stack, control device outlet, or boiler outlet when at least one of typically three measured flue gas concentrations was detected.

Source: *Study of Hazardous Air Pollutant Emission from Electric Utility Steam Generating Units--Interim Final Report Volumes 1-3*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. EPA-453/R-96-013b. October 1996.

R0075168

Table 24: Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Coal-Fired Units

Coal-Fired Units: Organic HAP	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total Tons	Computer Program: 2010 Total Tons
1,1,2-Trichloroethane	1	4.7	40	53
2-chloroacetophenone	3	0.29	2.4	3.2
2,4 -Dinitro toluene	3	0.015	0.13	0.17
Acetaldehyde	12	6.8	58	76
Acetophenone	7	0.68	5.8	7.7
Acrolein	6	3.3	28	37
Benzene	20	2.5	21	28
Benzyl chloride	1	0.0056	0.048	0.063
Bis(2-ethylhexyl) phthalate	9	4.1	35	46
Bromoform	1	6.6	57	75
Carbon disulfide	8	4.3	37	48
Carbon tetrachloride	2	3.3	28	37
Chlorobenzene	2	3.2	27	36
Chloroform	2	3.2	28	36
Cumene	1	0.29	2.5	3.2
Dibutyl phthalate	5	2.8	24	32
Ethylbenzene	5	0.40	3.5	4.6
Ethylchloride	1	2.4	20	27
Methylchloroform	4	3.4	29	38
Ethylenedichloride	3	3.1	27	35
Formaldehyde	15	4.0	35	45
Hexane	2	0.82	6.9	9.1
Hexachlorobenzene	1	0.079	0.68	0.89
Isophorone	2	24	200	270
Methylbromide	6	0.88	7.7	10
Methylchloride	3	5.9	51	67
Methylethylketone	6	8.0	69	90
Methyliodide	1	0.40	3.4	4.5
Methylisobutyl ketone	3	4.9	42	53
Methylmethacrylate	1	1.1	9.3	12
Methyltertbutylether	1	1.4	12	16
Methylenechloride	5	13	110	150

R0075169

Table 24 (continued) : Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Coal-Fired Units

Coal-Fired Units: Organic HAP	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total Tons	Computer Program: 2010 Total Tons
n-nitrosodimethylamine	1	0.68	5.9	7.7
Naphthalene	11	0.77	6.6	8.7
n,p-cresol	2	0.68	5.8	7.6
o-cresol	3	1.7	14	19
p-cresol	1	0.95	8.2	11
perylene	1	0.075	0.65	0.85
Pentachlorophenol	1	0.0082	0.070	0.093
Phenol	10	6.1	52	69
Phthalicanhydride	1	4.9	42	56
Propionaldehyde	4	10	89	120
Quinoline	1	0.053	0.46	0.61
Styrene	7	3.1	27	35
Tetrachloroethylene (Perchloroethylene)	5	3.1	27	35
Toluene	17	3.6	31	41
Trans 1,3-dichloropropene	1	4.7	40	53
Trichloroethylene	1	3.1	27	35
Vinyl acetate	1	0.42	3.5	4.6
Vinylidnechloride	2	9.7	84	110
Xylene	2	4.7	40	53
o-xylene	5	0.82	6.9	9.1
m,p-xylene	8	1.5	13	17
Total TEQ' for 2,3,7,8-tetra-chlorodibenzo-p-dioxin	-	-	1.5×10^{-4}	2.0×10^{-4}
2,3,7,8-tetrachloride-benzo-p-dioxin	4	1.6×10^{-6}	1.4×10^{-5}	1.9×10^{-5}
1,2,3,7,8-pentachlorodi-benzo-p-dioxin	3	4.3×10^{-6}	3.7×10^{-5}	4.8×10^{-5}
1,2,3,4,7,8-hexachlorodi-benzo-p-dioxin	4	9.7×10^{-6}	8.3×10^{-5}	1.1×10^{-4}
1,2,3,6,7,8-hexachlorodi-benzo-p-dioxin	4	5.8×10^{-6}	5.0×10^{-5}	6.6×10^{-5}
1,2,3,7,8,9-hexachlorodi-benzo-p-dioxin	4	7.3×10^{-6}	6.3×10^{-5}	8.3×10^{-5}
1,2,3,4,6,7,8-heptachlorodi-benzo-p-dioxin	9	5.7×10^{-6}	4.9×10^{-5}	6.5×10^{-5}
Heptachlorodi-benzo-p-dioxin	6	1.1×10^{-4}	9.2×10^{-4}	1.2×10^{-3}
Hexachlorodi-benzo-p-dioxin	8	2.4×10^{-5}	2.1×10^{-4}	2.7×10^{-4}
Octachlorodi-benzo-p-dioxin	6	5.8×10^{-5}	5.0×10^{-4}	6.6×10^{-4}
Pentachlorodi-benzo-p-dioxin	6	9.8×10^{-6}	8.5×10^{-5}	1.1×10^{-4}

Table 24 (continued) : Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Coal-Fired Units

Coal-Fired Units: Organic HAP	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total Tons	Computer Program: 2010 Total Tons
Tetrachloride-benzo-p-dioxin	9	7.1×10^{-6}	6.1×10^{-5}	8.0×10^{-5}
2,3,7,8-tetrachloride-benzofuran	8	3.9×10^{-6}	3.4×10^{-5}	4.5×10^{-5}
1,2,3,7,8-pentachlorodi-benzofuran	5	2.4×10^{-6}	2.1×10^{-5}	2.8×10^{-5}
2,3,4,7,8-pentachlorodi-benzofuran	5	1.0×10^{-5}	9.0×10^{-5}	1.2×10^{-4}
1,2,3,4,7,8-hexachlorodi-benzofuran	6	1.3×10^{-5}	1.1×10^{-4}	1.5×10^{-4}
1,2,3,6,7,8-hexachlorodi-benzofuran	5	4.0×10^{-6}	3.4×10^{-5}	4.5×10^{-5}
1,2,3,7,8,9-hexachlorodi-benzofuran	4	8.5×10^{-6}	7.3×10^{-5}	9.6×10^{-5}
2,3,4,6,7,8-hexachlorodi-benzofuran	5	1.6×10^{-5}	1.4×10^{-4}	1.8×10^{-4}
1,2,3,4,6,7,8-heptachlorodi-benzofuran	8	2.0×10^{-5}	1.7×10^{-4}	2.2×10^{-4}
1,2,3,4,7,8,9-heptachlorodi-benzofuran	4	1.7×10^{-4}	1.5×10^{-3}	2.0×10^{-3}
Heptachlorodi-benzofuran	8	2.4×10^{-5}	2.1×10^{-4}	2.7×10^{-4}
Hexachlorodi-benzofuran	8	1.9×10^{-5}	1.6×10^{-4}	2.1×10^{-4}
Octachlorodi-benzofuran	10	1.7×10^{-5}	1.4×10^{-4}	1.9×10^{-4}
Pentachlorodi-benzofuran	9	1.8×10^{-5}	1.6×10^{-4}	2.1×10^{-4}
Tetrachloride-benzofuran	10	1.2×10^{-5}	1.0×10^{-4}	1.3×10^{-4}
1-methylnaphthalene	2	0.0085	0.076	0.1
2-chloronaphthalene	2	0.04	0.35	0.46
2-methylnaphthalene	6	0.024	0.2	0.26
Acenapthene	6	0.008	0.07	0.09
Acenapthylene	5	0.0042	0.036	0.047
Anthracene	4	0.0042	0.036	0.047
Benz(a)anthracene	4	0.0021	0.018	0.002
Benzo(a)pyrene	6	0.001	0.0088	0.012
Benzo(e)pyrene	1	0.0012	0.01	0.014
Benzo(b)fluoranthene	1	0.0081	0.07	0.092
Benzo(b+k)fluoranthene	1	0.0016	0.014	0.018
Benzo(k)fluoranthene	1	0.0036	0.031	0.04
Benzo(g,h,i)perylene	2	0.0032	0.028	0.036
Biphenyl	1	0.34	3.1	4
Chrysene	4	0.0026	0.022	0.03
Dibenzo(a,h)anthacene	1	0.0003	0.003	0.004
Fluoranthene	6	0.007	0.06	0.082

R0075171

Table 24 (continued) : Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Coal-Fired Units

Coal-Fired Units: Organic HAP	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total tons	Computer Program: 2010 Total tons
Fluorene	5	0.013	0.11	0.15
Indeno(1,2,3-c,d)pyrene	2	0.0064	0.054	0.072
Phenanthrene	7	0.032	0.031	0.36
Pyrene	4	0.009	0.081	0.103

* Toxic equivalent emissions.

Source: *Study of Hazardous Air Pollutant Emission from Electric Utility Steam Generating Units--Interim Final Report, Volumes 1-3.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. October 1996. EPA-453/R-96-013b.

R0075172

Table 25: Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Oil-Fired Units

Oil-Fired Units: Organic HAPs	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total Tons	Computer Program: 2010 Total Tons
Acetaldehyde	1	8.2	5	2.6
Benzene	6	1.4	0.88	0.45
Ethylbenzene	2	0.49	0.29	0.15
Formaldehyde	9	30	19	9.5
Methylchloroform	3	7.6	4.6	2.4
Methylenechloride	2	32	20	10
Naphthalene	4	0.33	0.21	0.1
Phenol	2	24	15	7.5
Tetrachloroethylene (Perchloroethylene)	1	0.55	0.34	0.17
Toluene	6	8	4.9	2.5
Vinyl acetate	2	5.2	3.2	1.6
o-Xylene	1	0.84	0.51	0.26
m,p-Xylene	2	1.4	0.82	0.42
Total TEQ[a] for 2,3,7,8-tetra-chlorodibenzo-p-dioxin	--	--	1.1×10^{-5}	5.4×10^{-6}
2,3,7,8-tetrachloride-benzo-p-dioxin	1	6.5×10^{-6}	4.5×10^{-6}	2.0×10^{-6}
1,2,3,7,8-pentachlorodi-benzo-p-dioxin	2	5.8×10^{-6}	3.5×10^{-6}	1.8×10^{-6}
1,2,3,4,7,8-hexachlorodi-benzo-p-dioxin	1	1.2×10^{-5}	7.6×10^{-6}	3.9×10^{-6}
1,2,3,6,7,8-hexachlorodi-benzo-p-dioxin	2	5.4×10^{-5}	3.3×10^{-6}	1.7×10^{-6}
1,2,3,7,8,9-hexachlorodi-benzo-p-dioxin	2	8.3×10^{-6}	5.1×10^{-6}	2.6×10^{-6}
1,2,3,4,6,7,8-heptachlorodi-benzo-p-dioxin	2	2.0×10^{-5}	1.2×10^{-5}	6.2×10^{-6}
Heptachlorodi-benzo-p-dioxin	2	2.0×10^{-5}	1.2×10^{-5}	6.2×10^{-6}
Hexachlorodi-benzo-p-dioxin	2	8.1×10^{-6}	5.0×10^{-6}	2.5×10^{-6}
Octachlorodi-benzo-p-dioxin	1	2.3×10^{-5}	1.4×10^{-5}	7.3×10^{-6}
Pentachlorodi-benzo-p-dioxin	2	5.8×10^{-6}	3.5×10^{-6}	1.8×10^{-6}
Tetrachloride-benzo-p-dioxin	2	5.7×10^{-6}	3.4×10^{-6}	1.8×10^{-6}
2,3,7,8-tetrachloride-benzofuran	2	4.6×10^{-6}	2.9×10^{-6}	1.4×10^{-6}
1,2,3,7,8-pentachlorodi-benzofuran	2	4.3×10^{-6}	2.6×10^{-6}	1.3×10^{-6}
2,3,4,7,8-pentachlorodi-benzofuran	2	4.8×10^{-6}	3.0×10^{-6}	1.5×10^{-6}
1,2,3,4,7,8-hexachlorodi-benzofuran	2	6.1×10^{-6}	3.7×10^{-6}	1.9×10^{-6}
1,2,3,6,7,8-hexachlorodi-benzofuran	2	3.8×10^{-6}	2.3×10^{-6}	1.2×10^{-6}

Table 25 (continued): Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Oil-Fired Units

Oil-Fired Units: Organic HAPs	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total Tons	Computer Program: 2010 Total Tons
1,2,3,7,8,9-hexachlorodi-benzofuran	2	5.8×10^{-6}	3.5×10^{-6}	1.8×10^{-6}
2,3,4,6,7,8-hexachlorodi-benzofuran	1	4.8×10^{-6}	3.0×10^{-6}	1.4×10^{-6}
1,2,3,4,6,7,8-heptachlorodi-benzofuran	1	9.4×10^{-6}	5.7×10^{-6}	3.0×10^{-6}
1,2,3,4,7,8,9-heptachlorodi-benzofuran	1	1.0×10^{-5}	6.2×10^{-6}	3.2×10^{-6}
Heptachlorodi-benzofuran	1	1.5×10^{-6}	8.8×10^{-7}	4.4×10^{-7}
Hexachlorodi-benzofuran	2	9.6×10^{-6}	5.8×10^{-6}	3.0×10^{-6}
Octachlorodi-benzofuran	1	1.0×10^{-5}	6.2×10^{-6}	3.2×10^{-6}
Pentachlorodi-benzofuran	2	7.3×10^{-6}	4.4×10^{-6}	2.2×10^{-6}
Tetrachloride-benzofuran	2	5.0×10^{-6}	3.1×10^{-6}	1.5×10^{-6}
2-methylnaphthalene	4	0.017	0.01	0.0052
Acenaphthene	2	0.38	0.22	0.11
Acenaphthylene	1	0.017	0.01	0.0052
Anthracene	2	0.015	0.0093	0.0047
Benz(a)anthracene	3	0.03	0.018	0.0092
Benzo(b+k)fluoranthene	2	0.033	0.02	0.01
Benzo(g,h,i)perylene	2	0.021	0.013	0.0065
Chrysene	3	0.021	0.013	0.0066
Dibenzo(a,h)anthracene	2	0.0081	0.005	0.0025
Fluoranthene	6	0.016	0.0097	0.0049
Fluorene	5	0.021	0.013	0.0065
Indeno(1,2,3-c,d)pyrene	2	0.024	0.014	0.0073
Nitrobenzofluoranthene	1	0.015	0.0092	0.0047
Nitrochrysene/benzanthracene	1	0.016	0.0098	0.005
Phenanthrene	9	0.025	0.015	0.0077
Pyrene	6	0.037	0.022	0.011

* Toxic equivalent emissions

Source: *Study of Hazardous Air Pollutant Emission from Electric Utility Steam Generating Units--Interim Final Report. Volumes 1-3.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. October 1996. EPA-453/R-96-

Table 26: Median Emission Factors From Test Report Data, and Total 1990 and 2010 HAP Emissions, Projected With the Emission Factor Program for Organic HAPs From Gas-Fired Units

Gas-Fired Units: Organic HAPs	Number of Emission Factors	Median Emission Factor (lb/trillion Btu)	Computer Program: 1990 Total Tons	Computer Program: 2010 Total Tons
Benzene	1	1.4	1.8	2.7
Formaldehyde	8	35.5	55	83
Naphthalene	2	0.7	0.66	1
Toluene	2	10	13	19
2-methylnaphthalene	2	0.026	0.025	0.038
Fluoranthene	1	0.0028	0.0034	0.0055
Fluorene	1	0.0026	0.0034	0.0051
1-phenanthrene	2	0.013	0.016	0.024
Pyrene	1	0.0049	0.0061	0.0094

Source: *Study of Hazardous Air Pollutant Emission from Electric Utility Steam Generating Units--Interim Final Report, Volumes 1-3.* U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. October 1996. EPA-453/R-96-013b.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways, such as reducing material inputs, re-engineering processes to reuse byproducts, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be implemented feasibly. In the waste management hierarchy, if source reduction is not feasible the next alternative is recycling of wastes, followed by energy recovery, and waste treatment as a last alternative.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the fossil fuel electric power generation industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be used effectively. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Coal is considered the primary energy source for power generation now and in the future. Coal is relatively abundant and inexpensive. However, environmental impacts associated with coal combustion, most notably, acid rain, represent a cost to the environment and human health. This section emphasizes technologies for coal-fired electric power generation plants, but includes pollution prevention practices that apply to other fossil fuel electric plants as well. Many of the technologies and practices may be employed in existing plants, in the repowering of existing plants, and in the design and construction of new plants.

V.A Pollution Prevention Technologies in the DOE Clean Coal Technology Demonstration Program

The DOE is charged with protecting the Nation's energy interests. In recognition of the vital role of coal as a sustainable energy source, DOE vigorously researches and promotes ways to reduce the environmental impacts associated with coal combustion under the Clean Coal Technology Demonstration (CCT) Program. Specific goals of the CCT Program include (1) increasing the efficiency of electricity production and (2) enhancing the efficient and cost effective use of U.S. coal reserves, while ensuring achievement of national and environmental goals.

One way in which the CCT Program progresses towards these goals is by building a portfolio of advanced, coal-based technology demonstration projects. Included in the portfolio are technologies that result in improved efficiency with fewer environmental consequences. The technologies demonstrated under the CCT Program include commercially viable processes, as well as projects whose commercial viability is still being explored. These technologies may be categorized as (1) power systems, (2) environmental control devices, and (3) clean coal processing. Pollution prevention technologies being demonstrated under the CCT Program are included under the categories labeled "power systems" and "clean coal processing." Technologies categorized as "environmental control devices" may not be considered pollution prevention technologies; however, they may enable the recovery of pollutants for subsequent reuse/resale in products.

A brief discussion of emerging power systems and coal processing technologies being demonstrated under the CCT Program is provided below. DOE's *Clean Coal Technology Demonstration Program, Program Update 1995* (April 1996) provides a more detailed discussion.

V.A.1 Emerging Technologies

Pollution prevention opportunities in advanced coal-fired power systems are realized by the increase in overall efficiency of the combustion (electricity produced per amount of fuel) resulting in the reduction of environmental pollutants released. Efficiency of a technology is determined by the portion of energy in fuel that is converted into electricity. Thus, the process of combustion and heat transfers are critical variables. In considering advanced technologies, one must consider the environmental transfer of wastes from one media to another. Unless the transfer represents a more manageable form of the waste, there may be little or no environmental gain.

A brief description of power system technologies is provided below. While none of the technologies described are currently commercially viable, they may be in the future. Table 27 summarizes demonstration projects for power system technologies funded by DOE and participating companies.

Table 27: Summaries of Clean Coal Technologies Under DOE's Clean Coal Technology Demonstration Program

Demonstration: Pressurized Fluidized-Bed Combustion Combined-cycle, Tidd Project-The Ohio Power Company

Status: *Completed on the 70 MW scale, future testing on 340 MW scale planned.*
Size: *55 MW steam turbine, 15 MW gas turbine*
Efficiency: *Combustion efficiency of 99.6%. Heat rate efficiency of 33.2 percent*
Environmental Benefits: *SO_2 removal of up to 95%. Resulting NO_X emissions of 0.15-0.33lb/million Btu.*

Demonstration: Integrated Gasification Combined-cycle Repowering Project

Status: *Currently still in design stage.*
Size: *65 MW*
Projected Efficiency: *Heat efficiency of approximately 43%.*
Environmental Benefits: *Expected CO_2 reduction, improved efficiency over coal-fired plant with flue gas desulfurization.*

Demonstration: Indirect Fired Cycle-Repowering, Pennsylvania Electric Co. Warren Station, Unit No. 2

Status: *Currently still in design stage.*
Size: *62.4 MW*
Projected Heat Rate: *9,650 BTU/KWh (31.3% improvement over existing).*
Environmental Benefits: *Eliminates the need for hot gas cleanup systems.*

Demonstration: Coal Diesel Combined-Cycle Project, Arthur D. Little, Inc.

Status: *Currently in design stage.*
Size: *14 MW*
Projected Efficiency: *Heat efficiency of approximately 48%.*
Environmental Benefits: *Emissions reductions to levels of 50%-70% below NSPS.*

Demonstration: Slagging Combustor, Heavy Clean Coal Project, Alaska Industrial Development and Export Authority, Golden Valley Electric Association

Status: *Currently in construction stage.*
Size: *50 MW*
Projected Efficiency: *Projected SO_2 removal of 90%, NO_X emissions/million BTU emissions of less than 0.015 lb/million BTU, particulates of 0.0015 lb/million BTU.*
Environmental Benefits: *SO_2, NO_X, particulates emissions reductions.*

Fluidized-Bed Combustion

Fluidized bed combustion (FBC) technology includes three designs: atmospheric, pressurized, and two-stage bubbling bed. Although FBC technology is not yet widespread in the industry, it allows any kind of fuel to be burned while controlling the emission of SO_2 without the use of a flue gas scrubbing device. In the FBC process, a sorbent, such as crushed limestone, is introduced with pulverized coal in the combustion chamber. Air forced into the combustion chamber suspends the coal-limestone mixture. Sulfur, released from the coal, combines with the sorbent to form a solid waste that is relatively easy to handle and dispose of. The advantage of FBC technology is that it creates a turbulent environment conducive to a high rate of combustion and a high rate of sulfur capture and allows for lower operating temperatures than conventional boilers. Because operating temperatures are below the threshold of thermally induced NO_X formation, NO_X emissions are reduced. In addition, the operating temperature tends to be below the ash fusion range for coal, resulting in less wastes present in fireside wash waters and less frequent cleaning requirements.

Integrated Gasification Combined-cycle

In the IGCC, coal is converted into a gaseous fuel, purified, and combusted in a gas turbine generator to produce electricity. The constituents react to produce a fuel gas. Heat from the exhaust gas is recovered and used to generate steam, which produces additional electricity. Gasification is a process in which coal is introduced to a reducing atmosphere with oxygen or air and steam. In some systems, a limestone sorbent is added to the gasifier for sulfur removal. The environmental advantages of IGCC include:

- High efficiency
- Removal of nitrogen, sulfur, and particulates prior to the addition of combustion air, thereby lowering the volume of gas requiring treatment
- Sulfur in the gas is in the form of hydrogen sulfide, which is removable to a greater extent than SO_2
- NO_X removal of more than 90 percent
- Reduced CO_2 emissions compared to traditional coal-fired boilers.

Currently, gas cleanup in IGCC requires the gas to be cooled; however, hot gas cleanup systems are being developed that will remove 99.9 percent of the sulfur and result in a saleable sulfur product. The IGCC system is well suited for repowering because it can use the existing steam turbine, electrical generator, and coal-handling facilities in most cases.

Indirect-Fired Cycle

An indirect-fired cycle operates such that coal or biomass combustion products do not come in direct contact with gas turbine components. Instead, heated gases pass on the shell side of an air heater. On the tube side of the air heater, compressed gas is heated and passes through a gas turbine. The environmental advantage is that this eliminates the need for hot gas cleanup since the corrosive and abrasive fuel products do not come into direct contact with the turbines. Heat is recovered from air heater exhaust and is used to produce steam, which powers a steam turbine. In addition, corrosive gas products do not come into direct contact with the turbine, thereby eliminating the need for hot gas cleanup. Although the technology is still in the design stage, the efficiency is expected to be 20 percent greater than that of a pulverized coal plant. Furthermore, SO_2 reductions of 90 percent, as well as reduced NO_X and particulate emissions, are expected.

Integrated Gasification Fuel Cell

An integrated gasification fuel cell system consists of a coal gasifier with a gas cleanup system, a fuel cell, an inverter, and a heat recovery system. Coal gas, made through the reaction of steam, oxygen, and limestone, is introduced to a fuel cell composed of an anode and a cathode and separated by an electrolytic layer. The fuel cell converts the chemical energy of the gas to direct current electrical energy and generates heat, and an inverter converts direct current to alternating current. A heat recovery system delivers heat to a bottoming steam cycle for further generation of electricity. Pollution prevention is realized by improved emissions reduction associated with the gas cleanup system and solid-waste reduction.

Coal-Fired Diesel

Diesel generators are modified to accept a coal/water slurry as a fuel source. Environmental control systems are typically installed to remove NO_X, SO_2, and particulates. The advantage of a coal-fired diesel system is that it is well suited to small generators (below 50 megawatts). In addition, it is estimated to result in emissions reduction of 50 percent below New Source Performance Standards. Similarly, coal-oil mixture technology can replace up to 50 percent of fuel oil with pulverized coal for burning in conventional oil or gas burners.

Slagging Combustor

In a slagging combustor, coal is burned at very high combustion temperatures outside the furnace cavity, and combustion gasses pass into the boiler, where heat exchange takes place. In a conventional boiler, the ash enters the boiler and collects on boiler tubes, thus decreasing the efficiency of heat exchange. Alternatively, the high temperature of the slagging combustor causes ash to form slag, which is collected in cyclones. The advantage of the slagging combustor is that it prevents a loss in heat exchange efficiency that would occur from ash accumulation on boiler tubes.

V.A.2 Coal Processing for Clean Fuels

Pollution prevention entails removal of the pollutants from coal in the precombustion stage. This is accomplished through coal cleaning, whereby pollutants are removed without altering the solid state of the coal, or by conversions (gasification or liquefaction), which represent transformations in the state of the coal.

Coal Cleaning

Most coal cleaning occurs at the mouth of the mine. The cleaning method depends on the size of the coal pieces. Typically, coal is cleaned by pulsing currents of water through a bed of coal in a jig to separate the impurities from the coal. Coal cleaning can be achieved through physical, biological, or chemical means. Physical cleaning is the most common method and involves the separation of coals to obtain coals with lower ash content. A lower ash content helps in meeting particulate emissions standards and results in lower operating and maintenance costs associated with ash handling. Coal cleaning can also reduce the trace metal content, thus reducing trace metal content in ashes. Furthermore, cleaning is effective in removing sulfur from coal. This is sulfur that may otherwise end up as SO_2 emissions. There is a tradeoff between sulfur reduction and energy recovery.[36] It should be noted, however, that a reduction in energy recovery is associated with sulfur removal.

A study cited in a report written by the Virginia Department of Environmental Quality compared two FBC conceptual plant designs using mine-run coal versus washed coal. The washed coal facility reduced SO_2 emissions by more than 50 percent on the basis of equivalent heat input and sulfur removal. The NO_X emissions from the washed coal are about one-third lower in comparison to mine-run coal based on equivalent heat input. In addition, the washed coal facility was physically smaller, had lower installation costs, required less storage area for limestone and ash, used less water, and generated less high-volume wastes.

Coal Gasification

Gasification is the process of converting coal to a gaseous fuel—coal gas—followed by chemical cleaning. Coal gas has the benefit of burning as cleanly as natural gas. The process entails coal gas reacted with steam and an oxidant in a reducing atmosphere. If air is the oxidant, a low-BTU gas results; if oxygen is the oxidant, a medium-BTU gas results.

Mild Gasification

In mild gasification, coal is heated in a oxygen-free reactor, which produces gaseous, solid, and liquid products. The environment in the reactor drives off the condensed, volatile hydrocarbons and leaves behind carbon. The benefit of mild gasification is that it produces multiple fuels and feedstocks using medium temperature treatment of coal.

Coal Liquefaction

Hydrogen added to coal increases the fuel's ratio of hydrogen to carbon to a level similar to that of petroleum-based fuels. Coprocessing is a liquefaction process, whereby heavy petroleum residue combined with coal produces a liquid fuel. The liquids can be cleaned of sulfur and ash prior to use as a fuel and have higher thermal efficiencies (60-70 percent range), high product yield, and potentially marketable byproducts, such as gasoline.

V.B Other Pollution Prevention Technologies

Cogeneration

Cogeneration is the production of electricity and heat from a single power plant unit. Because of the heat recovery aspect, cogeneration itself is a pollution prevention strategy. In cogeneration, heat that would otherwise be released from a steam turbine, gas turbine, or diesel engine is recaptured and used to heat buildings or other industrial processes or to generate additional electricity. In fact, whereas the typical efficiency at a fossil fuel electric plant is around 33 to 38 percent, cogenerators can obtain up to 80-percent efficiency because of the heat recaptured. The heat recovered comes mainly from the flue gases.[37]

Cogeneration plants were originally industrial applications. They are still used primarily to provide power for industries, hotels, universities, etc., yet they are increasingly being designed for larger capacities and are competing with utilities for power production. Cogeneration plants may be owned by an industrial company, supplying its own power, or they may be owned by small entrepreneurial companies. Besides size requirements, factors such as type of fuel to burn, methods of recapturing heat, and control of emissions, should be considered when evaluating cogeneration as a power source.

DOE's Office of Industrial Technology (OIT) has several projects underway to promote cogeneration, which is a commercially available technology. For example, OIT teamed up with Riegel Textile Corporation to design and test an innovative 4.3 MW high-back-pressure steam cogeneration system using a modified coal-fired boiler. The turbine exhaust (225 psig at 570 degrees Fahrenheit) is hot enough to be used for process heating and can also be used to drive an existing low-pressure turbine to generate additional electricity. In 1994, 17 such systems were in operation.[38]

Repowering

Repowering is a way in which power generation facilities can improve and increase both the production and efficiency of standard thermal generating facilities. Repowering options include expanding a unit's size or changing the type or quality of the fuel used. In most cases, it involves partial or complete replacement of the steam supply system and usually a more or less complete retention, refurbishment, and reuse of the turbine/generator. Many of the technologies listed above are appropriate for repowering.

Fuel Cells

Natural gas fuel cell (NGFC) energy systems improve gas utilization and efficiency. Like batteries, fuel cells are based on the principles of electrochemistry, except that they consume fuel to maintain the chemical reaction. The most common electrochemical reaction in a fuel cell is that of hydrogen with oxygen. The oxygen is usually derived from the air, and the hydrogen is usually obtained by steam-reforming fossil fuel. Natural gas is the most common fuel; however, other fuels can be used: peaked-shaved gas, air-stabilized gas from local production such as landfills, propane, or other fuels with high methane content. Fuel Cells, being electrochemical, are more efficient than combustion systems. In addition, emissions are reduced from typical gas systems because there is no combustion of fossil fuel. Although many fuel cells are being researched, developed, and demonstrated around the world, only one system is commercially available at this time. It is a 200 kW phosphoric acid fuel cell system.[39]

Because emissions are reduced, State and local air quality regulating agencies have begun to grant and/or consider exemptions from air quality permitting requirements. For example, after extensive emissions testing, the South Coast Air Quality Management District has granted NGFC's exemption in the Los Angeles area. Exemptions have also been granted by the Santa Barbara Air Quality Management District, the Bay Area Air Quality Management District, and the State of Massachusetts. These exemptions may create economic incentives to install NGFC systems to avoid permitting fees and violation fines, or to take advantage of emissions credits. A Federal incentive program is being managed by the DOE Morgantown Energy Technology Center to reduce the cost of the fuel cell by $1,000 per kW.[40]

Additional information on this technology may be obtained from the North American Fuel Cell Owner Group (NAFCOG), an independent users group comprised of owners and operators of NGFCs.

V.C Other Pollution Prevention and Waste Minimization Opportunities

In addition to the technologies discussed previously, several other pollution prevention methods can be employed. Some of the methods are common solutions applicable to a wide range of facilities; others are more tailored to site-specific situations. Some of the methods are relatively simple, whereas others require more technological modifications. This section includes not only physical tasks, but management and training steps that foster pollution prevention.

V.C.1 Process or Equipment Modification Options

Fuel Sources

As discussed under the CCT Program, the initial fuel source may be examined as a potential pollution prevention opportunity. Clean coal technologies remove the pollutants prior to the major processes of electrical generation. But on a case-by-case basis, one can also consider the option of using fuels that are naturally lower in pollutants. Low-sulfur coals produce less SO_2 emissions, and there is less pollution associated with coal pile runoff. However, a tradeoff exists in that most low-sulfur coal in the United States is "low rank" (i.e., it has a higher ash and moisture content). Several operational difficulties stem from switching from high-rank to low-rank coal. Nonetheless, processing techniques to improve the BTU and remove sulfur from low-rank coals are being developed. For example, SynCoal (Western Energy Company) is a technology that produces a fuel with a 0.5 percent sulfur content, a moisture content of greater than 5 percent, a heating value of 11,800 Btu per pound, and ash content of approximately 9 percent.

Another related technology that has been researched extensively is co-firing using refuse derived fuel (RDF) pellets and coal in power plants. In 1992, DOE's OIT, in cooperation with several organizations, operated a power plant with a mixture of coal and up to 25 percent RDF pellets. The project found that the mixture resulted in reduced acid gas emissions. The CAA amendments of 1990 allow the combustion of up to 30 percent municipal solid waste in coal plants. The results of this project are facilitating commercialization of the co-combustion technology.

Cooling Water

Cooling water is used in steam turbine electric power plants and is circulated through the condenser to condense the steam left after the generation of electricity. The resulting condensate can then be pumped back into the high-pressure boiler. Cooling systems may be once-through, where cooling water is discharged into a receiving water body after use, or recirculating, which involves the use of cooling towers, lakes, or ponds. Scaling of heat exchange equipment and piping occurs from cooling water contact and reduces the efficiency of the equipment. To prevent scaling, chemical additives, such as polyphosphates, polyester, phosphates, and polyacrylates, are added to cooling water. In the past, cooling tower treatment chemicals contained hexavalent chromium. Recent regulations have restricted the use of chrome-based treatment to reduce the associated public health and environmental impacts. As a result, industry has switched to non-chrome treatment chemicals.

Corrosion, fostered through aeration of cooling water in cooling towers, is another problem. A number of different chemicals such as zinc, molybdate, silicate, polyphosphate, aromatic azole, carboxylate, and sometimes chromate are added to cooling water for corrosion control. Fouling and biological growth are commonly controlled through the addition of polyester, phosphates, polyacrylates, non-oxidizing biocides, chlorine, and bromine.

Pollution prevention opportunities for cooling water address minimizing chemical additives and conserving water. Table 28 presents a few general pollution prevention recommendations for reducing cooling tower emissions.

First and foremost, a facility can determine the optimum chemicals for the prevention of biologic growth and corrosion. In general, chlorinated biocides are less toxic than brominated biocides, and polyphosphate and organo-phosphate inhibitors are less toxic than chromate corrosion inhibitors. Another possible means to reduce the need for chemical additives for control of scaling is magnetic water conditioning.

Widespread attention has focused on ozone treatment in lieu of common biocide use. Ozone acts to rupture bacterial cells through oxidation. Reductions in scaling, biofouling, and overall toxics may be realized from ozone. It has been successful mainly in once-through cooling water systems for power plants. Drawbacks in the use of ozone treatment include (1) the potential for corrosion in cooling towers, unless careful dosing is practiced to maintain the oxidation-reduction potential rate and (2) ozone treatments have been shown to exhibit rapid fouling on high temperature surfaces such as would be found in recirculating systems. In addition, health and safety issues associated with worker exposure to ozone must be considered.

Table 28: Pollution Prevention Opportunities for Reducing Cooling Tower Emissions
Pretreat makeup water: Pretreating the makeup water to cooling towers reduces the chemical treatment requirements for scale and corrosion control and can increase the number of times cooling water may be recycled before blowdown.
Use inert construction materials: Polyethylene, titanium, and stainless steel are relatively nonreactive compared to carbon steel and require lesser quantities of scale and corrosion inhibitors.
Install automatic bleed/feed controllers and bypass feeders: By installing this equipment on the cooling towers, facilities have reduced volumes of cooling tower chemicals, as well as energy costs, labor, and water.
Recirculate the cooling water: When possible, cooling tower water should be recirculated instead of cycling once-through the system.
Use chlorinated biocides: Facilities can use chlorinated biocides instead of brominated biocides to reduce the toxicity of biocides.
Sources: *Fact Sheet: Eliminating Hexavalent Chromium from Cooling Towers.* City of Los Angeles Board of Public Works, Hazardous and Toxic Materials Office. Undated; *Fact Sheet: Water and Chemicals Reduction for Cooling Towers.* North Carolina Department of Environmental Health and Natural Resources, Pollution Prevention Program. May 1987; *Pollution Prevention/Environmental Impact Reduction Checklist for Coal-Fired Power Plants.* U.S. Environmental Protection Agency, Office of Federal Activities. Undated.

Fireside Washes

In the combustion of fossil fuels, products of incomplete combustion will rise with gas and collect on boiler tubes and heat transfer units. Fireside wastes consist primarily of bottom ash and damaged refractory brick, which may be contaminated with heavy metals from the ash. As the buildup increases, the heat exchange efficiency decreases. Periodically, the buildup is removed by applying a large volume of water to the boiler surfaces. The wash water contains trace metals (nickel, chromium, iron, vanadium, and zinc), calcium, sodium, chlorides, nitrates, sulfates, and organics contained in suspended soot. The resulting waste is a wet ash sludge. This sludge may be co-managed for disposal with large volume combustion waste (fly ash, bottom ash, FGD sludge) or managed separately with other low-volume wastes and treated through physical or chemical precipitation, as well as pond evaporation.

Soot blowers use steam, air, or water to clean fireside fouled heat transfer surfaces. The removed soot and ash deposits are either reintroduced into the combustion process, redeposited for easier removal, or captured by particulate control equipment. Sonic horns generate sound waves that cause the heat transfer surface to vibrate and dislodge soot and ash. Manual cleaning includes brushing, sweeping, and vacuuming.

Abrasive cleaning methods remove contaminants by blasting a compound at the substrate. Typical blasting compounds are sand, walnut shells, or carbon dioxide pellets. The abrasive cleaning technology field is changing rapidly. New materials that may remove soot and ash without damaging the boiler tubes and refractory include plastic beads, sodium bicarbonate, and, potentially, liquid CO_2.

Table 29 provides some examples of pollution prevention opportunities for fireside washes.

Table 29: Pollution Prevention Options for Fireside Washes

Options	Comments
Use cleaner fuels	Natural gas is the cleanest burning fossil fuel, but availability limits widespread use. Cleaner burning fuel oils and coals are available but may be cost-prohibitive.
Use alternative cleaning methods	Soot blowers and sonic horns may be used to reduce the need for washing. Dry ash has higher potential for reuse. Abrasives may be used but add to waste created.
Recycle or reuse fireside wastes	Lime sludge from treatment may be sold to copper smelters. Vanadium recovery from fuel oil ash may be feasible. Coal ash can be used as a substitute for cement in concrete or as structural fill.

Source: *Industrial Pollution Prevention Handbook*. Freeman, Harry M., ed. McGraw Hill, Inc. 1995.

Boiler Chemical Cleaning Wastes

The purpose of boiler cleaning is to remove scale from the inside (water side) of boiler tubes. The waste generated contains spent cleaning solution and the scaling components: copper, iron, zinc, nickel, magnesium, and chromium. Certain cleaning agents target certain types of boilers and deposits. Boiler cleaning wastewaters may be difficult to treat and, in some cases, fall under the jurisdiction of the Resource Conservation and Recovery Act (RCRA) as a hazardous waste.

One way to minimize the volume of boiler cleaning wastes is to optimize the cleaning frequency. Specific practices that help to optimize cleaning frequency include:

- Maintaining records of operations
- Conducting biweekly chemical analysis to define normal cycle chemistry
- Sampling tubes annually
- Determining the location and/or type of deposits through ultrasonic imaging, thermocouples, removable test strips, and fiberscopic inspections.

Controlling the chemistry of the boiler feed water is a significant way to control the rate of scaling. Generally, boiler water is treated through fine filtration, chemical treatment, reverse osmosis, and/or ion exchange to remove minerals. Other constituents in the boiler water targeted for removal may include oxygen and carbon dioxide.

While most utilities use hydrazine and morpholine in the chemical treatment of boiler feed water, an elevated oxygen treatment process has been demonstrated that results in the accumulation of a finer-grained, more unified, magnetite layer that necessitates less frequent cleaning. To create this condition, oxygen or hydrogen peroxide is added to condensate at a pH of 7 to 7.5, oxygen and ammonia are added at a pH of 8 to 8.5, and ammonia is added at a pH of 9 or greater, until ammonia concentrations of 250 parts per billion are reached.

The boiler cleaning frequency may be decreased by reducing the amount of oxygen entering the boiler due to leaks in the system. Leaks can be corrected through inspection and replacement of seals on steam cycle components. Maintenance schedules and monitoring techniques are effective practices in preventing leaks. Furthermore, maintaining high quality performance of the oxygen deaerators will also help to prevent oxygen ingress.

Another effective pollution prevention technique is determining the optimum frequency of boiler cleanouts. Utilities should clean the boilers based on the actual deposit thickness instead of according to a predetermined schedule. According to a survey performed by EPRI, one California utility monitors both scale thickness and composition by means of small, retrievable test strips placed inside the boiler. Base unit boilers are now cleaned about once every 72 months, and cycling units are cleaned once every 48 months. Other California utilities report cleaning schedules as often as once every 24 months.[41]

On-line cleaning involves boiler cleaning while the boiler remains in operation. This can be done by injection of a sodium poly-acrylate additive into the boiler feedwater to a concentration of 400 mg/L. The most critical outer layer of magnetite is removed, but an inner layer remains. This method requires less cleaning time than traditional boiler cleaning, uses less hazardous chemicals, and results in a more easily handled waste. The drawbacks of on-line cleaning include the risk of contaminating the steam turbine, less deposits removed, and potentially poor copper removal. Cost savings associated with the use of this technology at a 300-MW unit have been estimated to be $25,000 to $30,000 per year.[42]

Sodium bicarbonate-based blast media can be used in association with specifically designed delivery systems to meet a wide range of cleaning needs, including general facility maintenance (e.g., floor cleaning, paint stripping and boiler tube cleaning). Sodium bicarbonate blasting is becoming increasingly common in the electric utility industry.[43]

In areas where water costs are high, utilities may choose to reuse their boiler chemical cleaning wastewater as makeup for cooling towers, fly ash scrubbers, or flue gas desulfurization systems.[44] Also, depending on the composition of the chemical cleaning sludge, it may be economically feasible to recycle the sludge for its metal content. Arizona Electric Power Cooperative (AEPCO), Incorporated, for example, uses this cleaning material, rather than face potentially expensive disposal costs. The EPA, the Arizona Department of Environmental Quality, the California Department of Toxic Substances Control, and the Occupational Safety and Health Administration approved the use of by products from chemical cleaning from AEPCO's boilers. AEPCO sells the by-product to Pacific Gas & Electric Company for hydrogen sulfide gas abatement at its Geysers Power Plant, a geothermal power generation facility.[45]

Table 30 lists pollution prevention opportunities for boiler cleaning wastes.

Fly Ash

Fly ash is typically collected in the flue of the combustion unit and transported to a centralized containment area for treatment and storage. Both wet ash transport and dry collection are commonly practiced. Some facilities use wet ash, creating a slurry as the mechanism for transport. The disadvantage of wet ash transport is that it increases the volume of the ash waste and it must eventually be separated out and treated. In contrast, a dry process control electrostatic precipitator avoids the added volume due to water and allows the collection of a dry product for recycling and/or beneficial reuse.

Chemical Substitutions

Several process modifications described previously have required material substitution (e.g., switching fuels). However, material substitutions are not

Table 30: Pollution Prevention Options for Boiler Cleaning Wastes

Options	Comments
Improve boiler water supply	Regenerate ion exchange resins promptly. Install reverse osmosis equipment ahead of ion exchange systems to reduce mineral loading and reduce regeneration frequency.
Control boiler water chemistry	Use hydrazine to control dissolved oxygen and morpholine to control carbon dioxide.
Reduce contaminant ingress	Improve equipment seals to prevent air and cooling water leaks into the boiler.
Base cleaning on fouling	Use coupons to measure scale buildup and schedule cleaning accordingly.
Use on-line cleaning	Sodium polyacrylate injection may be used to remove deposits without having to shut down boiler. Further research required.
Reuse wastewater	Wastewater may be used for cooling tower makeup or as feedwater to ash scrubbers and flue gas desulfurization units. Some pretreatment and/or segregation may be required.
Reuse lime sludge	Sludges from lime treatment of chemical cleaning wastes may be sold to copper smelters for reuse.
Control H_2S	Ethylenediamine-tetraacetic acid (EDTA)-based cleaning processes can produce Fe-EDTA, which is an effective chelating agent for H_2S control.

Source: Adapted from *Industrial Pollution Prevention Handbook.* Freeman, Harry M., ed. McGraw Hill, Inc. 1995.

limited to major processes. Sometimes, toxic chemicals are used unnecessarily on a wide-scale basis for a variety of operations and maintenance activities (e.g., cleaning, lubrication). By substituting less toxic chemicals, a facility can avoid unnecessary risks associated with worker exposure and the potential for release into the environment. The first step in determining the viability of material substitutions is to inventory the chemicals used at the site. The chemical can be evaluated as to its hazard potential, its necessity, and possible alternatives. For example, San Diego Gas and Electric Company determined several different solvents onsite could be replaced by just a few different solvents. By eliminating the wide array of solvents, the company is now able to install a solvent recovery unit, which will reduce the amount of solvent waste.

V.C.2 Inventory Management and Preventative Maintenance for Waste Minimization

Fossil fuel electric power generation facilities, like many industrial facilities, use solvents and other chemicals for everyday operations. Everyday

R0075190

operations include parts washing, lubricating, general cleaning, and degreasing application during plant and equipment maintenance activities. Often, chemical wastes generated by these operations are made up of out-of-date, necessary, off-specification, and spilled or damaged chemical products. Actual costs for materials used include not only the cost of the original product, but also the costs of disposal. Inventory management and preventative maintenance are ways these facilities can decrease the amounts of chemical wastes generated in a cost-effective manner.

There are two categories of inventory management including inventory control and material control. Inventory control includes techniques to reduce inventory size, reduce toxic and/or hazardous chemical use, and increase current inventory turnover. Material control includes the proper storage and safer transfer of materials. Proper material control will ensure that materials are used efficiently to reduce waste and preserve the ability to recycle the wastes.

Corrective and preventative maintenance can reduce waste generation. A well run preventative maintenance program will serve to identify the potential for releases and correct problems before material is lost and/or considered a waste. New or updated equipment can use process materials more efficiently, producing less waste. Table 31 provides examples of inventory management and preventative maintenance waste minimization techniques that can be used at fossil fuel electric power generation facilities.

V.C.3 Potential Waste Segregation and Separation Options

Fossil fuel electric power generation facilities can reduce their waste disposal costs by carefully segregating their waste streams. In particular, facilities should segregate RCRA nonhazardous wastes from hazardous wastes to reduce the quantity of waste that must be disposed of as a hazardous waste. For example, facilities should segregate used oil from degreasing solvents because uncontaminated used oil can be recycled or fed into the boiler as a supplemental fuel. Oil contaminated with polychlorinated biphenyls (PCBs) should be segregated from other used oils. Absorbent material that is not fully saturated with oils, etc., should be stored separately from saturated material so that it can be reused. Recycling companies typically offer a higher price for segregated recyclables (e.g., clean office paper, scrap metal) than mixed waste streams.

Table 31: Inventory Management and Preventative Maintenance Waste Minimization Opportunities
Inventory Management
Inventory Control
• Purchase only the quantity of material needed for the job or a set period of time • Evaluate set expiration date on materials, especially for stable compounds, to determine if they could be extended. • Search the inventory at other company sites for available stock before ordering additional material • Purchase material in the proper quantity and the proper container size. If large quantities are needed, purchase in bulk. If the material has a short shelf-life or small quantities are needed, purchase in small containers • If surplus inventories exist, use excess material before new material are ordered • Contact supplier to determine if surplus materials can be returned. If not, identify other potential users or markets • Evaluate whether alternative, non-hazardous substitutes prior to purchase and checked for acceptance at the facility.
Material Control
• Reduce material loss through improved process operation, increased maintenance and employee training to identify sources of loss • Handle and manage wastes to allow recycling.
Maintenance Programs
Operational and Maintenance Procedures
• Reduce raw material and product loss due to leaks, spills, and off-specification products • Develop employee training procedures on waste reduction • Evaluation the need for operational steps and eliminate practices that are unnecessary • Collect spilled or leaked material for re-use whenever possible • Consolidate like chemicals and segregate wastes to reduce the number of different waste streams and increase recoverability.
Preventive Maintenance Programs
• Perform maintenance cost tracking • Perform scheduled preventive maintenance and monitoring • Monitor closely "Problem" equipment or processes that are known to generate hazardous waste (e.g., past spills).
Source: Adapted from "ComEd Operation and Maintenance Manual" and "Pollution Prevention Success" Fact Sheets. Received From Edison Electric Institute. July 1997.

V.C.4 Recycling Options

With the exception of cooling water and used oil, fly ash represents the greatest waste component at fossil fuel plants. For this reason, recycling options for fly ash present a significant opportunity for pollution prevention. Typical uses include incorporating fly ash into construction materials, such as asphalt or cement. However, new uses are being found every day. Table 32 lists existing and potential marketable uses for fly ash. More information about the production and use of fly ash and other coal combustion materials can be obtained from the American Coal Ash Association.[46]

R0075192

Table 32: Current and Potential Uses for Fly Ash
Current Uses for Fly Ash
Flowable fill Soil stabilization Lightweight aggregate building material Roofing materials Roofing granules Plastics, paint Filter cloth precoat for sludge dewatering Pipe bedding Structural fills Concrete and block Portland cement Mine reclamation Agricultural enhancement Road paving: as a sub-base or fill material under a paved road
Potential Uses for Fly Ash
Ingredient of golf ball coverings Flue gas reactants An additive to sewage sludge for use as a soil conditioner An alkali reactivity minimizer in concrete aggregate The footprint of a structure, a paved parking lot, sidewalk, walkway, or similar structure

The Carolina Power and Light (CP&L) is successful in selling 80 to 100 percent of the fly ash generated at three coal-fired power plants. The CP&L estimates capital costs to be $1 to $2/ton of fly ash and operation and maintenance costs to be $3 to $4/ton of fly ash. The ash sales revenues have resulted in reduced disposal costs. Duke Power has experienced similar success. Duke Power has sold more than 230,000 tons of fly ash and 65,400 tons of bottom ash for use in concrete production. Other markets for the fly ash included plastic manufacturing and asphalt production. In addition, Duke Power donated 30,000 tons of bottom ash to the State of North Carolina to use as a base in road construction.

It should be noted that uses for fly ash vary greatly according to market conditions and transportation costs. In addition, for most uses, the ash must have a low carbon content. However, available commercial technologies can separate the ash into carbon-rich and carbon-poor fractions.

Pollution prevention associated with boiler blowdown was discussed previously; however, boiler blowdown water may potentially be recycled and used as makeup to cooling tower waters and flashing blowdown to generate additional steam. This is accomplished through the regeneration of demineralizer waters.

Sulfur is produced through the cleaning of fuels and ores and the use of clean scrubbers. Recycling options include the following:

- Substituting sulfur for Portland cement and water to act as a binding agent to produce a durable, acid-resistant concrete
- Using sulfur in protective coatings to improve the resistance of conventional building materials to chemical and other stresses; fabric can be impregnated with sulfur and additive materials to produce flexible or rigid lining materials
- Using sulfur as an asphalt extender or as an asphalt replacement to totally eliminate the need for asphalt.

The FGD units can produce sulfur, sulfuric acid, gypsum, or some non-saleable sludge material. Select FGD units can produce saleable materials, as indicated in the following examples:

- Gypsum can be processed into a quality gypsum grade for resale to wall board producers or sold for use in cement manufacturing.
- Sodium sulfate and sulfuric acid can be produced for resale.
- An electron beam scrubbing system can be used to produce ammonium sulfate and ammonium nitrate for sale as a fertilizer supplement.
- A pozzolanic stabilization reaction process can be implemented where lime-based reagent is added to scrubber sludge and fly ash to create a mineral product suitable for roadway base course. (Pozzolans are siliceous or siliceous/aluminous materials that, when mixed with lime and water, form cementitious compounds.)

V.C.5 Facility Maintenance Wastes

In addition to the wastes associated with the power production operations, fossil fuel electric power generation facilities also generate wastes from support operations, such as facility and equipment maintenance, storage areas, transportation, and offices. Pollution prevention techniques can greatly reduce many of these waste streams for relatively little cost.

Table 33 highlights several basic pollution prevention options for equipment and facility maintenance. All of the options involve the use of commercially available equipment that is already in widespread use. In addition to the options described in Table 33, common pollution prevention options include:

- Establishing preventive maintenance programs for equipment
- Testing fluids prior to changing them
- Purchasing equipment to enable recycling of antifreeze, solvents, and oil/water mixtures

- Purchasing longer lasting/reusable absorbent materials and rags
- Laundering rags offsite instead of disposing of them
- Using steam cleaning equipment or sodium bicarbonate blast systems for general facility cleaning
- Purchasing electric-powered vehicles for onsite use
- Upgrading bulk storage equipment and spill prevention practices
- Improving spill containment equipment and equipment for transferring fluids
- Using low- or no-VOC paints for facility maintenance and restricting color choices
- Recycling office paper, cardboard, plastics, scrap metals, wood products, etc.
- Purchasing products with recycled content
- Finding alternatives to replace ozone depleting substances (e.g., refrigerants, fire suppression, degreasers)
- Practicing integrated pest management to reduce the use of pesticides in grounds maintenance operations
- Using less toxic products for custodial operations.

Table 33: Pollution Prevention Opportunities For Facility Maintenance Wastes	
Options	**Comments**
Rotating Equipment Maintenance	
Use high quality fluids	While costing more initially, high quality fluids may last twice as long in service.
Routinely monitor fluid condition	Waste fluid generation can be reduced by switching to a replacement schedule based on fluid condition. Low-cost testing services can provide detailed information.
Use nonleak equipment	Use dry disconnect hose couplings, self sealing lock nuts, and elastomeric flange gaskets to reduce oil leakage. Canned or magnetically driven pumps, bellow valves, and bellow flanges are also effective.
Clean and recycle dirty fluids	Dirty fluids may be cleaned for extended use by small filtration devices. More complex systems may use centrifugation or vacuum distillation.
Use waste oils as boiler fuel	This depends on boiler size, PCB content, and halogen content of the waste oil. Would not apply to synthetic hydraulic fluids.
Facility Maintenance	
Eliminate use of hazardous materials	Major accomplishments have been made in this area, including eliminating the use of PCBs, asbestos insulation, chromium-based cooling water treatment chemicals, and leaded paints.
Replace tricarboxylic acid (TCA) and chlorofluorocarbons (CFCs) with non-ODS cleaners	Petroleum distillate and D-limonene blends are effective cleaners for electrical equipment. Detergents are good for general purpose cleaning but must be kept out of yard drains and oil water separators.
Use high transfer efficiency painting equipment	Brushes, rollers, and hand mitts are very efficient but labor-intensive. Airless spray is common for field use since a source of clean, dry air is not required.
Use an enclosed cleaning station	Several air districts mandate the use of enclosed gun cleaners and prohibit the spraying of cleanup solvent into the air.
Avoid the removal of leaded paint	Removal of lead-based paint should only be performed when the paint fails to provide adequate protection. Use wet blasting or vacuum collective devices to prevent the generation of leaded paint dust.
Source: *Industrial Pollution Prevention Handbook*. Freeman, Harry M., ed. McGraw-Hill, Inc. 1995.	

V.C.6 Storm Water Management Practices

An important pollution prevention consideration at fossil fuel electric power generation plants is the management of runoff. Coal pile runoff is perhaps the most significant. Coal pile runoff results from precipitation coming into contact with coal storage piles. The most effective way to eliminate coal pile runoff is to store coal indoors. In many instances, this is not feasible, at which point, pollution prevention turns to managing runoff. A facility's storm water pollution prevention plan should address storm water controls (e.g., dikes, levies) and the potential for reuse of storm water. Coal-handling areas also represent potential for coal pollutants to contaminate storm water. Table 34 lists practices that can prevent pollutants in coal from contaminating storm water.

Table 34: Common Pollution Prevention Practices for Managing Runoff at Coal Storage and Handling Areas [47]
• Consider rail transport of coal over barge transport, because the potential impacts to water are lessened. • Cover coal off-loading areas, crushers, screens, and conveyors to reduce dust emissions. • Cover coal storage piles or store in silos to prevent contact with precipitation and to minimize dust. • Spray coal piles with anionic detergents. This will reduce the acidic content of the pile by reducing bacterial oxidation of sulfide minerals. • Configure a storm water collection system based on slopes, collection ditches, diversions and storage, and treatment ponds. • If settling ponds exist, consider recycling the dredgings.

Some of the practices listed in the table are applicable to fly ash storage and handling areas, as well as coal pile runoff. For example, if dry ash transport is employed, covers will prevent dust and contact with precipitation. Other areas of concern with respect to storm water pollution prevention include fuel and chemical handling and storage areas where there is potential for spills. Table 35 provides some recommended practices that apply to these areas. Ideally, these practices should be addressed in a facility's storm water pollution prevention plan.

Table 35: Storm Water Pollution Prevention Opportunities at Fossil Fuel Electric Power Generation Facilities

Areas of Concern	Storm Water Pollution Prevention Opportunities
Fuel Oil Unloading Areas	• Use containment curbs to contain spills • Station personnel familiar with spill prevention and response procedures at areas during deliveries to ensure quick response for leaks or spills • Use spill and overflow protection technologies
Chemical Unloading/Loading Areas	• Use containment curbs to contain spills • Cover area • Station personnel familiar with spill prevention and response procedures at areas during deliveries to ensure quick response for leaks or spills
Miscellaneous Loading/Unloading Areas	• Use grading, berming, and curbing to minimize runon • Locate equipment and vehicles so leaks can be controlled in existing containment and flow diversion system • Cover area
Liquid Storage Tanks	• Use dry cleanup methods • Use containment curbs to contain spills • Use spill and overflow protection technologies
Large Bulk Fuel Storage Tanks	• Use containment curbs to contain spills
Oil-Bearing Equipment Storage Areas	• Use level grades and gravel surfaces to retard flow and limit spread of spills • Collect storm water in perimeter ditches
Ash-Loading Areas	• Establish procedures to reduce or control tracking of ash or residue from ash loading areas • Clear ash from building floor and immediately adjacent roadways of spillage, debris, and excess water before each loaded vehicle departs
Areas Adjacent to Disposal Ponds	• Reduce ash residue, which can be tracked onto access roads traveled by residue trucks or residue handling vehicles • Reduce ash residue on exit roads leading into and out of residue-handling areas
Material Storage Areas	• Use level grades • Collect runoff in graded swales or ditches • Implement erosion protection measures at steep outfall sites • Provide cover for material

Source: Preamble to NPDES Storm Water Multi-Sector General Permit for Industrial Activities (60 *FR* 50974 Friday, September 29, 1995).

R0075198

V.C.7 Training and Supervision Options

While the major pollution prevention gains are achieved through process controls and reuse/recycling, many day-to-day common sense practices are relatively easy and inexpensive to incorporate. Through training, these practices can become effective means of pollution prevention. Examples of proactive employee behavior includes training for careful use and disposal of cleaners and detergents to prevent them from entering floor and yard drains. If these substances do enter the drains, they may interfere with oil/water separators. Good housekeeping will ensure optimum performance of these treatment units.

V.C.8 Demand-Side Management Programs

In the past, electric utilities have implemented demand-side management (DSM) programs to achieve two basic objectives: energy efficiency and load management. Through these demand-side programs, the utilities have successfully reduced toxic air emissions and achieved cost effectiveness for both the utility and the consumer, mainly by deferring the need to build new power plants.[48] The energy efficiency goal has been achieved primarily by reducing the overall consumption of electricity from specific end-use devices and systems by promoting high-efficiency equipment and building design.

With the advent of deregulation and restructuring in the utility power generation industry, DSM programs appear to be diminishing. The industry is reducing DSM spending and experiencing a reduction in the rate of growth on energy savings. Among other factors, the potential for restructuring could affect the utilities interest in energy savings or may create new types of DSM activities.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe, the applicable Federal requirements, as well as to provide citations for more detailed information. This sections includes:

- Section VI.A, a general overview of major statutes
- Section VI.B, a list of regulations specific to this industry
- Section VI.C, a list of pending and proposed regulations.

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. This section also provides EPA hotline contacts for each major statute.

VI.A General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act of 1976, which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (listed wastes). Listed wastes are designated with a specific code. Hazardous wastes designated with the code "P" or "U" are commercial chemical products including technical grades, pure forms, off-specification products, sole-active-ingredient products, or spill or container residues of these products. "P" wastes are considered acutely hazardous and are subject to more stringent requirements. Hazardous wastes from specific industries/sources are designated with the code "K" and hazardous wastes from non-specific sources are designated with the code "F." Materials that exhibit a hazardous waste characteristic (i.e., ignitability, corrosivity, reactivity, or toxicity) are designated with the code "D."

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities generally must obtain a permit either from EPA or from a State agency that EPA has authorized to implement the permitting program if they store hazardous wastes for more than 90 days before treatment or disposal. Facilities may treat hazardous wastes stored in less-than-ninety-day tanks or containers without a permit. Subtitle C permits contain general facility standards, such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.101) for conducting corrective actions that govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, and disposal facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated authority to implement various provisions of RCRA to 47 of the 50 States and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. The following list highlights important RCRA regulatory requirements:

- **Identification of solid and hazardous wastes** (40 CFR Part 261) lays out the procedure every generator must follow to determine whether the material in question is considered a hazardous waste or a solid waste or is exempted from regulation.

- **Standards for generators of hazardous waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and fulfilling record keeping and reporting requirements. Providing they meet additional requirements described in 40 CFR Part 262.34, generators may accumulate hazardous waste for up to 90 days (or 180 or 270 days depending on the amount of waste generated and the distance the waste will be transported) without obtaining a Subtitle C permit.

- **Land disposal restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet LDR treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated treatment, storage, and disposal (TSD) facility to ensure proper treatment prior to disposal.

- **Used oil management standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (i.e., one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including tanks and containers. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities that store such waste, including large quantity generators accumulating waste prior to shipment off-site.

- **Underground storage tanks** containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that must be met by December 22, 1998.

- **Boilers and industrial furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. The BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

The EPA RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m. ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law known commonly as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. In addition, CERCLA enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs (including remediation costs) incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act.

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance that equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA or by one or more Federal or State emergency response authorities.

The EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as removals. The EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1,300 sites. Both EPA and states can act at sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

The EPA RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund Program. The CERCLA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m. ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act of 1986 created EPCRA, a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. The EPCRA required the establishment of State emergency response commissions (SERCs), which are responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

The EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities that store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and LEPC in the event of a release equaling or exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** applies to facilities covered in SIC major groups 10 (except 1011, 1081, and 1094), 12 (except 1241), or 20 through 39; SIC codes 4911, 1193, and 4939 (limited to facilities that combust coal and/or oil for the purposes of generating power for distribution in commerce); or 4935 (limited to facilities regulated under RCRA, Subtitle C), or 5169, or 5171, and 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis). These facilities must also have 10 or more employees and manufacture, process, or use specified chemicals in amounts greater than threshold quantities. Facilities that meet these criteria must submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media and allows EPA to compile the national TRI database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

The EPA RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and distributes guidance regarding the EPCRA regulations. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m. ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the Nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "nonconventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The NPDES Program (CWA §502) controls direct discharges into waters of the U.S. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized 42 States to administer the NPDES Program), contain industry-specific, technology-based limits and may also include additional water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the Nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set the conditions and effluent limitations on the facility discharges.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines, which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987, the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated the NPDES storm water permit application regulations. These regulations require facilities with the following storm water discharges to apply for a NPDES permit: (1) a discharge associated with industrial activity, (2) a discharge from a large or medium municipal storm sewer system, or (3) a discharge that EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" is a storm water discharge from 1 of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes, while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified in the following list:

- **Category I**: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

- **Category ii**: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC code 26-paper and allied products (except paperboard containers and products); SIC code 28-chemicals and allied products (except drugs and paints); SIC code 291-petroleum refining; and SIC code 311-leather tanning and finishing; SIC code 32 (except 323)-stone, clay, glass, and concrete, 33-primary metals, 3441-fabricated structural metal, and 373-ship and boat building and repairing.

- **Category iii**: Facilities classified as SIC code 10-metal mining; SIC code 12-coal mining; SIC code 13-oil and gas extraction; and SIC code 14-nonmetallic mineral mining.

- **Category iv**: Hazardous waste treatment, storage, or disposal facilities.

- **Category v**: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

- **Category vi**: Facilities classified as SIC code 5015-used motor vehicle parts; and SIC code 5093-automotive scrap and waste material recycling facilities.

- **Category vii**: Steam electric power generating facilities.

- **Category viii**: Facilities classified as SIC code 40-railroad transportation; SIC code 41-local passenger transportation; SIC code 42-trucking and warehousing (except public warehousing and storage); SIC code 43-U.S. Postal Service; SIC code 44-water transportation; SIC code 45-transportation by air; and SIC code 5171-petroleum bulk storage stations and terminals.

- **Category ix**: Sewage treatment works.

- **Category x**: Construction activities except operations that result in the disturbance of less than five acres of total land area.

- **Category xi**: Facilities classified as SIC code 20-food and kindred products; SIC code 21-tobacco products; SIC code 22-textile mill products; SIC code 23-apparel related products; SIC code 2434-wood kitchen cabinets manufacturing; SIC code 25-furniture and fixtures; SIC code 265-paperboard containers and boxes; SIC code 267-converted paper and paperboard products; SIC code 27-printing, publishing, and allied industries; SIC code 283-drugs; SIC code 285-paints, varnishes, lacquer, enamels, and allied products; SIC code 30-rubber and plastics; SIC code 31-leather and leather products (except leather and tanning and finishing); SIC code 323-glass products; SIC code 34-fabricated metal products (except fabricated structural metal); SIC code 35-industrial and commercial machinery and computer equipment; SIC code 36-electronic and other electrical equipment and components; SIC code 37-transportation equipment (except ship and boat building and repairing); SIC code 38-measuring, analyzing, and controlling instruments; SIC code 39-miscellaneous manufacturing industries; and SIC code 4221-4225-public warehousing and storage.

To determine whether a particular facility falls within one of these categories. consult the regulation.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national pretreatment program (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

The EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities that could reasonably be expected to discharge oil in harmful quantities prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR §112.20) and for PCB transformers and PCB-containing items were revised and finalized in 1995.

EPA's Office of Water, at (202) 260-5700, will direct callers that questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water Resource Center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water by controlling underground injection of liquid wastes.

The EPA has developed primary and secondary drinking water standards under its SDWA authority. The EPA and authorized States enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable, health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) Program (40 CFR Parts 144-148) is a permit program that protects underground sources of drinking water by regulating five classes of injection wells. The UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit and must meet applicable

RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented sole source aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented wellhead protection program which is designed to protect drinking water wells and drinking water recharge areas.

The EPA Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m. ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks that may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

The TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. The EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce of, limit the use of, require labeling for, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, CFCs, and PCBs.

The EPA TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to TSCA standards. The Service operates from 8:30 a.m. through 4:30 p.m. ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as titles, that direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. The CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established NAAQS to limit levels of criteria pollutants, including carbon monoxide (CO), lead (Pb), NO_2, PM, ozone, SO_2, and volatile organic compounds (VOCs). Geographic areas that meet NAAQS for a given pollutant are classified as attainment areas; those that do not meet NAAQS are classified as non-attainment areas. Under section 110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards. Revised NAAQS for particulates and ozone were proposed in 1996 and may go into effect as early as late 1997.

Title I also authorizes EPA to establish new source performance standards (NSPS), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPS are based on the pollution control technology available to that category of industrial source.

Under Title I, EPA establishes and enforces national emission standards for hazardous air pollutants (NESHAPs), which are nationally uniform standards oriented towards controlling particular HAPs. Title I, section 112(c) of the CAA further directed EPA to develop a list of sources that emit any of 188 HAPs and to develop regulations for these categories of sources. To date, EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on maximum achievable control technology (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV of the CAA establishes a SO_2 and NO_2 emissions control program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of SO_2 sulfur dioxide releases. Reduction of nitrogen will be obtained by required reduction of nitrogen oxides from power plants and new cars.

Title V of the CAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once EPA approves a State program that state will issue and monitor permits.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of CFCs and chloroform, were phased out (except for essential uses) in 1996.

The EPA Clean Air Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and the EPA EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities (http://www.epa.gov/ttn then select Directory and then CATC).

VI.B Industry Specific Requirements

Since the 1960s, there has been an increased public awareness that industrial growth, as well as its inherent need for energy produced using fossil fuels, is accompanied by the release of potentially harmful pollutants into the environment. Hence, the fossil fuel electric power generation industry has become one of the most highly regulated industries. In addressing environmental issues, the industry has moved from providing not only the lowest cost energy, to providing the lowest cost energy with an acceptable impact on the environment. Air pollution control has been of most concern, with a significant percentage of the cost of a power plant going towards the purchase of air pollution control equipment. However, control of hazardous effluent discharges and proper management and disposal of solid wastes have also been key concerns. This section summarizes the current major Federal regulations affecting the fossil fuel electric power generation industry.

National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) applies to all Federal agencies and to Federal actions that may significantly impact the environment. The NEPA requires that all Federal agencies prepare detailed statements assessing the environmental impact of, and alternatives to, major Federal actions that may significantly affect the quality of the human environment. Implementing regulations are issued by the Council on Environmental Quality (CEQ) at 40 CFR Parts 1500-1508. NEPA implementing regulations that are most applicable to the fossil fuel electric power generation industry can be found at 40 CFR Part 6 (EPA) and 10 CFR Part 1021 (DOE). Each government agency has issued its own implementing regulations under NEPA. The types of Federal activities associated with fossil fuel electric power generating facilities that may be subject to NEPA requirements include siting, construction, and operations of federally owned facilities, federally issued NPDES, RCRA, and air permits, and federally issued operation licenses.

Each Federal activity subject to NEPA must follow certain environmental review procedures. If there is enough information to determine at the outset that the Federal action will cause a significant effect on the environment, then an environmental impact statement (EIS) must be prepared. If there is insufficient information available, an environmental assessment (EA) must be prepared to assist the agency in determining if the impacts are significant enough to require an EIS. If the assessment shows the impacts not to be significant, the agency must prepare a finding of no significant impact (FONSI). Further stages of the Federal activity may then be excluded from the NEPA requirements.

Clean Air Act

Numerous existing standards and programs under the Clean Air Act may affect the fossil fuel electric power generation industry. These regulations and programs include Title I New Source Performance Standards, Title III National Emissions Standards for Hazardous Air Pollutants, Title IV Acid Rain Program, and Title V Operating Permits Program. The NAAQS under Title I may affect the industry indirectly through permits.

National Ambient Air Quality Standards

Regulations for NAAQS do not directly affect the fossil fuel electric power generation industry because they are not applied to sources. Rather, these standards are applied to the ambient air in a particular area. Fossil fuel electric power generators may be indirectly affected by these standards if they are located in or near an area with nonattainment status. In meeting NAAQS, States develop and implement SIPs that prescribe use of reasonably available control technologies (RACTs) for major sources. In addition, as fossil fuel electric power generation facilities are typically one of the largest emitters of criteria pollutants, they may be targeted for more stringent controls implemented through operating permits.

The NAAQS currently exist for the following criteria pollutants (40 CFR Part 50): PM_{10}, SO_2, CO, Pb, ozone, and NO_X.

On July 16, 1997, new and/or revised standards for particulate matter and ozone were promulgated. The regulations revise the current primary standard by adding a new annual $PM_{2.5}$ (or PM "fine") standard set at 15 micrograms per cubic meter ($\mu g/m^3$) and a new 24-hour $PM_{2.5}$ standard set at 65 $\mu g/m^3$. These regulations revise the current 1-hour primary standard for ground level ozone by adding an 8-hour standard set at 0.08 ppm (the 1-hour standard will eventually be phased out).

Among the tools proposed for implementing these new ambient standards is a trading plan for emissions from utilities. The new standards will require local controls in 2004 for ozone and 2005 for particulate matter, with compliance by 2007 and 2008, respectively.

A group called the Ozone Transport Assessment Group (OTAG) was formed between EPA, the Environmental Council of States, and various industry and environmental groups. The primary objective of OTAG is the collective assessment of the ozone transport problem and the development of a strategy for reducing ozone pollution on a regional scale.

New Source Review and New Source Performance Standards

New source review (NSR) requirements in 40 CFR §52.21(b)(1)(I)(a)-(b) apply to all new facilities and may apply to expansions of existing facilities or process modifications. The NSRs are typically conducted by State agencies in accordance with their SIP. SIPs are the primary tool for meeting NAAQS and are administered through State and local agencies.

Prevention of significant deterioration (PSD) reviews are performed for areas meeting NAAQS. Nonattainment reviews are performed for areas violating the NAAQS. In nonattainment areas, permits may be issued to require new sources to meet lowest achievable emission rate (LAER) standards. Operators of the new sources must procure reductions in emission of the same pollutants from other sources in the nonattainment area in equal or greater amounts to the emissions from the new source. These "emission offsets" may be banked and traded through the State agencies. In PSD areas, permits require the best available control technology (BACT), and the operator must conduct continuous air monitoring for one year prior to the startup of the new source to determine the effects that the new emissions may have on air quality.

Under NSPS, given at 40 CFR Part 60, EPA sets standards for LAER and BACT for the following subcategories of the fossil fuel electric power generation industry:

- Subpart D: Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction Is Commenced After August 17, 1971
- Subpart Da: Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction Is Commenced After September 18, 1978
- Subpart Db: Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units
- Subpart Dc: Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units
- Subpart GG: Standards of Performance for Stationary Gas Turbines.

The standards in each subcategory apply to units of a specified size and age. Table 36 provides the NSPS.

Table 36: New Source Performance Standards

Emission	Standards
SO_2	General standard for various levels of ng/J (lb/mm Btu) heat input and % reduction, depending on fuel type and sulfur content (see 40 CFR Subparts D, Da, Db, and Dc). For gas turbines, no gases in excess of 0.015% by volume (at 15% O_2 by volume) or with sulfur contents in excess of 0.8% by weight shall be burned.
NO_X	Between 0.2 and 0.8 lb/mm BTU, depending on category of combustion. For gas turbines, NO_X standards specified in equation in 60.332(a)(1) or (2) as directed in 60.332(b), (c), and (d).
PM	Between 0.05 and 0.20 lb/mm BTU, unless a low nitrogen fuel is used, in which case compliance is based on results of performance tests.
Opacity	20%.

R0075214

National Emission Standards for Hazardous Air Pollutants

Current regulations at 40 CFR Part 61 provide standards for eight substances identified as air toxics: vinyl chloride, mercury, beryllium, radon, radionuclides, benzene, asbestos, and arsenic. Under Title III of the CAA, EPA is required to identify source categories of 188 HAPs or toxic air pollutants and then issue (at 40 CFR Part 63) MACT standards for each source category according to a prescribed schedule. The standards are to be based on best demonstrated control technologies or practices within the regulated industry. Eight years after a MACT is installed on a source, EPA is required to evaluate the risk levels remaining at the facilities and determine whether additional controls are needed to reduce the risk to acceptable levels.

The EPA has issued an initial list of categories of major and area sources that will be subject to regulation under Section 112 (57 FR 31576). The list contains numerous sources from the fossil fuel electric power generation industry, and standards are currently being developed under the Industrial Combustion Coordinated Rulemaking (see Section VI.C.).

Acid Rain Program

The 1990 amendments to the CAA added a new provision (Title IV) to control acid deposition. Title IV of the CAAA sets primary goals to reduce annual emissions of both SO_2 and NO_2.

Upwards of 20 million tons of SO_2 are emitted annually in the United States. Most of this amount is from the burning of fossil fuels by electric utilities. Because acid rain is a problem, Title IV requires EPA to reduce SO_2 emissions to 10 million tons below the 1980 level. Reduction in SO_2 will be attained in two phases by a marketable emission allowance program (40 CFR Part 73). Phase I, which became effective in January 1995, required 110 power plants to reduce their emissions to a level equivalent to the product of an emissions rate of 2.5 pounds (lbs) of SO_2/mmBtu times an average of their 1985-1987 fuel use. Plants that use certain control technologies to meet the Phase I reduction requirements received a 2-year extension of compliance until 1997. The new law also allows for special allocation of 200,000 annual allowances per year, in each of the 5 years of Phase I, to power plants in Illinois, Indiana, and Ohio.

Under the new requirements, utilities may trade allowances within their systems and/or buy or sell allowances to and from other affected sources. Phase I facilities were allocated allowances based on historic fuel consumption and a specific emission rate. One allowance equals the right to emit one ton of SO_2. Affected facilities are required to turn into the EPA one

R0075215

allowance for each ton emitted in a calendar year. Unused allowances may be sold, traded, or banked by the facilities. Power plants that do not have sufficient allowances to cover annual emissions are subject to fees and requirements to offset the excess emissions the following year.

Power plants that emit less than 1.2 lbs of SO_2/mmBtu are allowed to increase emissions by 20 percent until the year 2000.

Phase II of the CAAA SO_2 reduction requirement becomes effective January 1, 2000, and affects all utilities generating at least 25 MW of electricity. These requirements require approximately 2,128 electric power utilities to reduce emissions to a level equivalent to the product of an emissions rate of 1.2 lbs of SO_2/mmBtu times the average of their 1985-1987 fuel use. SO_2 emissions from electric utilities will be capped at 8.95 million tons per year.

Title IV of the CAAA requires a 2 million ton reduction in NO_X emissions from 1980 levels. The EPA has developed regulations to help reduce NO_X emissions that may affect the fossil fuel electric power generation industry. As in the SO_2 reduction program, the NO_X Emission Reduction Program is being implemented in two phases for two categories of coal-fired electric utility boilers. The NO_X program differs from the SO_2 program in that it neither "caps" the NO_X emissions, nor utilizes an allowance trading system.

Phase I of the program for "Group I" boilers was effective on January 1, 1996, and affected dry-bottom wall fired boilers and tangentially fired boilers that are required to meet NO_X performance standards (40 CFR Part 76). Regulations for Phase II of the NO_X reduction program were promulgated in December 1996. These rules become effective in the year 2000. These regulations set lower emission limits for Group 1 boilers. In addition, the regulation establishes initial NO_X emission limitations for Group 2 boilers. Group 2 boilers include boilers applying cell burner technology, cyclone boilers, wet bottom boilers, and other types of coal-fired boilers.

Facilities covered by the Acid Rain Program must apply for an Acid Rain Permit. Most utilities must apply for permits in either Phase I or Phase II of the program. Two categories of utility units may be eligible for exemption: small new units burning clean fuels and retired units. Some cogeneration units are not covered under the program.

To support the mandated reductions in SO_2 and NO_X, the 1990 CAAA also required EPA to issue regulations requiring facilities to install continuous emissions monitoring systems (40 CFR Part 75). Fossil fuel electric power generation units over 25 megawatts and new units under 25 megawatts that use fuel with a sulfur content greater than .05 percent by weight are required to measure and report emissions under the Acid Rain Program.

Federal/State Operating Permits Programs

Title V of the CAAA requires the development of a comprehensive permitting program to control air emissions from major stationary sources. Major sources include those that emit 100 tons/year or more of VOCs or criteria pollutants, 10 tons/year or more of any single toxic air pollutant, or 25 tons/year or more of a combination of toxic air pollutants. This program is modeled after the NPDES program under the CWA and serves to bring together all of the requirements concerning air emissions that apply to affected sources. Like the NPDES program, administration of the operating permit program is also delegated to States with approved programs.

This program requires all significant sources of air emissions to obtain permits. In general, utility fossil fuel steam electric power plants are all considered major sources, so they will most likely be required to obtain permits. Other types of fossil fuel electric power generation facilities, such as those employing small gas turbines, may not be considered a major source and may not be required to apply for a permit. Any operational change that increases emissions above specified limits will most likely necessitate permit modifications. Permit terms are determined by State regulations for delegated programs but may not exceed 5 years.

Clean Water Act

Wastewater discharges from fossil fuel electric power generation facilities released to waters of the United States are covered under the CWA. Any point source discharge is required to apply for, and obtain, an NPDES permit (40 CFR Part 122). Permits may be issued by EPA or a State, depending upon whether the State has a delegated program. The NPDES permits serve to regulate point source discharges by establishing pollutant limitations and other special conditions. Facilities discharging to a POTW may be required to obtain a permit from a POTW that has an approved pretreatment program.

Current technology-based effluent limitations guidelines and pretreatment standards for discharges from the steam electric generating point source category were promulgated in 1982 (40 CFR Part 423). The waste streams covered and parameters limited are summarized in Table 37 below.

Table 37: Waste Streams and Pollutants Regulated Under National Effluent Limitation Guidelines for the Steam Electric Generating Point Source Category

Type of Waste Stream	BAT Effluent Limitations Guidelines
All discharges	pH , PCBs
Bottom ash transport waters and low volume waste sources	TSS, oil and grease
Chemical boiler metal cleaning wastes	TSS, oil and grease, iron, and copper
Non-chemical metal cleaning wastes	Reserved (low volume wastewater limits apply)
Fly ash transport water (including economizer ash)	No discharge allowed (based on the availability of dry disposal methods and the potential for reuse of fly ash transport water)
Once-through cooling water	Total residual chlorine (TRC) or free available chlorine (FAC), depending on facility's generating capacity
Cooling tower blowdown	FAC, chromium, zinc, other 126 priority pollutants where they are found in chemicals used for cooling tower maintenance
Coal pile runoff	TSS

In general, steam electric facilities built after 1982 are considered new sources and must comply with the 1982 effluent limitations. Less stringent guidelines may apply for facilities constructed between 1974 and 1982 (see 1974 guidelines and standards). Steam electric generating facilities that have been repowered are considered new sources.

Steam electric facilities that discharge to a POTW may be required to meet pretreatment standards for existing sources (PSES) or for new sources (PSNS). General pretreatment standards applying to most industries discharging to a POTW are described in 40 CFR Part 403. Pretreatment standards applying specifically to the steam electric generating point source category are listed in 40 CFR §§423.16 and 17.

Beyond the applicable technology-based effluent limitations described above, permits may also establish technology-based limits for other pollutants based on the application of best professional judgement (BPJ). Permit limits and special conditions may also be established based on water quality considerations. Thermal limitations are often placed in permits for steam electric power plants based on Section 316(a) of the CWA and water quality considerations. Additionally, permits may require the performance of a demonstration study and implementation of control technologies to minimize adverse environmental impacts from cooling water intake structures.

Storm water discharges associated with any industrial activity onsite at a fossil fuel electric power generation facility are covered under the National

Storm Water Program. Steam electric power generating activities are listed as one of the categories of industrial activities subject to the storm water permit application requirements (category vii). The regulations at 40 CFR Part 122.26 require facilities discharging storm water from 1 of the 11 categories of industrial activities to apply for a storm water permit if the storm water discharges to waters of the United States. In most permits, facilities are required to develop and implement a storm water pollution prevention plan. However, limitations and other special conditions may be included on a case-by-case basis. Some permits may include the numeric effluent limitation guideline for coal pile runoff. Storm water discharges associated with other industrial activities at fossil fuel electric power generation facilities are typically not subject to numeric limits, however.

Resource Conservation and Recovery Act

The 1980 Solid Waste Disposal Act Amendments conditionally exempted from regulation under Subtitle C large volume wastes, including fly ash waste, bottom ash waste, boiler slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels (RCRA §3001). Section 8002(n) of RCRA directed EPA to study these wastes.

In 1993, EPA issued a regulatory determination addressing large volume wastes (fly ash, bottom ash, boiler ash, boiler slag, and flue gas emission control wastes) generated by coal-fired utility power plants, including independent power producers not engaged in any other industrial activity. The regulatory determination stated that these wastes should not be regulated as Subtitle C wastes when they are managed separately from other wastes. A similar determination for other large volume fossil fuel combustion wastes and co-managed wastes was deferred pending additional studies.

Wastes exempt from hazardous waste regulation (currently all wastes from fossil fuel combustion) are addressed by Subtitle D of RCRA (for nonhazardous solid wastes). There are currently no Federal nonhazardous waste regulations. As a result, fossil fuel electric power generation waste management is addressed solely by the States, either through their general industrial solid waste programs or through specific programs for fossil fuel combustion wastes. These State programs vary considerably.

Subtitle I of RCRA has stringent requirements for underground petroleum and hazardous substances storage tank (UST) systems with 110-gallon or greater capacity. Any storage of fuels in USTs onsite at a fossil fuel electric power generation facility would be covered under these regulations at 40 CFR Part 280.

Subtitle C of RCRA provides for a comprehensive cradle to grave system of management for hazardous waste and includes rules governing waste disposal on land; recycling and generators; and treatment, storage, or disposal facilities (TSDFs). Low volume fossil fuel combustion wastes not co-managed with ash, slag, or flue gas desulfurization wastes and other wastes that are not directly associated with the combustion process are not exempted from hazardous waste regulation. As such, they are hazardous wastes if they are listed as hazardous wastes from non-specific sources (e.g., spent solvents) or if they exhibit one or more of the RCRA hazardous waste characteristics of toxicity, corrosivity, reactivity, and ignitability. The identification of specific listed wastes and the definitions of the hazardous waste characteristics are listed in 40 CFR Part 261.

Fossil fuel electric power generating plants do not typically generate large quantities of hazardous waste. Furthermore, the requirements and costs of operating an onsite hazardous waste TSDF are extensive. Therefore, most electric power generating facilities send any generated hazardous waste to offsite RCRA-permitted commercial TSDFs for permanent disposal.

Some steam electric power generating plants co-fire their boilers with hazardous wastes (e.g., spent solvents), along with their primary fossil fuel source. Such facilities are subject to RCRA regulation under the BIF Rule (40 CFR Part 266, Subpart H). The BIF Rule includes operating condition requirements, as well as testing requirements, for air emissions and residuals to ensure adequate destruction of toxic constituents.

Emergency Planning and Community Right-to-Know Act

In a recent rulemaking (62 FR 23834, May 1, 1997), EPA expanded the list of industry groups subject to reporting requirements under Section 313 of EPCRA (61 FR 33587). The expanded list of industry groups includes electric utilities classified in the following SIC codes: 4911 Electric Services, 4931 Electric and Other Services Combined, and 4939 Combination Utilities, Not Elsewhere Classified. EPCRA Section 313 now requires electric generating facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce to evaluate their chemical use and management activities to determine potential reporting responsibilities. Section 313 establishes annual requirements for amounts released and otherwise managed of "section 313 chemicals" (a list of more than 650 chemicals and chemical categories).

For each Section 313 chemical or chemical category, covered facilities must report total routine and accidental amounts entering each environmental media, as well as onsite waste management via, and offsite transfers for.

disposal, waste treatment, energy recovery and recycling, and onsite source reduction activities. This information is submitted on the TRI reporting form called Form R if the facility has met or exceeded certain thresholds. The first period of reporting for this industry will be on or before July 1, 1999, for the period from January 1 to December 31, 1998. Reporting will be required annually thereafter. For additional information on these new TRI reporting requirements, contact the Emergency Planning and Right-to-Know Hotline at (800) 535-0202 (in Virginia and Alaska (703) 412-9877; TDD (800) 553-7672).

VI.C Pending and Proposed Regulatory Requirements

Clean Air Act Amendments of 1990

Hazardous Air Pollutants

In response to requirements under Section 112 of the CAA as well as Section 129, EPA is developing a unified set of Federal air emission regulations for industrial combustion sources. This rulemaking effort is being called the Industrial Combustion Coordinated Rulemaking (ICCR).

The ICCR will cover sources from industrial/institutional/commercial boiler, process heaters, industrial/commercial and other solid waste (not including hazardous, medical, or large municipal) incinerators, stationary gas turbines, and stationary internal combustion engines. These sources are not limited to use of fossil fuels and have the potential to emit both HAPs and criteria pollutants. This rulemaking effort will produce approximately seven separate regulations, six of which are expected to be finalized by November 2000. For additional information on the ICCR, contact Fred Porter, U.S. EPA Office of Air and Radiation, at (919) 541-5251.

Section 112(n) requires that EPA perform studies to evaluate the health risks associated with emissions of toxic air pollutants from electric utility steam generating units. Electric utility steam generating units are defined as any fossil fuel-fired combustion unit of more than 25 MW electric that serves a generator that produces electricity for sale. Cogenerators that supply more than one-third of their potential electric output capacity and more than 25 MW output to any utility power distribution system for sale will also be covered. A preliminary study has been completed and was issued as an interim final in October 1996. Additional studies will be performed, as well as an in-depth study of potential public health concerns due to mercury emissions from utilities. These findings will be published in a report to Congress at a later date and will include costs and technologies available to control these emissions and recommendations as to whether regulations are needed for air toxics emissions from this industry. For additional information on this study, contact Bill Maxwell, U.S. EPA Office of Air and Radiation, at (919) 541-5430.

Clean Water Act

Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category

The existing 1982 effluent limitations guidelines and standards and pretreatment standards for wastewater discharges from the Steam Electric Point Source Category are currently being reviewed by the Office of Water. A preliminary study has been completed by the Office of Water to evaluate the guidelines and standards based on current technical feasibility, environmental factors, economic impacts, and utility to permit writers. The study was performed because the steam electric power generating industrial category is considered as a candidate for possible regulatory revisions in the future. For additional information, contact Joe Daly, U.S. EPA Office of Water, at (202) 260-7186.

Cooling Water Intake Structure Regulations

Section 316(b) of the Clean Water Act requires that "...any standard established pursuant to Section 301 or 306... and applicable to a point source shall require that the location, design construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." Since fossil fuel electric power generators with steam turbines withdraw by far the greatest quantity of cooling water of any single industrial sector, it is expected that this industry will be the most affected by this requirement. Although some EPA regions and States have developed programs to minimize impacts from cooling water structures, no uniform national standards or implementing regulations are currently in force. As set forth in a consent decree *(Cronin v. Browner)*, EPA has initiated the information collection activities needed to develop proposed regulations to address impacts from the intake of cooling water by 1999. Final EPA action is scheduled for the year 2001. For additional information on the Section 316(b) rulemaking effort, contact Deborah Nagle, U.S. EPA Office of Water, at (202) 260-2656.

Resource Conservation and Recovery Act

A regulatory determination on whether large volume wastes at utility oil-fired, nonutility coal- and oil-fired, and fluidized bed combustion power plants and co-managed large volume wastes at all utility and nonutility coal- and oil-fired electric generation facilities should be considered hazardous wastes under Subtitle C is expected to be finalized in 1998, pending additional data collection. For additional information, contact Dennis Ruddy, U.S. EPA Office of Solid Waste, at (703) 308-8430.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the EPA to track compliance with CAA, RCRA, CWA, and other environmental statutes. Within the last several years, the EPA has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's IDEA system. The IDEA has the capacity to "read into" EPA's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match air, water, waste, toxics/pesticides/EPCRA, TRI, and enforcement docket records for a given facility and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are being developed.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consist of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census. For the fossil fuel electric power generation industry, statistics about the industry are collected by the DOE EIA (see Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries: one for the past five calendar years (April 1, 1992, to March 31, 1997) and the other for the most recent 12-month period (April 1, 1996, to March 31, 1997). The 5-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or led by EPA. However, the table breaking down the universe of violations does give a crude measurement of EPA's and States' efforts within each media program. The presented data illustrate the variations across EPA regions for certain sectors.[a] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

Facility Indexing System - This system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis - This data integration system can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are: AIRS (Office of Air and Radiation), PCS (Office of Water), RCRIS (Resource

[a] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in Sections IV and VII of this notebook were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with three enforcement actions counts as one facility.

Total Enforcement Actions describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times, e.g., a facility with three enforcement actions counts as three.

State Lead Actions shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the CWA, CAA, and RCRA. Inspections and actions from the TSCA/FIFRA/ EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA air, water, waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A Fossil Fuel Electric Power Generation Industry Compliance History

This section examines the historical enforcement and compliance data on the fossil fuel electric power generation sector. As noted earlier, these data were obtained from EPA's IDEA system. The five exhibits within this section provide both a 5-year and a 1-year review of the data from the sector and also provide data from other sectors for comparison purposes. It should be noted that the data are accessed in the IDEA database system through SIC codes. Therefore, only those facilities whose primary SIC codes indicate the potential for power generation activities can be accessed (see Section II). This means that the data retrieved from IDEA may be more inclusive (e.g., include transmission and distribution facilities). Other industry facilities that have associated power generation activities cannot be identified because their primary SIC codes do not indicate power generation.

Table 38 provides an overview of the reported compliance and enforcement data for the fossil fuel electric power generations sector over the past 5 years (April 1992 to April 1997). These data are also broken out by EPA Regions thereby permitting geographical comparisons. A few points evident from the data are listed below. As shown, 3,270 facilities were identified through IDEA with SIC codes that indicate power generation may be occurring (see discussion above). Of those, approximately 66 percent (2,166) were inspected in the last 5 years. Other points of interest include:

- 14,210 inspections were conducted over the last 5 years. Of the 3,166 facilities inspected, on average, each received over 6 inspections in the past 5-year period.

- The 14,210 inspections resulted in 403 facilities having enforcement actions taken against them. At those 403 facilities, there were a total of 789 enforcement actions; therefore, each facility averaged nearly 2 enforcement actions over the 5-year period.

- The average enforcement to inspection rate is 0.06, with the rate across the regions ranging from 0.02 to 0.13. There appears to be no correlation between State versus Federal lead on the inspections and the enforcement to inspection rate.

Table 38: Five-Year Enforcement and Compliance Summary for the Fossil Fuel Electric Power Industry

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	250	140	664	23	36	55	84%	16%	0.08
II	269	199	1,455	11	75	187	84%	16%	0.13
III	305	221	1,997	9	57	130	87%	13%	0.07
IV	559	353	3,039	11	45	84	82%	18%	0.03
V	552	344	2,287	14	76	134	69%	31%	0.06
VI	315	222	1,079	18	30	61	54%	46%	0.06
VII	409	259	1,170	21	22	28	36%	64%	0.02
VIII	134	91	643	13	15	35	60%	40%	0.05
IX	273	251	1622	10	38	57	84%	16%	0.04
X	204	86	254	48	9	18	61%	39%	0.07
TOTAL	3,270	2,166	14,210	14	403	789	76%	24%	0.06

VII.B Comparison of Enforcement Activity Between Selected Industries

Tables 39 and 40 allow the compliance history of the fossil fuel electric power generation sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Tables 39 and 40 permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering the last 5 years (April 1992 to April 1997) to that of the past year (April 1996 to April 1997). As shown in the data, the 3,270 fossil fuel electric power generation facilities is the sixth largest number of facilities identified through IDEA, with ground transportation having the most facilities with 7,786. However, while approximately 66 percent of the fossil fuel electric power generation facilities have been inspected in the past 5 years, only 41 percent of the ground transportation facilities have been inspected. Other points of interest from the 5-year summary include:

- The number of inspections over the past 5 years for fossil fuel electric power generation facilities (14,210) is more than 3 times the amount conducted in most other sectors.
- The enforcement to inspection rate of 0.06 over the past 5 years is one of the lower rates of the listed sectors.

Points of interest from the 1-year summary include:

- The 1,318 fossil fuel electric power generation facilities inspected in the past year places this sector among the top four sectors for number of facilities inspected.
- The total number of inspections in this sector is 2,430 which compares with the number of inspections performed in the ground transportation and non-metallic mining sectors, but is 1.5 to 17 times more than the other sectors which range from 1,436 down to 141.
- The enforcement to inspection rate of 0.06 is about average among all the sectors, with the lowest being 0.01 (dry cleaning) and the highest being 0.23 (petroleum refining). This is relatively constant with the 5-year average for the fossil fuel electric power generation sector.

Tables 41 and 42 provide a more in-depth comparison between the fossil fuel electric power generation sector and others by organizing inspection and enforcement data by environmental statute. As in the previous Tables (Tables 39 and 40), the data cover the last 5 years (Table 41) and the last

R0075230

Table 39: Five-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

R0075231

Table 40: One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

Table 41: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

R0075233

Table 42: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

R0075234

one year (Table 42) to facilitate the identification of recent trends. Points of interest from the 5-year summary include:

- Compared to other sectors, the fossil fuel electric power generation sector has one of the higher percentages of CAA inspections (57%) and one of the lower percentages of RCRA inspections (11%), when measured against the total number of inspections conducted. As a result, it has one of the higher percentages of CAA enforcement actions (59%) and one of the lowest percentages of RCRA enforcement actions (10%), when measured against total enforcement actions.

The 1-year inspection and enforcement summary reflects similar numbers to those from the past 5 years. No notable exceptions are apparent.

VII.C Review of Major Legal Actions

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

VII.C.1 Review of Major Cases

As shown in the previous tables, the number of enforcement actions taken over the past 5 years, when compared to the number of inspections conducted, is minimal. Even though there have been 871 total enforcement actions, major cases involving fossil fuel electric power generation facilities are rare. Since 1992, however, there have been at least 13 actions against such facilities.

The 13 cases were broken out as follows:

- 6 cases under the CAA (asbestos NESHAPs, NO_X monitoring violations, and SO_2 violations)
- 2 cases under the CWA (NPDES permit violation, wetlands)
- 2 cases under TSCA (PCBs)
- 2 cases under EPCRA (release in excess of reportable quantities)
- 1 multimedia case (CWA, EPCRA, and TSCA).

The average penalty associated with these cases was just more than $150,000. In addition, two SEPs were associated with the 13 cases. Those are discussed in more detail in the following section.

The two most significant cases against fossil fuel electric power generation facilities included CWA violations by Potomac Electric Power Company (PEPCO) and CAA violations by Public Service Electric & Gas (PSE&G). In the PEPCO case, the violations occurred from 1988 to 1993, during which time a site supervisor either pumped or oversaw the pumping of polluted water from holding ponds into an adjacent swamp. PEPCO discovered the illegal discharge and informed EPA. The consent decree provides for a penalty of $975,000. Because the violation was self-disclosed, no criminal charges were brought against the company or its officers.

In *United States v. Public Service Electric & Gas*, PSE&G was charged with violating the CAA, specifically the asbestos NESHAP. While commuting home from work, an off-duty EPA inspector noticed a pile of old pipes laying in a yard. A subsequent inspection of the old gas-cracking operation revealed the NESHAP violations. The PSE&G was required to pay a civil penalty of $230,000 and complete an extensive worker training and notification program.

VII.C.2 Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the internet at EPA's Enviroene website: http://es.inel.gov/sep.

As mentioned above, there were two SEPs at fossil fuel electric power generation facilities. The SEPs were negotiated with IES Utilities, Incorporated, of Cedar Rapids, Iowa, and Consumers Power Company of West Olive, Michigan.

The case against IES Utilities, Incorporated, was the first acid rain administrative penalty action in the country. The complaint alleged IES failed to complete timely certification testing of the acid rain continuous emission monitors required for SO_2, NO_X, CO_2, and volumetric flow at several of its generating stations. As part of the settlement, IES agreed to a SEP involving the purchase and permanent surrender by the utility to EPA of 589 SO_2 allowances. Each allowance constitutes an authorization to emit during or after a specified calendar year one ton of SO_2. The value of the allowances permanently removed from the market was $76,570 at the time of the settlement. IES was also required to pay a penalty of $25,630 to settle the claims.

R0075236

In the Consumers Power Company case, the company agreed to carry out three SEPs at a total estimated cost of $247,742. The projects include (1) converting heat exchangers from ethylene glycol to propylene glycol, which is 300 times less toxic, (2) sending information on EPCRA requirements to an estimated 3,000 facilities in Michigan, and (3) conducting an outreach program on the EPCRA Section 302 notification requirement to rural communities. The company must also certify its compliance with EPCRA. In its complaint, EPA alleged that the company failed to notify authorities about an accidental release of 1,400 pounds of sodium hypochlorite.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those initiated independently by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

Clean Air Power Initiative

The goal of the Clean Air Power Initiative (CAPI) is to improve air pollution control efforts within the electric power generating industry by developing an integrated regulatory strategy for three major pollutants emitted by electric power generators: SO_2, NO_X, and air toxics (specifically, mercury). The project was initiated in 1995 by EPA's Assistant Administrator for Air and Radiation. Through the Initiative, EPA hopes to provide the electric power industry with greater regulatory flexibility and cost savings while achieving environmental goals for ozone, fine particles, regional haze, and toxics. The Initiative will use existing CAA authority where possible, although ultimately new congressional authority may be required. The EPA believes focusing on regional reductions of the pollutants and implementing a "cap and trade" approach for some pollutants, such as NO_X, SO_2, and mercury, would be most effective. The EPA is meeting with representatives of the power industry, State and local officials, environmental groups, and pollution control vendors to obtain their views and input for the regulatory framework for the Initiative. (Contact: Linda Reidt Critchfield, at (202) 233-9087. Website: http://www.epa.gov/capi).

EPA Regional Compliance And Enforcement Activities

The EPA Region VIII has focused on enforcement and compliance activities for coal-fired power plants. This industrial sector was targeted by Region VIII because they have 38 significant operating plants (i.e., generate greater than 25 MW electricity). The region has experienced ongoing compliance issues related to the new Acid Rain Program, impacts from plants in PSD Class I areas, and impacts in nonattainment areas. The goal of this EPA regional compliance and enforcement initiative is to comprehensively evaluate the compliance status of the facilities. The region is also evaluating any environmental justice issues due to the location of the facilities. States in Region VIII are participating in the sector initiative by performing annual air program and NPDES permit inspections on a yearly basis. South Dakota has conducted multimedia inspections at two coal-fired power plants.

Department of Energy Environmental Research Programs

The DOE maintains numerous laboratories and field facilities that perform research and development type activities. The following facilities are of interest to the fossil fuel electric power generation industry and environmental compliance:

- **Argonne National Laboratory:** The Argonne National Laboratory (ANL) conducts applied research and engineering development in energy and environmental technologies, high performance computing, and scientific research in physical and life sciences. The Energy Systems Division of ANL focuses its expertise on controlling environmental impacts of industrial energy use. The division is committed to a revitalized competitiveness in the national economy. (Website: http:\\www.anl.gov).

- **Oak Ridge National Laboratory:** The Oak Ridge National Laboratory performs research on a broad range of energy-related problems and provides technical information and assistance on energy research for State and local governments and the private sector. Areas of research include waste management, fossil, fuel power generation technology, nuclear power generation technologies, fusion technology, conservation, and environment. (Website: http:\\www.ornl.gov).

- **Federal Energy Technology Center:** The Federal Energy Technology Center (FETC), one of the government's principal fossil fuel energy research centers, is responsible for research and development programs in the technical and administration management of fossil energy. The FETC is part of the Bruceton Research Center, which is the Nation's largest governmental lab devoted to coal research and development. The center's program responsibilities include clean coal technology, coal preparation, combustion technology, alternative fuels utilization, flue gas cleanup, coal liquefaction, advanced research and technology development in direct utilization and liquefaction, and solids transport. (Website: http:\\www.fetc.doe.gov).

VIII.B EPA Voluntary Programs

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative developed by EPA that focuses on improving environmental performance, encouraging voluntary compliance, and building working relationships with stakeholders. EPA initiated a one year pilot program in 1995 by selecting 12 projects at industrial facilities and federal installations that demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, pollution prevention, community involvement, and mentor programs. In return for participating, pilot participants received public recognition and were given a period of time to correct any violations discovered during these experimental projects. Four fossil fuel electric power generation facilities proposals were accepted and are listed in Table 43. Progress reports and fact sheets from these pilot programs are now available from EPA or off the web.

Table 43: List of Power Plants That Participated in the Environmental Leadership Program For 1995 and 1996
1. Arizona Public Service, Deer Valley Facility (Phoenix, AZ)
2. Duke Power Riverbend Steam Station (Mt. Holly, NC)
3. Ocean State Power (Burrillville, RI)
4. Salt River Project (Phoenix, AZ)

EPA is making plans to launch its full-scale Environmental Leadership Program in 1997. The full-scale program will be facility-based with a 6-year participation cycle. Facilities that meet certain requirements will be eligible to participate, such as having a community outreach/employee involvement programs and an environmental management system (EMS) in place for 2 years. (Contact: Debby Thomas, ELP Deputy Director, (202)564-5041. Website: http://es.inel.gov/elp).

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information

R0075240

regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Fax-on-Demand Hotline 202-260-8590, or Christopher Knopes at EPA's Office of Policy, Planning and Evaluation (202)260-9298. Website: Web: http://www.epa.gov/ProjectXL)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and DOE. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Program participants are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, (202)260-4407. Website: http://www.oit.doe.gov/Access/climate).

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program saves money for businesses and organizations and creates a cleaner environment by reducing pollutants released into the atmosphere. The program has over 2,345 participants which include major corporations, small and medium sized businesses, federal, state and local governments, non-profit groups, schools, universities, and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. As of March 1997, participants had lowered their electric bills by $289 million annually. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and an information hotline. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Green Light/Energy Star Hotline at 1-888-STARYES or Maria Tikoff Vargar, EPA Program Director, at (202)233-9178. Website: http://www.epa.gov/greenlights.html).

R0075241

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1997, the program had about 500 companies as members, one third of whom are Fortune 1000 corporations. Members agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports. To member companies, EPA, in turn, provides technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at 1-800-372-9473 or Joanne Oxley, EPA Program Manager, (703)308-0199. Website: http://www.epa.gov /epaoswer/non-hw/reduce/wstewise/ index.html)

NICE[3]

The U.S. Department of Energy is administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE[3]). By providing grants of up to 45 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, and demonstrate new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the forest products, chemicals, petroleum refining, steel, aluminum, metal casting and glass manufacturing sectors. (Contact: Chris Sifri, DOE, (303)275-4723 or Eric Hass, DOE, (303)275-4728. Website: http//www.oit.doe.gov/access/ nice3).

VIII.C Trade Association/Industry Sponsored Activity

Trade associations, in conjunction with their industry members, sponsor activities that serve to further regulatory compliance initiatives. This section describes a major environmental compliance assistance program being sponsored by the utilities in the fossil fuel electric power generation industry, as well as some of the major trade associations serving the fossil fuel electric power generation industry.

VIII.C.1 Environmental Programs

Climate Challenge Program

The Climate Challenge Program is a joint initiative of DOE and the electric utility industry to reduce greenhouse gas emissions. Electric utilities voluntarily commit to undertake actions to reduce, avoid, or sequester more than 47 million metric tons of carbon equivalent by the year 2000. These commitments are formalized in individual utility participation accords for large utilities, and letters of participation for utilities with less than 50,000 customers. Utilities report greenhouse gas emissions data and submit annual reports, which describe their achievements, to DOE. The Climate Challenge Options Workbook describe more than 50 options for utilities to implement to meet their participation commitments. The workbook was jointly developed by the electric power industry and DOE. (Contact: Larry Mansueti, Program Director, Office of Utility Technologies, EE-10, U.S. DOE, 1000 Independence Avenue SW, Washington, DC 20585. Website: http://bejing. dis.anl.gov/ ee-cgi-bin/ccap.pl)

The utility industry has also developed a set of initiatives to help utilities meet their commitments. These include:

- **EnviroTech Investment Fund**, which fund invests in companies focusing on regenerating energy technologies that are more energy efficient than those currently in use.
- **International Utility Efficiency Projects** that support energy development in a way that is environmentally beneficial.
- **Utility Forest Carbon Management Program**, which comprises domestic and international forestry projects to manage CO_2 emissions.

VIII.C.2 Summary of Trade Associations

Trade associations and professional organizations that serve the fossil fuel electric power generation industry are numerous and varied in their focus. They range from serving a relatively small portion of the industry (e.g., independent power producers) to serving the industry as a whole. This section briefly describes some major trade and professional organizations for this industry.

American Coal Ash Association (ACAA) 2760 Eisenhower Avenue, Suite 304 Alexandria, VA 22314 Phone: (703) 317-2400 Fax: (703) 317-2409 Website: http://www.acaa-usa.org	Members: 110 Staff: 5 Contact: Samuel S. Tyson

Founded in 1968, ACAA's mission is to advance the management and use of Coal Combustion Products (CCPs) in ways that are technically sound, commercially competitive, and environmentally safe.

American Public Power Association (APPA) 2301 M Street, NW Washington, DC 20037 Phone: (202) 467-2900 Fax: (202) 467-2910 Website: http://www.appa.org/	Members: 2,000 Staff: 60 Contact: Alan H. Richards

Founded in 1940, APPA's members include public utility systems, State- and county-owned electric systems, and rural cooperatives. The APPA maintains a library on the electric power industry and publishes a bimonthly magazine. The APPA also conducts research programs, compiles statistics, and offers utility education courses in electric power. The association holds an annual conference and workshops.

Association of Energy Engineers (AEE) 4025 Pleasantville Road., Suite 420 Atlanta, GA 30340 Phone: (770) 447-5083 Fax: (770) 446-3969 Website: http://www.aeecenter.org/	Members: 8,500 Staff: 9 Contact: Ruth M. Bennett

Founded in 1977, the members of the AEE are engineers, architects, and other professionals interested in energy management and cogeneration. The AEE promotes advancement of the profession and contributes to the professional development of its membership. The AEE provides scholarships for students in energy engineering, supports the National Energy Policy Council, and sponsors the Cogeneration and Competitive Power Institute, a research organization. The AEE publishes journals and newsletters and sponsors several technical and managerial congresses each year.

Edison Electric Institute (EEI) 701 Pennsylvania Avenue, NW Washington, DC 20004-2696 Phone: (202) 508-5000 Fax: (202) 508-5360 Website: http://www.eei.org/	Members: 202 Staff: 262 Contact: Thomas Kuhn, President

Founded in 1933, EEI members are investor-owned electric utility companies operating in the United States. Some affiliated members are from Canada, Mexico, and Central and South America. The EEI acts as a representative for the shareholder-owned electric power industry on subjects of public interest and provides a medium for the exchange of ideas and information within the electric power industry. The institute maintains a library and database and compiles statistics. The EEI provides educational programs and publishes surveys, which provide statistical and factual information about operation, rates, regulation, and environmental practices.

Electric Power Research Institute (EPRI) 3412 Hillview Road Palo Alto, CA 94303 Phone: (415) 855-2000 Fax: (415) 855-2041 Website: http://www.epri.com/	Members: 700 Staff: 500 Contact: Kurt Yeager, Exec. Officer

The EPRI was founded in 1972 and serves all sectors of the electric utility industry. The EPRI mission is to conduct a broad economically and environmentally acceptable program of research and development in technologies for electric power production, distribution, transmission, and utilization. The EPRI primary research areas are advanced power systems, coal combustion systems, electrical systems, energy analysis, and environment and energy management and utilization. The institute maintains a library and a database of current and completed research in the electric power industry. The institute also publishes a guide and a journal.

Electric Power Supply Association (EPSA) 1401 H Street NW, Suite 760 Washington, DC 20005 Phone: (202) 789-7200 Fax: (202) 789-7201	Members: 90 Staff: 12

The EPSA was formed by a merger of two former trade associations: the Electric Generating Association and the National Independent Energy Producers (NIEP). (The Electric Generation Association was formed by the merger of the Independent Power Producers Working Group and the

R0075245

Cogeneration and Independent Power Coalition of America.) The EPSA mission is to advance the interests of its members: competitive generators, power marketers, and other suppliers. The EPSA advocates domestic and international policies that will result in a fully competitive electric power supply marketplace. The EPSA supports the development of a market in which existing commitments, such as independent power contracts, are honored and in which all customers have a choice of electric suppliers by a certain date.

National Rural Electric Cooperative Association (NRECA) 4301 Wilson Boulevard Arlington, VA 22203 Phone: (703) 907-5500 Fax: (703) 907-5521 Website: http://www.nreca.org/	Members: 1000 Staff: 600 Contact: Glenn English

The NRECA, founded in 1942, represents rural electric cooperatives, public power districts, and public utility districts in 46 States. The NRECA is an advocate for energy and operational issues, as well as rural electric development. The association maintains a library of 20,000 volumes, holds professional conferences, and publishes a magazine and newsletter. Other activities include legislative representation; energy, regulatory, and legal expertise; industry public relations; management institutes; training and energy research and development consulting services; insurance and safety programs; wage and salary surveys; and an international program.

North American Electric Reliability Council (NERC) Princeton Forrestal Village 116-390 Village Boulevard Princeton, NJ 08540-5731 Phone: (609) 452-9550 Fax:(609) 452-7669 Website: http://www.nerc.com/	Members: 9 Regional Councils Contact: Michehl R. Gent

The NERC is a nonprofit company owned by nine regional councils. The members of the regional councils and one affiliate are individual utilities representing all ownership categories of the electric utility industry, including investor-owned, municipal, rural electric cooperatives, Federal, independent power producers, power marketers, and power brokers. The principal purpose of NERC is to coordinate, promote, and communicate the reliability of North American electric utilities. The organization annually reviews the reliability and adequacy of the bulk electricity systems in North America and maintains several databases. In addition, the organization facilitates

R0075246

development of reliability-related planning and operating criteria and standards, and publishes reports and reference documents.

Utility Air Regulatory Group (UARG) c\o Hunton & Williams 1900 K Street NW Washington, DC 20460 Phone: (202) 955-1500 Fax: (202) 778-2201	Members: 74

The UARG is a voluntary, nonprofit, unincorporated, ad hoc group of 74 electric utilities, the EEI, the NRECA, and the APPA. The UARG's purpose is to participate on behalf of its members collectively in Federal air pollution control regulatory activities and in related litigation.

Utility Solid Waste Activities Group (USWAG) c\o EEI 701 Pennsylvania Ave. NW Washington, DC 20004 Phone: (202) 508-5645 Fax: (202) 508-5150	Members: 83 Contact: Jim Roewer

The USWAG is an informal consortium of the EEI, the APPA, the NRECA and approximately 80 electric utility companies. Together, USWAG members represent more than 85 percent of the total electric generating capacity of the United States and service more than 95 percent of the Nation's consumers of electricity. The mission of USWAG is to help member companies manage all utility wastes and byproducts in a manner that is protective of human health and the environment and is of reasonable cost.

Utility Water Act Group (UWAG) c\o Hunton & Williams 1900 K Street NW Washington, DC 20460 Phone: (202) 955-1500 Fax: (202) 778-2201	Members: 78 Contact: John (Jack) F. Mackenzie, Chair Pacific Gas and Electric Co. Phone: (415) 973-6901 Fax: (415) 973-9201

The UWAG is an association of 75 individual utilities and three national trade associations of electric utilities--the EEI, the NRECA, and the APPA. The UWAG purpose is to participate on behalf of its members in EPA's rulemakings under the CWA and in litigation arising from those rulemakings.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the fossil fuel electric power generation industry a list of contacts and publications are provided below.

Contacts

Name	Organization	Telephone	Subject
Rafael Sanchez	EPA/OECA/METD	(202) 564-7028	Compliance assistance
Chris Oh	EPA/OECA/METD	(202) 564-7004	Compliance assistance
Joe Daly	EPA/OST/EAD	(202) 260-7186	Steam Electric Effluent Guidelines

Acknowledgments

The contacts listed below have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this sector notebook.

Joseph Daly - EPA/Office of Water (EPA/OW)
Rafael Sanchez - EPA/Office of Enforcement and Compliance Assurance (EPA/OECA)
Bill Maxwell - EPA/Office of Air Quality Standards and Planning (EPA/OAQSP)
Samuel S. Tyson - American Coal Ash Association (ACAA)
Bill Wemhoff - American Public Power Association (APPA)
Kara M. Downey - Arizona Electric Power Cooperative, Inc.(AEPC)
Ruth M. Bennett - Association of Energy Engineers (AEE)
Alice Meyer - Edison Electric Institute (EEI)
Richard W. Sternberg - National Rural Electric Cooperative Association (NRECA)
Anthony Riai - EPA/Office of Enforcement and Compliance Assurance (EPA/OECA)

General Profile

1995 Capacity and Generation of Non-Utility Sources of Energy. Prepared by the Edison Electric Institute, Washington, D.C. November 1996.

Annual Energy Outlook 1997 - With Projections to 2015. U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0383(97).

Directory of U.S. Cogeneration, Small Power, and Industrial Power Plants. Giles, Ellen, and Fred Yost. Twelfth Edition. Utility Data Institute, A Division of McGraw-Hill Company. June 1985. UDI-2018-95.

Electric Power Annual, 1995, Volume 1. U.S. Department of Energy, Energy Information Administration, Washington, D.C. July 1996. DOE/EIA-0348(95/1).

Electric Power Annual 1995, Volume II. U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0348(95)/2.

Federal Technology Alert. U.S. Department of Energy, Washington, D.C. May 1997.

Financial Statistics of Major U.S. Publicly-Owned Electric Utilities - 1994. U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1995. DOE/EIA-0437/(94)/2.

Financial Statistics of Major U.S. Investor-Owned Electric Utilities - 1995. U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0437/(95)/1.

Inventory of Power Plants in the United States, As of January 1, 1996. U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0095(95).

The Changing Structure of the Electric Power Industry: An Update. U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0562(96).

The Changing Structure of the Electric Power Industry, 1970-1991. U.S. Department of Energy, Energy Information Administration, Washington, D.C. March 1993. DOE/EIA-0562.

Process Descriptions and Chemical Use Profiles

Clean Power From Fossil Fuels. Energy and the Environment, the Linacre Lectures 1991-1992. Chester, Peter. Bryan Cartledge, ed. Oxford University Press, Oxford. 1993.

Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. 1982. EPA 440/1-82/029.

EIA Guidelines for New Source Fossil Fueled Steam Electric Generating Stations. U.S. Environmental Protection Agency, Office of Federal Activities by SAIC, Falls Church. VA, 1994.

Electric Power Annual 1995. Energy Information Administration. U.S. DOE Office of Coal, Nuclear, Electric and Alternate Fuels, Washington, D.C. 1996.

Energy, Electric Power and Man. Healy, Timothy J. Boyd & Fraser Co. San Francisco, CA. 1974.

Standard Handbook of Power Plant Engineering. Elliot, Thomas C., ed. McGraw-Hill, Inc., New York, NY. 1989.

Steam and its Generation and Use, 40th edition. Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992.

Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Interim Final Report, Volume 1. U.S. Environmental Protection Agency, Office of Air Quality Planning & Standards, Research Triangle Park, N.C. 1996. EPA-453/R-96-013a.

Wastes from the Combustion of Coal by Electric Utility Power Plants. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Remediation, Washington, D.C. 1988. EPA 530-SW-88-002.

Regulatory Profile

Development Document For Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. November, 1982.

EIA Guidelines for New Source Fossil Fueled Steam Electric Generating Stations. U.S. Environmental Protection Agency, Office of Federal Activities by SAIC, Falls Church, VA, 1994.

Electricity Generation and Environmental Externalities: Case Studies. U.S. Department of Energy, Assistant Secretary for Fossil Energy, Washington, D.C.. September 1995. DOE/FE-0598

Standard Handbook of Power Plant Engineering. Elliot, Thomas C., ed. McGraw-Hill, Inc., New York, NY. 1989.

Steam and its Generation and Use, 40th edition. Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992.

Pollution Prevention

Case Summaries of Waste Reduction by Industries in the Southeast. Gary Hunt, *et al.*, eds. North Carolina Department of Natural Resources and Community Development. July 1989.

Clean Coal Technology Demonstration Program, Program Update 1995. U.S. Department of Energy, Assistant Secretary for Fossil Energy, Washington, D.C. April 1996. DOE/FE-0346.

Coal Combustion Product Production and Use: 1966-1994, Report for Coal Burning Electric Utilities in the United States. American Coal Ash Association, Inc. Alexandria, VA. May 1996.

EnviroSense, Fact Sheet: Pollution Prevention: Strategies for Fossil Fuel Electric Power Generation. Center for Hazardous Material Research (CHMR). Pittsburg, PA. Online, Available: http://es.inel.gov.com. Last updated January 9, 1996.

EnviroSense, Cogeneration of Steam and Electric Power: Pollution Prevention Opportunities and Options, Report 49-1, September 1994, Prepared by: Commonwealth of Virginia Department of Environmental, Quality Office of Pollution Prevention. Richmond, VA. Online, Available: http://es.inel.gov.com, Last updated January 29, 1996.

EnviroSen$e, Pollution Prevention Opportunities in Fossil Fuel Electric Power Generation. October 1990. Online, Available: http://es.inel.gov.techinfo/facts/epa/fosilful.html.

Fact Sheet: Eliminating Hexavalent Chromium from Cooling Towers. City of Los Angeles, Board of Public Works, Hazardous and Toxic Materials Office. Undated.

Fact Sheet: Water and Chemicals Reduction for Cooling Towers. North Carolina Department of Environmental Health and Natural Resources, Pollution Prevention Program. May 1987.

Industrial Pollution Prevention Handbook. Harry M. Freeman, ed. McGraw-Hill Inc. 1995.

Pollution Prevention/Environmental Impact Reduction Checklist for Coal-Fired Power Plants. U.S. Environmental Protection Agency, Office of Federal Activities, Washington, D.C. Undated. Online, Available: http://es.enel.gov./oeca/ofa/pollprev/coal.html.

Preamble to NPDES Storm Water Multi-sector General Permit for Industrial Activities (60 FR 50974, Friday, September 29, 1995).

Summary of Results from Programs Conducted by the Office Of Industrial Technologies. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Office of Industrial Technologies, Washington, D.C. October 1995.

U.S. Electric Utility Demand-Side Management 1994. Energy Information Administration. Office of Coal, Nuclear, Electric and Alternate Fuels. U.S. Department of Energy. Washington, D.C. December 1995. DOE/EIA-0589(94).

ENDNOTES

1. *Inventory of Power Plants in the United States, As of January 1, 1996.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0095(95).

2. *1995 Capacity and Generation of Non-Utility Sources of Energy.* Prepared by the Edison Electric Institute, Washington, D.C. November 1996.

3. *Electric Power Annual 1995, Volume II.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0384(95)/2.

4. *Inventory of Power Plants in the United States, As of January 1, 1996.* U.S. Department of Energy, Energy Information administration, Washington, D.C. December 1996. DOE/EIA-0095(95).

5. *1995 Capacity and Generation of Nonutility Sources of Energy.* Edison Electric Institute, Washington, D.C. November 1996.

6. *1995 Capacity and Generation of Nonutility Sources of Energy.* Edison Electric Institute, Washington, D.C. November 1996.

7. *1995 Capacity and Generation of Nonutility Sources of Energy.* Edison Electric Institute, Washington, D.C. November 1996.

8. *Electric Power Annual 1995, Volume II.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0384(95)/2.

9. *The Changing Structure of the Electric Power Industry: An Update.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0562(96).

10. *The Changing Structure of the Electric Power Industry: An Update.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0562(96).

11. *Annual Energy Outlook 1997 - With Projections to 2015.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0383(97).

12. *Annual Energy Outlook 1997 - With Projections to 2015.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0383(97).

13. *Electric Power Annual 1995, Volume I.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. July 1996. DOE/EIA-0348(95)/1.

14. *Energy, Electric Power and Man.* Healy, Timothy. J. Boyd & Fraser Co., San Francisco, CA. 1974.

15. *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. Ed. McGraw-Hill, Inc. New York, NY. 1989.

16. *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. Ed. McGraw-Hill, Inc. New York, NY. 1989.

17. *Standard Handbook of Power Plant Engineering*. Elliot, Thomas C. Ed. McGraw-Hill, Inc. New York, NY. 1989.

18. *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996. DOE/EIA-0348(95)/1&2.

19. *Energy, Electric Power and Man*. Healy, Timothy. J. Boyd & Fraser Co., San Francisco, CA. 1974, and *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996.

20. *Energy, Electric Power and Man*. Healy, Timothy. J. Boyd & Fraser Co., San Francisco, CA. 1974, and *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996.

21. *Clean Power From Fossil Fuels*. Chester, Peter, and Bryan Carteledge, eds. Linacre Lectures 1991-1992. Oxford University Press, Oxford, 1974. DOE/EIA-0348(95)/1&2.

22. *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996. DOE/EIA-0348(95)/1&2.

23. *Steam, Its Generation and Use, 40th Edition.* Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992.

24. *Steam, Its Generation and Use, 40th Edition.* Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992.

25. *Standard Handbook of Power Plant Engineering.* Elliot, Thomas C. Ed. McGraw-Hill, Inc. New York, NY. 1989.

26. *Steam, Its Generation and Use, 40th Edition.* Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992.

27. *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996. DOE/EIA-0348(95)/1&2.

28. *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996. DOE/EIA-0348(95)/1&2.

29. *Electric Power Annual 1995, Volumes I and II.* U.S. Department of Energy, Energy Information Administration. Washington, D.C. July and December 1996. DOE/EIA-0348(95)/1&2.

30. *Steam, Its Generation and Use, 40th Edition.* Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992.

31. *Steam, Its Generation and Use, 40th Edition.* Stultz and Kitto, eds. Babcock & Wilcox, Barbeton, OH. 1992

32. *Power Statistics Database* (1994 Data). Edison Electric Institute. Prepared by the Utility Data Institute, McGraw-Hill, Inc. Washington, D.C. 1995.

33. Personal communication with Joe Daly, EPA Office of Science and Technology, Engineering and Analysis Division. March 14, 1997.

34. *Electric Power Annual 1995, Volume II.* U.S. Department of Energy, Energy Information Administration, Washington, D.C. December 1996. DOE/EIA-0384(95)/2.

35. *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units -- Interim Final Report.* U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, NC. October 1996. EPA-453/R-96-013a.

36. *EnviroSense, Cogeneration of Steam and Electric Power: Pollution Prevention Opportunities and Options, Report 49-1.* Commonwealth of Virginia, Department of Environmental Quality Office of Pollution and Prevention. September 1994. Online, Available: http://es.enel.gov.com. Last updated January 29, 1996.

37. *Case Summaries of Waste Reduction by Industries in the Southeast.* Gary M. Hunt et. al., eds. North Carolina Department of Natural Resources and Community Development. July 1989.

38. *Summary of Results from Programs Conducted by the Office Of Industrial Technologies.* U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Office of Industrial Technologies. October 1995.

39. *Federal Technology Alert.* U.S. Department of Energy, Washington, D.C. May 1997.

40. *Federal Technology Alert.* U.S. Department of Energy, Washington, D.C. May 1997.

41. *IndustrialPollution Prevention Handbook.* Freeman, Harry M. Ed. McGraw Hill Inc. 1995.

42. *Pollution Prevention/Environmental Impact Reduction Checklist for Coal-Fired Power Plants.* U.S. Environmental Protection Agency, Office of Federal Activities. Undated. Online, Available: pollprev/coal.html.

43. Personal Communication. Leonard Swann, Specialty Products Inc. Distributor for Armex Accustrip systems. March 7, 1997.

44. *Industrial Pollution Prevention Handbook.* Freeman, Harry M. Ed. McGraw Hill Inc. 1995.

45. "Boiler Chemical Cleaning Waste Can Make Money." *Electric Co-op Today.* May 2, 1997.

46. *Coal Combustion Product Production and Use: 1966-1994, Report for Coal Burning Electric Utilities in the United States.* American Coal Ash Association, Inc. Alexandria, VA. May 1996.

47. *U.S. Electric Utility Demand-Side Management 1994.* Office of Coal, Nuclear, Electric and Alternate Fuels. U.S. Department of Energy, Energy Information Administration. Washington, D.C. December 1995. DOE/EIA-0589(94).

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.epa.gov/comply/sector/index.html

or use

www.epa.gov/oeca - then select the button labeled Industry and Gov't Sectors and select the appropriate sector from the menu. The Notebook will be listed.

Direct technical questions to the Feedback function at the bottom of the web page or to Shhonn Taylor at (202) 564-2502

[This page intentionally left blank.]

EPA
United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States Environmental Protection Agency

Enforcement And Compliance Assurance (2223A)

EPA 310-R-97-002
September 1997

EPA

Profile Of The Ground Transportation Industry—Trucking, Railroad And Pipeline

SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 18 1997

THE ADMINISTRATOR

Message from the Administrator

Since EPA's founding over 25 years ago, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and those as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper and smarter. As a result, we no longer have rivers catching fire. Our skies are clearer. American environmental technology and expertise are in demand around the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

The Environmental Protection Agency has undertaken its Sector Notebook Project to compile, for major industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with an extensive series covering other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to understand better their regulatory requirements, and learn more about how others in their industry have achieved regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that we together achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-97-002

EPA Office of Compliance Sector Notebook Project:

Profile of the Ground Transportation Industry Trucking, Railroad, and Pipeline

September 1997

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-049394-3

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

hazardous waste. Nevertheless, RCRA issues at trucking facilities include several non-transportation activities.

Some fluids used in truck maintenance are considered hazardous waste, requiring specific storage treatment, and disposal. Waste accumulated or generated during trucking maintenance may cause facilities to be considered small or large quantity generators depending on the volume waste. The primary RCRA issues for maintenance facilities are used oil, lead-acid motor vehicle batteries, vehicle maintenance fluids, and scrap tire disposal.

EPCRA

Most trucking companies do not store listed chemicals for use in their facilities. The only exception is diesel fuel or gasoline, which when stored at facilities in quantities slightly over 10,000 pounds,* requires reporting to Local Emergency Response Commissions (LERCs) and State Emergency Response Commissions (SERCs). Chemicals in transition are exempt from inventory reporting under EPCRA. This includes all hazardous materials shipments in packages or bulk quantities.

* The previous version incorrectly stated the quantity in gallons.

OPA

OPA imposes contingency planning and readiness requirements on certain facilities defined to include rolling stock and motor vehicles. These requirements may affect some trucking establishments.

VII.B.3. Pipelines

Almost all of the petroleum feed stock and products used in the U.S. are, at some point, transported through a Federally-regulated pipeline. The Office of Pipeline Safety (OPS), part of the DOT's Research and Special Programs Administration, regulate essentially all of the approximately 155,000 miles of hazardous liquid pipelines in the U.S., as well as the approximately 255,000 miles of gas transmission lines.

RCRA

Natural gas pipelines do not generate significant quantities of listed hazardous waste. Typical pipeline wastes include condensate, cleaning solvents, and used oil. Each gas pipeline compressor station typically produces an average of 20,000 gallons of used oil each year. This figure depends on the amount of maintenance performed on engines, how often the engines are running, and how much oil is drained from the engines. Under RCRA, used oil is not necessarily a hazardous waste and most gas pipeline companies sell it to refiners.

May 1999 | ERRATA SHEET | EPA/ 310-R-97-002ES

Document Title: Profile Of The Ground Transportation Industry – Trucking, Railroad And Pipeline

EPA 310-R-97-002
September 1997

Correction on page 84 under EPCRA :

Note that the unit of measure in which a trucking facility is required to report to Local Emergency Response Commissions (LERCs) and State Emergency Response Commissions (SERCs) when storing diesel fuel or gasoline is 10,000 pounds. This was incorrectly expressed in gallons in the previous version.

The corrected page appears on the reverse side of this sheet.

R0075263

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, and local governments, and the media from EPA's National Center for Environmental Publications and Information at (800) 490-9198. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, EPA.

Sector Notebooks Contacts

The Sector Notebooks were developed by the EPA Office of Compliance. Questions relating to the Sector Notebook Project can be directed to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Jane Engert	564-5021
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Robert Lischinsky	564-2628
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Manmade Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Fossil Fuel Electric Power Generation. Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	Sector Notebook Data Refresh. 1979	Seth Heminway	564-7017

R0075265

GROUND TRANSPORTATION INDUSTRY
(SIC 40, 42, 46, AND 49)
TABLE OF CONTENTS

List of Exhibits

List of Acronyms

AAR -	Association of American Railroads
AFS -	AIRS Facility Subsystem (CAA database)
AGA -	American Gas Association
AIRS -	Aerometric Information Retrieval System (CAA database)
ATA -	American Trucking Associations
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
LERCs -	Local Emergency Response Commissions
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NAICS -	North American Industrial Classification System
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigations Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide

R0075270

NOV -	Notice of Violation
NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)
NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
RPI -	Railway Progress Institute
RSPA -	Research and Special Programs Administration
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SPCC -	Spill Prevention Control and Countermeasure
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSDF -	Treatment, Storage and Disposal Facility
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

TRANSPORTATION INDUSTRY (SIC 40, 42, 46, AND 49)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Integrated environmental policies based upon comprehensive analysis of air, water and land pollution are a logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was originally initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded to its current form. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process who enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2223-A), 401 M St., SW, Washington, DC 20460. Comments can also be uploaded to the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing this system. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not already covered, please contact the Office of Compliance at 202-564-2395.

II. Introduction to the Ground Transportation Industry

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the ground transportation industry. Facilities described within this document are described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

This notebook pertains to the transportation industry as classified by the Office of Management and Budget (OMB) under Standard Industrial Classification (SIC) codes 40 (Rail Transportation); 42 (Trucking); and 46, 4922-4924 (Pipelines). Where possible, data are specific to sub-divisions of these SIC codes. In many cases, information about the industries (i.e., rail, trucking, and pipeline) does not directly correlate to SIC distinctions. This is due to various factors, including different reporting requirements and classifications within each industry that are not consistent with SIC delineations. This limitation is discussed throughout the notebook, as appropriate. OMB is in the process of changing the SIC code system to a system based on similar production processes called the North American Industrial Classification System (NAICS). In the NAICS system, Rail Transportation is classified as NAIC 482, Trucking is NAIC 484 and 492, and Pipelines are NAIC 486.

The transportation industry includes other modes of transport such as water and air. Although these are not addressed in this document, they make up an important portion of overall transportation activity in the United States.

The transportation industry affects nearly every American. Either through the necessity of traveling from one place to another, shipping goods and services around the country, or working in a transportation-related job. transportation's share of the national economy is significant. According to the Eno Transportation Foundation, for all transportation-related industries, total transportation expenditures in the U.S. accounted for 16.1 percent of the gross national product in 1993.

II.B. Industry Sectors Analyzed

II.B.1. Rail Transportation

The rail transportation industry includes establishments furnishing transportation by line-haul railroad, and switching and terminal establishments. These terms refer to the distance the particular railroad operation covers — line-haul operations cover longer distances, often connecting two cities, while switching and terminal railroads generally travel through a single city. For the purpose of this notebook, rail transportation does not include passenger railways serving a single municipality, contiguous municipalities, or a municipality and its suburban areas; these economic units are classified in SIC 41. Other services related to railroad transportation are classified in SIC 47; lessors of railroad property are classified in SIC 6517. The rail SIC sectors covered in this notebook are shown in the following table.

SIC 40 - RAILROAD TRANSPORTATION	
4011	Railroads, Line-Haul Operations
4013	Railroad Switching and Terminal Establishments

II.B.2. Trucking

The trucking industry includes establishments engaged in motor freight transportation and warehousing. This includes local and long-distance trucking or transfer services, and establishments engaged in the storage of farm products, furniture, and other household goods, or commercial goods of any kind. For the purpose of this notebook, the trucking industry also includes the operation of terminal facilities for handling freight, both those with and without maintenance facilities. The trucking SIC sectors covered in this notebook are shown in the following table.

SIC 42 - MOTOR FREIGHT TRANSPORTATION & WAREHOUSING	
4212	Local Trucking Without Storage
4213	Trucking, Except Local
4214	Local Trucking With Storage
4215	Courier Services, Except by Air
4221	Farm Product Warehousing & Storage
4222	Refrigerated Warehousing & Storage
4225	General Warehousing & Storage
4226	Special Warehousing & Storage, NEC*
4231	Terminal & Joint Terminal Maintenance Facilities for Motor Freight Transportation

* NEC = Not Elsewhere Classified

R0075275

II.B.3. Pipelines

The pipeline industry includes establishments primarily engaged in the pipeline transportation of petroleum and other commodities. Pipelines are classified within two SIC categories, Major Group 46 (Pipelines, except Natural Gas) and Major Group 49 (Electric, Gas, and Sanitary Services). This notebook will integrate the relevant operations from the two groups whenever possible. Occasionally, due to surveys that focus only on one of the groupings, data is segregated. The pipeline SIC sectors covered in this notebook are shown in the following table.

SIC 46 - PIPELINES, EXCEPT NATURAL GAS	
4612	Crude Petroleum Pipelines
4613	Refined Petroleum Pipelines
4619	Pipelines, NEC*
SIC 49 - ELECTRIC, GAS, AND SANITARY SERVICES	
4922	Natural Gas Transmission
4923	Natural Gas Transmission and Distribution
4924	Natural Gas Distribution
4925	Mixed, Manufactured, or Liquefied Petroleum Gas Production and/or Distribution

* NEC = Not Elsewhere Classified

Page 6 intentionally left blank.

III. RAIL TRANSPORTATION

III.A. Characterization of the Rail Transportation Industry

III.A.1. Industry Characterization

On February 28, 1827, the State of Maryland chartered the Baltimore & Ohio (B&O) Railroad, inaugurating America's first common-carrier railroad. The B&O marked the beginning of the nation's rail system. By 1850, rail trackage extended over 9,000 miles, mostly in the Northeast. Mirroring the movement of people to the American West, the first transcontinental rail link opened in 1869. By 1916, railroad tracks stretched across 254,000 miles. During the mid-twentieth century, railroads suffered from strict regulation and increased competition from trucks, buses, barges, and planes. By the late 1970s, nearly a quarter of the nation's rail mileage was operated in bankruptcy.

Railroads began to recover economically in 1980 with the passage of the Staggers Rail Act. This legislation partially deregulated the shipment rates charged by railroads, but continued to allow the Interstate Commerce Commission (ICC) to protect shippers from market abuse. The economic balance struck by the Staggers Act renewed the rail industry: by 1990, the rates charged to ship goods by rail had fallen 28.8 percent (adjusted for inflation). Ton-miles of freight moved by rail (reflecting the number of tons hauled and the miles traveled) per employee more than doubled from 1980 levels.

By 1993, the biggest railroads moved a record 1.1 trillion ton-miles of freight with 57 percent fewer employees, 30 percent fewer miles of track, 36 percent fewer locomotives, and 48 percent fewer freight cars than in 1980 (*Association of American Railroads Information Handbook*, 1994).

From an environmental standpoint, it is important to recognize that other industries have grown up around the rail industry. For example, railroads do not generally clean rail tank cars. This is usually performed by service companies on a fee-for-service basis. In addition, rail cars and tank cars are often owned and loaded by the shipper at its facility. Some of the operations described in this section are performed by these types of entities.

III.A.2. Industry Size and Geographic Distribution

Industry Size

Variations in facility counts occur across data sources due to many factors, including reporting and definition differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

The Interstate Commerce Commission (ICC) was the Federal agency that regulated many economic aspects of the rail industry. The ICC was abolished by an act of Congress in December 1995, with remaining essential functions transferred to a newly created Surface Transportation Board (STB) within the Department of Transportation. ICC statistics reported prior to the ICC's abolishment are referenced in this document. The ICC classified railroads based on their level of operating revenue. The levels are adjusted annually to reflect inflation. For 1994, the revenue threshold for Class I railroads was $255.9 million or more; Class II railroads had revenues of between $20.5 million and $255.8 million; and Class III railroads had revenues of less than $20.5 million. Since 1979, the ICC required reporting on financial and operating information from Class I railroads only. Class I railroad systems make up approximately two percent of the number of American railroads, but account for 73 percent of the mileage operated, 89 percent of the employees, and 90 percent of freight revenue in the industry. To fill the gap in information left by the ICC's decreased reporting requirements, the Association of American Railroads (AAR) annually surveys non-Class I railroads.

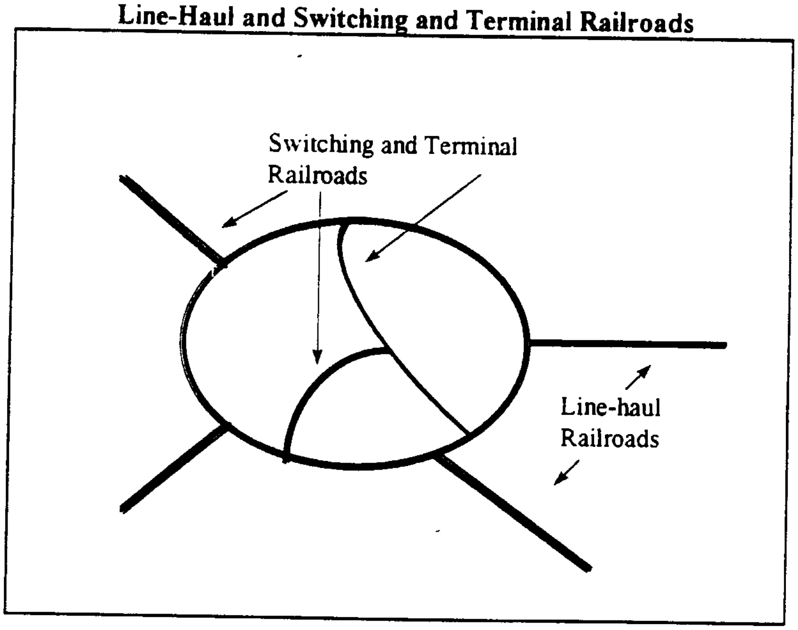
The AAR defines non-Class I railroads as being either regional or local (in contrast to the ICC definitions, which were based strictly on revenue). In 1994, regional railroads were defined as line-haul railroads operating at least 350 miles of road and/or earning revenue between $40 million and $255.9 million. Local railroads included those line-haul operations not meeting the regional criteria, plus switching and terminal railroads. Exhibit 1 summarizes the operating information for Class I, regional, and local railroads. Exhibit 2 depicts the relationship between line-haul railroads and switching and terminal railroads.

Exhibit 1
Facility Size Distribution of Rail Industry

Railroad	Number	Miles Operated	Year-End Employees	Freight Revenue
Class I	12	123335	189,240	$29,930,893
Regional	32	19842	10,701	$1,744,893
Local	487	25599	13,070	$1,422,285
Total	531	168776	213,011	$33,098,071

Source: Compiled from Railroad Facts (Association of American Railroads, 1995).

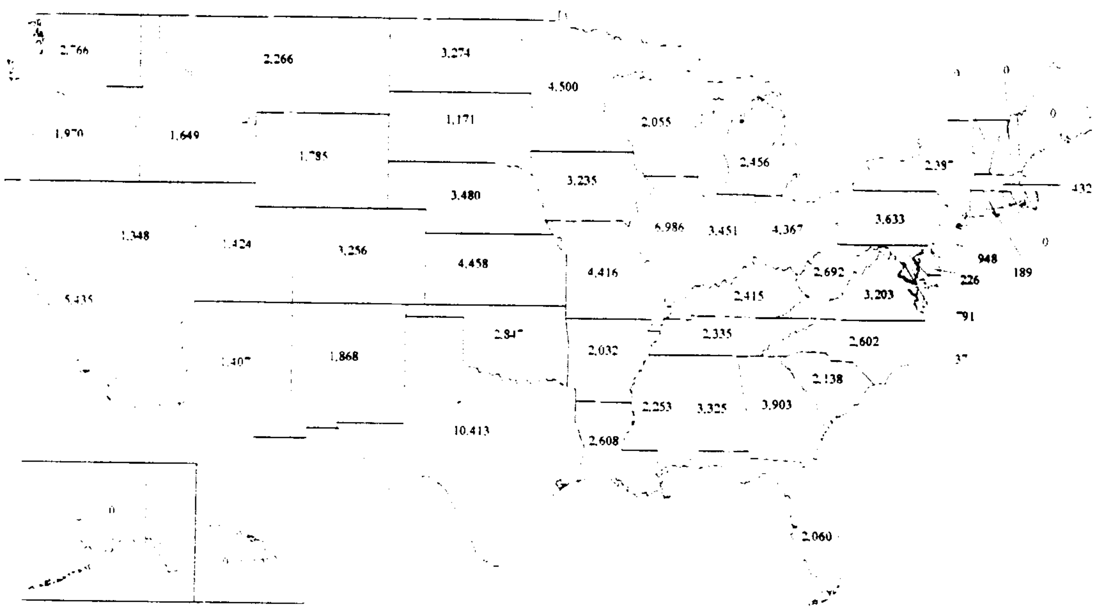
Exhibit 2
Line-Haul and Switching and Terminal Railroads



Geographic Distribution

Reflecting the national importance of railroad transportation, the rail industry is widely dispersed, and the rail system passes through every State in the country. Due to the nature of its operations, however, the rail industry is not characterized on a State-by-State basis, but rather by dividing the country into two halves, separated by the Mississippi River. Freight train-miles measure the movement of a train the distance of one mile, and are based on the distance between terminals and/or stations. Of the 440,896,000 total freight-train miles in the U.S. in 1994, 281,347,000 (64 percent) are West of the Mississippi and 159,549,000 (36 percent) are East of the Mississippi. Exhibit 3 illustrates the miles of track associated with major rail routes in the United States.

Exhibit 3
Geographic Distribution of Railroads in the United States: Mileage of Class I Railroads*



III.A.3. Economic Trends

The rail industry began to recover from a period of nearly 25 years of steady economic decline in 1980, with the passage of the Staggers Act. This legislation allowed railroad managers to restructure internal operations and meet competitive pressures. The Staggers Act authorized railroads to offer contract rate volume discounts for guaranteed shipments. The railroad is assured minimum volumes, which assists in capital budgeting and operations planning.

The railroad industry rebounded from the effects of widespread flooding in 1993 to post improved financial and operational results in 1994. Class I railroad traffic in 1994 increased 8.2 percent from 1993 to 1.201 trillion revenue ton-miles, reflecting increases in tons originated and longer average hauls. American railroads accounted for 39.2 percent of total inter-city revenue freight ton-miles.

Operating revenue rose 6.9 percent in 1994 to $30.8 billion, while operating expenses rose at a less rapid rate of 4.1 percent to $25.5 billion. Net railway operating income (defined as operating revenue minus the sum of operating expenses, current and deferred taxes, and rents for equipment and joint facilities) was $3.4 billion, an increase of 34.7 percent over 1993 figures.

Traditionally, the largest segment of railroad freight has been coal. In 1994, coal accounted for 39.1 percent of total tonnage and 21.7 percent of freight revenue. Other major rail commodities in 1994 included chemicals and allied products, motor vehicles and equipment, food and kindred products, and farm products. Exhibit 4 summarizes the tons originated and revenue associated with the shipment of commodities by Class I railroads in 1994.

Exhibit 4
Tons Originated and Revenue by Commodity — 1994*

	TONS ORIGINATED		REVENUE	
Commodity Group	Tons (thousands)	Percent of Total	$(millions)	Percent of Total
Coal	574,213	39.1	7,021	21.7
Chemicals & Allied Products	142,931	9.7	4,559	14.1
Farm Products	130,992	8.9	2,407	7.4
Non-metallic Minerals	106,404	7.2	862	2.7
Food & Kindred Products	87,710	6	2,427	7.5
Lumber & Wood Products	54,192	3.7	1,421	4.4
Primary Metal Products	47,799	3.3	1,165	3.6
Stone, Clay & Glass Products	42,257	2.9	1,009	3.1
Petroleum & Coke	41,564	2.8	928	2.9
Metallic Ores	40,367	2.7	378	1.2
Pulp, Paper & Allied Products	36,583	2.5	1,510	4.7
Waste & Scrap Materials	36,527	2.5	655	2
Motor Vehicles & Equipment	27,792	1.9	3,174	9.8
All Other Commodities	100,666	6.8	4,909	15.1
TOTAL	1,469,997	100	32,424	100

**Information is for Class I railroads only.*
Source: Railroad Facts (Association of American Railroads, 1995).

The 1990's saw an increase in the efficiency of railroads, the transport of different materials such as waste and scrap materials, and a shift from boxcar to the faster intermodal container transport. Intermodal is a term used to describe containerization of freight for easy transloading to different modes of transportation. For example, the same container may be transferred from a truck to a train, with both modes of transportation equipped with locks or other mechanisms to hold the container in place. In rail transport, there is a growing use of truck containers and trailers.

III.B. Operations in the Rail Transportation Industry

This section provides an overview of commonly employed operations in the railroad industry. This discussion is not exhaustive; the operations discussed are intended to represent the major sources of environmental hazards from railroad transportation practices. These operations are grouped into three categories: rail car refurbishing and maintenance; locomotive maintenance; and transportation operations. Rail car refurbishing and maintenance operations consist of cleaning the interiors and exteriors of the rail cars, striping and painting the rail cars, and maintaining/repairing rail car parts. Locomotive maintenance operations include the cleaning, repair, and maintenance of the engine and locomotive car. Transportation operations include all activities associated with the movement of locomotives and cars over a section of track, including the loading and unloading of freight.

III.B.1. Rail Car Refurbishing and Maintenance

Rail car refurbishing and maintenance consists of cleaning the interiors and exteriors of rail cars, refurbishing operations (i.e., striping and painting rail cars), and other maintenance operations (i.e., brake and wheel set repair).

The initial cleaning of rail cars involves two steps: a mechanical cleaning and a water wash. Mechanical cleaning is the physical shaking and vibrating of the rail cars to loosen dirt and other debris. Typically, dirt and debris fall through a steel grate in the floor of the maintenance facility and are intermittently collected for disposal. The wash step usually consists of a high pressure water cleaning, collection of wastewater, and wastewater treatment at an on-site treatment facility.

Refurbishing operations are not employed at all rail facilities. Many railroad establishments contract out refurbishing work. Refurbishing operations usually start with paint removal using a steel grit blast system or other method. Paint chips and grit are collected through a steel grate in the floor and the mixture is conveyed to a cyclone and filter system for separation of reusable grit and paint. Once the original paint has been removed from the rail cars, new paint is applied to the clean rail car surface.

Rail cars have brakes and wheel sets that must be maintained and sometimes repaired or replaced. Brake and wheel set maintenance and repair operations consist of disassembly, cleaning, and repair; or disassembly and replacement of damaged parts. When wheel sets and air brakes are to be replaced or rebuilt, the cars must first be disassembled. Axles that can be reused are washed in a caustic solution to remove grease and dirt. External debris is removed from the air brakes or wheels using a grit or bead blast system or other method. Parts cleaning may also include the removal of paint and cleaning with solvents or caustics. Repaired brakes or wheel set may require repainting with spray guns.

III.B.2. Locomotive Maintenance

Locomotive maintenance includes, but is not limited to, the following operations: brake repair; large scale equipment cleaning operations (e.g., locomotive car); small scale cleaning operations (e.g., engine parts); hydraulic system repair, locomotive coolant disposal, metal machining, oil filter replacement and used oil management, painting and metal finishing, paint stripping, and spent battery management.

Locomotive maintenance operations usually take place at facility that is owned and maintained by the railroad. Most used oil is recycled or reused in energy recovery. Most locomotive batteries are recycled.

III.B.3. Transportation

Transportation operations include all activities associated with the movement of locomotives and cars over a section of track. These activities include fueling and hazardous material transport.

III.C. Raw Material Inputs and Pollution Outputs

III.C.1. Rail Car Refurbishing and Maintenance

Pollutant outputs from rail car refurbishing and maintenance are generally in the form of wastewater from preliminary cleaning of interiors and exteriors, and hazardous wastes generated from painting, paint removal, and the cleaning of parts. Exhibit 5 shows typical hazardous wastes generated including: spent solvents and solvent sludges; spent caustics and caustic sludges; paint chips; and paint sludges. Volatile organic compound (VOC) air emissions are also generated during the use of solvents and paints. Wastewater from preliminary cleaning of the rail cars and spent caustic solution is often treated in an on-site wastewater treatment system and then discharged to a publicly owned treatment works (POTW). Hazardous wastes are typically drummed and shipped off site as RCRA hazardous waste. Spent solvents, however, can be sent off site for reclamation. Brake and wheel set repair is not a significant environmental hazard, but discarded brake shoes may be regulated under the Resource Conservation and Recovery Act (RCRA) in some States.

Exhibit 5
Rail Car Refurbishing and Maintenance Process Material Input/Pollutant Output

Process	Material Input	Waste
Oil and Grease Removal	Degreasers, engine cleaners, aerosol, solvents, acids/alkalies	Ignitable wastes, spent solvents, combustible solids, waste acid/alkaline solutions, used oil
Car and Equipment Cleaning	Degreasers, solvents, acids/alkalies, cleaning fluids	Ignitable wastes, spent solvents, combustible solids, waste acid/alkaline solutions, rags
Rust Removal	Strong acids, strong alkalies	Waste acids, waste alkalies
Paint Preparation	Paint thinners, enamel reducers, white spirits	Spent solvents, ignitable wastes, ignitable paint wastes, paint wastes with heavy metals, rags
Painting	Enamels, lacquers, epoxies, alkyds, acrylics, primers	Ignitable paint wastes, spent solvents, paint wastes with heavy metals, ignitable wastes, rags
Spray Booth, Spray Guns, and Brush Cleaning	Paint thinners, enamel reducers, solvents, white spirits	Ignitable paint wastes, heavy metal paint wastes, spent solvents
Paint Removal	Solvents, paint thinners, enamel reducers, white spirits	Ignitable paint wastes, heavy metal paint wastes, spent solvents, rags

Source: U.S. EPA Office of Solid Waste, 1993.

III.C.2. Locomotive Maintenance

Each of the locomotive maintenance operations listed above is a potential source of pollution outputs. Following are brief discussions of the wastes that can be generated by these locomotive maintenance operations.

Brake Repair

Brake repair does not pose a significant environmental hazard, but discarded brake shoes may be regulated under RCRA in some States. Some older brake shoes contain asbestos and may require special disposal.

Cleaning Operations

Sludges created as a result of cleaning operations may be characterized as hazardous. If so, hazardous waste regulations must be complied with prior to disposal. Waste waters from locomotive cleaning can contain elevated levels of oil, grease, suspended solids (a measure of particulate matter in water) and pH (acidity or alkalinity of water). These substances are regulated water pollutants, so wash waters must be processed in a way that is consistent with Clean Water Act (CWA) requirements. In most cases, the State has authority for enforcement of CWA provisions and permit administration. Treatment of wash waters may be required before release to a local sewer system or an outfall regulated by a National Pollutant Discharge Elimination

System (NPDES) permit. The type of cleaning solution used may also pose an environmental concern. If mineral sprits or other chemicals are used to clean equipment, a variety of environmental compliance issues may result. Mineral sprits are hazardous substances that have environmental compliance requirements for storage, handling, and disposal.

Hydraulic System Repair

Used hydraulic fluids are listed as used oils under RCRA. The major compliance issues associated with hydraulic system repair involve handling and disposing of the hydraulic fluid, spill containment, and storage. Environmental damage can occur from waste oil seepage into the soil, waste oil run-off into water bodies during storms, and other contamination methods.

Coolant Disposal

Locomotive cooling systems do not contain automotive type ethylene glycol-based antifreeze. Because of this, locomotive cooling systems may need to be drained when engines are shut down during road operation in cold weather. Failure to do so can result in serious engine damage due to freezing of the coolant. To protect the cooling system from corrosion, locomotive coolants contain a dilute additive package, which is basically a mixture of sodium borate and sodium nitrate. The additive package usually contains a dye, to help identify leaks and ensure the cooling system is protected. The compounds are diluted in the cooling system to approximately one to three percent. The concentrations of the individual corrosion inhibitors is a fraction of one percent. Used coolant must be disposed of properly.

Metal Machining

Metal machining and punching can generate regulated wastes that may contaminate the environment from direct release into water or from stormwater runoff. Pollutant-carrying stormwater runoff may violate the CWA. Coolants from metal multi-punch operations may be regulated substances under RCRA or local waste regulations and may require special handling.

Oil Filter Replacement and Used Oil Disposal

A variety of environmental issues need to be considered when performing any oil handling activities such as oil changes or oil filter replacement to locomotives. Oil can drip or spill during maintenance and repair operations, particularly during oil filter replacement operations. Oil releases to the environment from oil drippage can also occur during locomotive tie-up. Oil filter and used oil replacement are generally conducted indoors at locomotive maintenance facilities and locomotive idling is conducted, to the extent practical, over track pans, absorbent materials, or other collection devices. This makes it possible for most facilities to collect used oil and oil filters before they leak or spill oil into the environment. Some facilities have routed track pan drains to oil-water separation systems. Used oils are not typically categorized as hazardous wastes under RCRA, but used oils have strict disposal requirements in some States.

Painting

Painting operations can be significant sources of environmental harm. Air pollution from the evaporation of chemicals contained in the paint (e.g., solvents) can contribute to smog and worker health and safety problems. Solid and hazardous wastes from the painting process (e.g., paint-covered cloths) may contaminate water and soil if not disposed of properly. Whether hazardous wastes are generated during painting depends upon the type of paint applied. Typically, latex paints and related paint wastes are classified as non-hazardous. Ignitable or solvent-based paint or paint thinner wastes are classified as hazardous. Air pollution issues are typical concerns only for large-scale painting operations involving paint booths and associated air ducting.

Battery Storage and Disposal

Used battery storage and disposal can be a significant environmental liability for railroads since many spent signal batteries are classified as hazardous wastes under RCRA. Most locomotive batteries are lead acid and recycled as non-hazardous solid waste.

III.C.3. Transportation Operations

The three main transportation operations that pose potential environmental problems are fueling, hazardous material transport, and oil and coolant releases during transport.

Fueling Operations

Air pollution and fuel spillage are the major environmental concerns associated with fueling operations. While air emissions are a problem for volatile petroleum products such as gasoline, the railroad industry uses very little gasoline on site. Their largest fuel product is diesel fuel, which is less volatile. If gasoline is dispensed on site, it could contribute to local air quality problems, and may require permitting and control. Spilled fuel may contaminate soil, ground water, or water bodies. Some super tanker fueling systems deliver fuel at approximately four gallons per second, so even a small connection malfunction can result in a large spill event. Filling and maintenance of fuel storage may require air quality permitting in some States.

Hazardous Materials

The spilling/leaking of hazardous materials is a significant environmental concern for the rail industry. According to DOT statistics, approximately 16 percent of all hazardous material releases to the environment in 1988 were from rail transport. In addition to being harmful to the environment, hazardous material spills and releases are subject to a variety of environmental regulations and may result in costly cleanups or fines.

Valve leakage or safety valve releases can be sources of material spills on pressurized and general service tank cars or other hazardous material containers such as covered hoppers, intermodal trailers/containers, or portable tanks. These leaks can manifest themselves as odors or vapors clouds from tanker top valves; spraying or splashing from the tanker top valves; wetness on the side of the car; or drippage from the bottom outlet valve. In intermodal cars, spills/leaks can result from improper packing and resultant load shifting during transport. Intermodal container doors and other openings can be spill/release sources. Unloading and transfer facilities are high potential spill and release areas. It should be noted that it is the responsibility of the shipper to properly secure the transportation vehicles to prevent these types of occurrences. In the latest effort to identify the source of these leaks, in 1995 the Association of American Railroads (AAR) introduced the non-accident release (NAR) program. The purpose was to identify and report these releases so that corrective measures could be taken to reduce them.

If hazardous materials are transported, DOT requirements regulate car inspections, car placement, switching, and shipping papers (e.g., waybills, manifests). If hazardous materials pass through a facility, rail containers should be inspected for proper labeling, valve cover placement, any signs of leakage, proper car stenciling, and fulfillment of other DOT requirements. Placarding and/or labeling is required for all containers carrying hazardous materials.

Oil and Coolant Releases

Oil and coolant releases from the locomotive engine to the environment can occur during transport operations. Oils can contaminate surface water, ground water, and soil, and expose the rail facility to punitive fines from violations of a variety of environmental statutes. Coolants may be regulated substances under RCRA or local waste regulations.

Page 18 intentionally left blank.

IV. TRUCKING

IV.A. Characterization of the Trucking Industry

IV.A.1. Industry Characterization

Construction of the nation's first transcontinental highway, the Lincoln Highway (U.S. 30), started in 1912. It took 20 years to complete the 3385-mile road between New York City and San Francisco. In 1956, the Federal Aid Highway Act was signed into law, authorizing the 41,000-mile National System of interstate and defense highways to be completed by 1972 at a cost of $42 billion. In 1982, landmark legislation boosted Federal spending for highway construction and repair work. By 1986, more than 97 percent of the 42,500-mile interstate highway system was open to traffic as the program entered its 30th year. The system represented a total Federal and State investment of more than $120 billion. Currently, there are 44,700 miles of interstate highways with 132,000 miles of other arteries in the United States.

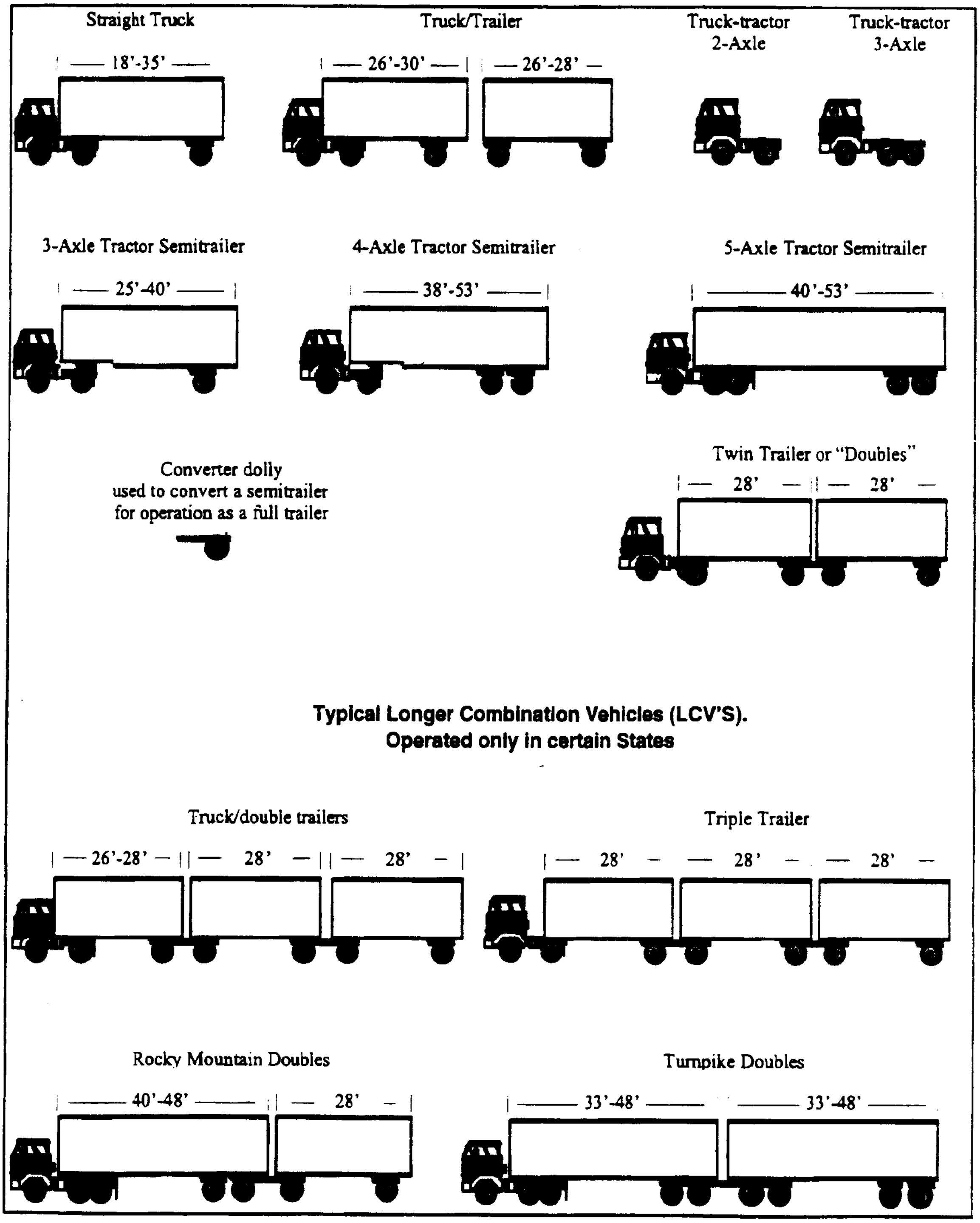
The types of trucks that travel these roads are diverse, ranging from small pickup trucks to large tractor trailer combination units. Methods of quantifying these vehicles vary as well. This section presents information from a variety of sources, including the Census Bureau and trucking associations. Different groups use various benchmarks to quantify the trucking industry. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

According to the American Trucking Associations (ATA), the total number of commercial trucks in 1993 was 16.2 million, with approximately 3.9 million commercial trailers registered in the same period. The ATA reports 322,739 interstate motor carriers on file with the U.S. Department of Transportation (DOT) as of January 5, 1995. Eighty-two percent of those operate fewer than six trucks, and 96 percent operate 28 or fewer trucks. 59,310 for-hire carriers were authorized by the Interstate Commerce Commission (ICC), to haul goods.

Types of trucks and trucking establishments are defined by various classifications. Exhibit 6 shows the shape and size of different truck types. This diagram does not include smaller trucks such as pickups, panels, vans, and utility trucks which are usually not counted in industry statistics because they are often used for personnel purposes.

In general, trucking establishments falls into two broad categories: private and for-hire. Private carriers are shippers, manufacturers, merchants, and others who use their own vehicles or leased trucks under their direct control for moving their own goods. For-hire carriers are compensated for providing transportation of freight belonging to another entity.

Exhibit 6
Truck Types



There are three types of interstate for -hire carriers: common, contract, and exempt carriers. Common carriers transport freight for the general public at published rates. Contract carriers are those in stipulated types of operations, such as trucks used only to carry newspapers, or vehicles used incidentally to support air transport. (*Motor Trucking Engineering Handbook*, James W. Fitch, Society of Automotive Engineers, 1994).

For-hire carriers regulated by the ICC were classified by size of operating revenue. The ICC was abolished by an act of Congress in December 1995, with remaining essential functions transferred to a newly created Surface Transportation Board (STB) within the Department of Transportation. ICC statistics reported prior to the ICC's abolishment are referenced in this document. As of January 1, 1994, the ICC defined Class I carriers as those establishments with annual revenues greater than $10 million, Class II carriers with annual revenues between $3 and $10 million, and Class III carriers with annual revenues of less than $3 million.

IV.A.2. Industry Size and Geographic Distribution

As discussed in Section IV.A.1 above, variation in facility counts occur across data sources due to many factors, including reporting and definition differences. This document does not attempt to reconcile these differences.

Industry Size

Trucking companies are diverse, ranging from large employers to private transporters who work for themselves and have no additional employees. A concise discussion of the trucking industry is complicated by the different methods used by the Census Bureau, the ICC, and trucking associations to estimate the size of the trucking industry. In some cases, as with most census data, only those companies with payrolls – those that pay drivers who were not also owners – are tracked. In addition, only those trucking companies formerly regulated by the ICC were required to report data.

The trucking industry consists of approximately 111,000 establishments with payrolls, employing nearly 1.6 million people. This does not include small, independent truckers who have no employees other than themselves. The total number of truck drivers holding commercial drivers licenses as of June 1995 exceeded 6.5 million. In 1993, these drivers drove 656.6 billion miles (American Trucking Trends, 1995). According to the American Trucking Associations (ATA), 7.8 million people were employed throughout the economy in jobs that relate to trucking activity and 2.8 million heavy-duty truck drivers (including linehaul, local, courier, government, etc.) were employed in 1994. In 1993, $226.9 billion was paid in wages relating to trucking activity.

Over 88 percent of trucking companies are small businesses, as defined by the Small Business Administration. According to the ATA, of the 359,787 interstate motor carriers on file with the Office of Motor Carriers, 82 percent operate six or few trucks, while 96 percent operate 28 or fewer trucks (as of February 1996).

Exhibit 7 illustrates the facility size distribution for those motor freight transportation and warehousing facilities with payrolls, based on the latest complete Census Bureau data (1992).

Exhibit 7
Facility Size Distribution of Trucking Industry*

Industry	SIC Code	Total Employees	Total Number of Facilities	Employees per Facility
Local Trucking Without Storage	4212	354,742	49,870	7.11
Trucking, Except Local	4213	758,435	40,821	18.6
Local Trucking with Storage	4214	64,417	4,512	14.3
Courier Services, Except by Air	4215	307,061	5,966	51.5
Farm Product Warehousing and Storage	4221	6,497	584	11.1
Refrigerated Warehousing and Storage	4222	18,963	929	20.4
General Warehousing and Storage	4225	49,091	6,753	7.3
Special Warehousing and Storage, NEC*	4226	20,594	1,452	14.2
Terminal and Joint Terminal Maintenance Facilities for Motor Freight Transportation	4231	295	21	14.1
Total		1,580,095	110,908	14.2

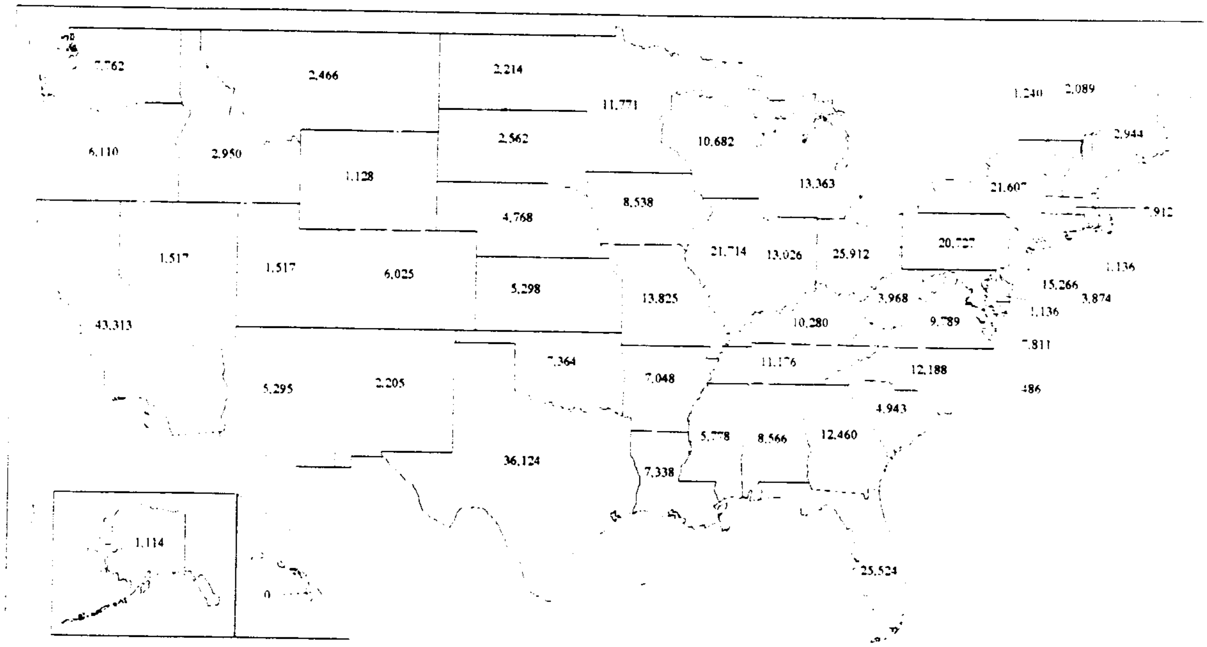
Source: Compiled from official 1992 statistics of the U.S. Bureau of the Census.
**Facilities with payrolls only.*

As demonstrated in Exhibit 7, the majority of establishments and employees in the trucking industry which maintain payrolls are classified in SIC Code 4212, Local Trucking Without Storage. This category includes dump trucking, general freight, and garbage and trash collection. Trucking, except local (SIC 4313), accounts for most of the other establishments and persons employed in the trucking industry. General freight trucking accounts for most trucking industry facilities.

Geographic Distribution

Reflecting the national importance of highway transit, the trucking industry is widely dispersed, with every State reporting the existence of at least 400 industry establishments (U.S. Bureau of the Census). The numbers in Exhibit 8 include both businesses with and without payrolls. All businesses covered by the economic censuses are included, except direct sales retail and tax exempt service businesses.

Exhibit 8
Geographic Distribution of Trucking Industry Facilities



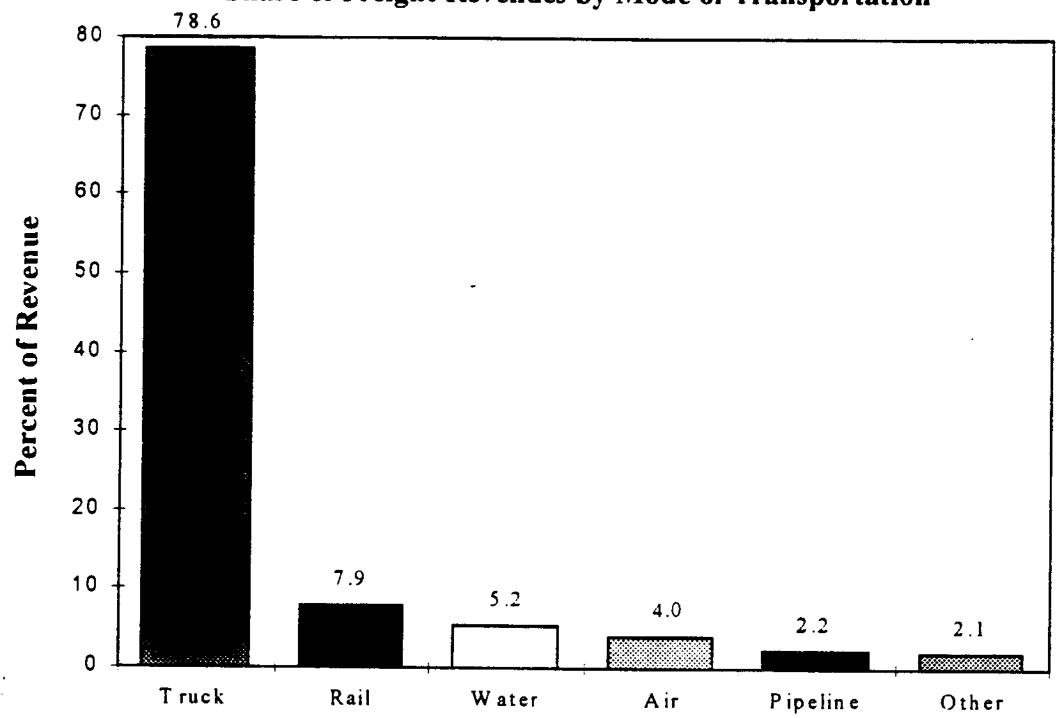
Source: Compiled from official 1992 statistics of the U.S. Bureau of the Census.

Although the trucking industry is highly represented throughout the country, motor freight facilities are most heavily concentrated around the Great Lakes States (Minnesota, Wisconsin, Illinois, Indiana, Michigan, and Ohio). Reflecting the important trade routes between these States and the Northeast, this concentrated area extends through Pennsylvania and New York. The five largest States in terms of number of trucking establishments with payrolls are California, Texas, Ohio, Florida, and New York.

R0075294

Exhibit 8 illustrates the number of trucking establishments as recorded by the Bureau of the Census. These numbers do not correlate to those presented in Exhibit 9, also from the Bureau of the Census, due to the different scope of the census data.

Exhibit 9
Share of Freight Revenues by Mode of Transportation



Source: American Trucking Trends, 1995

IV.A.3. Economic Trends

In terms of revenue, trucking accounts for the vast majority of total U.S. freight services. Exhibit 8 illustrates the trucking industry's enormous share of total freight revenue. This reflects trucking's higher revenues-per-ton and per-ton mile (a ton-mile equals the movement of one ton of weight over a one mile distance), compared to the rail and barge sectors, which generally carry lower-valued bulk commodities. Thus, the trucking industry's share of tons shipped (43 percent) and ton-miles (27 percent) is much lower than its share of revenues (U.S. Industrial Outlook 1994 – Transportation).

The growing use of rail transport and rail transport of truck containers and trailers has offered economic competition to motor freight companies. According to the ATA, by the year 2003, trucking will lose 1.9 percent of its share of total 1993 revenue – primarily to air and rail intermodal – but trucks will still account for 76.7 percent of freight transportation revenue.

Reportedly, the estimated profit margin of the companies and independent truckers averages one to two percent.

The following economic information is from the Census Bureau's *1993 Motor Freight Transportation and Warehousing Survey Report*. As with the census data conveyed in Exhibit 7, this survey excludes private motor carriers that operate as auxiliary establishments to non-transportation companies, as well as independent owner-operators with no paid employees. As a result, the dollar volume estimates and estimates of year-to-year percentage change presented in this report should not be interpreted as representing measurements of total trucking industry activity.

Revenue in 1993 for the for-hire trucking and courier services industry (excluding air courier services) was estimated at $135.9 billion, up six percent from 1992. Long-distance trucking, which accounted for approximately 75 percent of all motor carrier revenue, was up 5.6 percent over 1992. Local trucking revenue rose 9.6 percent from 1992 to approximately $31.6 billion in 1993. Truckload shipments accounted for approximately 61 percent of motor carrier revenue in 1993 and increased 6.8 percent from 1992.

Nearly 48 percent of motor carrier revenue comes from transporting manufactured products, such as furniture, hardware, glass products, textiles and apparel, and the delivery of small packages. Revenue in 1993 from the transport of metal products rose 8.8 percent from 1992. Expenses totaled $127.9 billion in 1993, up 5.8 percent from 1992. Revenue for the courier services industry, excluding air courier services (SIC 4215), rose 7.7 percent in 1992 to approximately $20.2 billion in 1993. The Truck Inventory and Use Summary (TIUS), part of the Census Bureau's Census of Transportation, provides data on the physical and operational characteristics of the U.S. truck population. According to TIUS, an increasing proportion of trucks are being used mainly for "personal transportation," i.e., commuting to work, outdoor recreation, etc. In 1992, almost 70 percent of all trucks were identified as being for personal use; in 1987 the proportion was 66 percent, and in 1982 only 57 percent.

Annual payroll accounted for approximately 33 percent of all trucking expenses, totaling $41.5 million for 1993. Purchased transportation rose 7.6 percent from 1992, while the cost of fuels and maintenance and repair expenses rose 6.7 percent and 7.0 percent, respectively.

Public Warehouse Services

Total operating revenue for public warehousing services increased 8.6 percent from 1992 to $8.1 billion. Total operating expenses rose 8.4 percent from 1992 to $6.8 billion. Employer contributions to employee benefit plans were up to 7.2 percent and represented almost eight percent of the warehousing industry's total operating expenses.

Over 50 percent of all revenue was from general warehousing and storage (SIC 4225). Revenue from refrigerated warehousing and storage (SIC 4222) increased 3.3 percent to $1.7 billion, and accounted for 21 percent of the warehousing industry's total operating revenue in 1993.

Revenue in 1993 for farm product warehousing and storage (SIC 4221), which represents approximately eight percent of the warehousing industry's total operating revenue, increased 9.2 percent to $686 million from 1992, while expenses for the industry were up 7.8 percent to $593 million over the same period.

IV.B. Operations in the Trucking Industry

This section provides an overview of commonly-employed processes within the trucking industry, broken down by operations. This discussion is not exhaustive; the operations discussed here are intended to represent the major sources of environmental hazards from trucking operations. The operations discussed include materials transport, truck maintenance, truck washing, tank truck cleaning, and transport operations.

IV.B.1. Truck Terminals and Maintenance Facilities

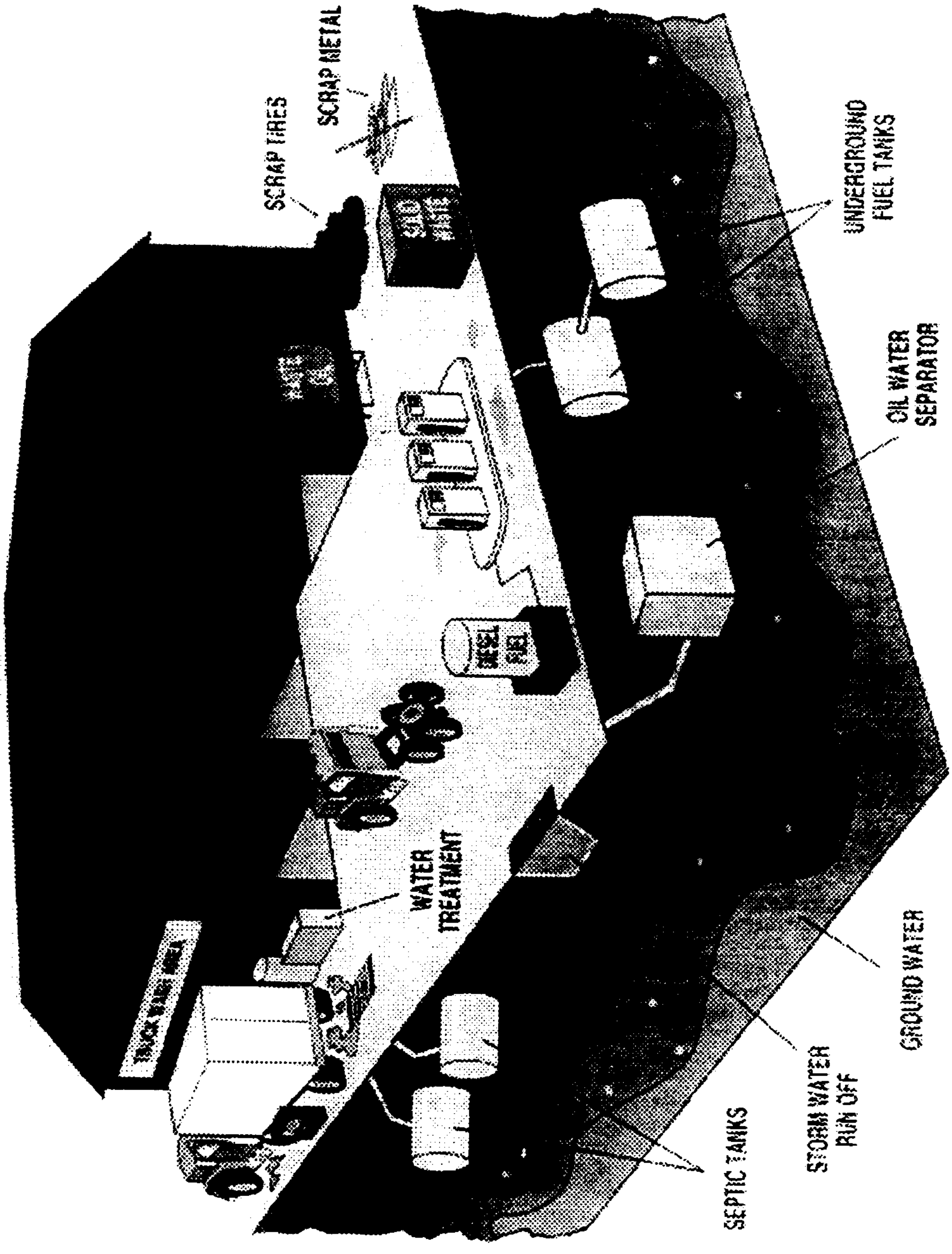
Many segments of the trucking industry operate their own truck terminals and maintenance facilities. Truck terminals are places where trucks come to consolidate and transfer loads of shipped goods. Terminals typically have large parking and staging areas for tractors and trailers, and a loading dock, from which freight is moved between trailers. Truck maintenance facilities, which may be located on the same property as the maintenance facilities, which may be located on the same property as the terminals, perform routine vehicle maintenance activities which are similar to those performed in the automotive service industry. These activities include replacement of fluids (e.g., motor oil, radiator coolant, transmission fluid, brake fluid), replacement of non-repairable equipment (e.g., brake shoes/pads, shocks, batteries, belts, mufflers, electrical components, water pumps),and repair of fixable equipment (e.g., brake calipers/rotors/drums, alternators, fuel pumps, carburetors). Some maintenance terminals also have fueling facilities, repair vehicle bodies, wash trucks, and perform painting operations.

Truck maintenance involves the regular changing of a number of fluids. Automotive fluids used to maintain trucks include brake fluid, transmission fluid, gear oil, radiator fluid, and motor oil. Truck parts removed for repair often require cleaning to allow for better visual inspection of the parts and to remove contaminated lubricants/greases that would lead to early failure of the repaired part. Rags are often used to clean up a fluid spill or to wipe grease from a part being repaired. If necessary, clean lubricants/greases are applied to the parts during reassembly.

Parts cleaning often involves the use of a parts washer. Washers used in the trucking industry include solvent parts washers, hot tanks, and jet spray washers. A solvent parts washer recirculates solvent continuously from the solvent drum to the solvent wash tray where the parts are cleaned. Old solvent is typically replaced with fresh solvent on a monthly basis. The solvents used for parts cleaning contain petroleum-based ingredients or mineral spirits. Carburetor cleaner contains methylene chloride. Electrically heated tanks are also used to clean parts. Parts are placed in a tank of hot aqueous detergent or caustic solution to achieve cleaning and air or mechanical agitation is employed to increase cleaning efficiency. Jet spray washers also use hot aqueous solutions for cleaning, but in this application, rotating jets spray the parts with cleaner. Both hot tanks and jet sprays are usually serviced monthly by removing the spent cleaner and sludge and recharging the washer with fresh detergent. Sludge that accumulates in the waste sump of the pressure spray cleaning bays and in area wash-down clarifiers is often taken off site to a local municipal landfill.

Truck maintenance facilities may also perform fueling operations. Fueling facilities typically dispense diesel fuel. Exhibit 10 shows the layout of a typical truck maintenance facility.

Exhibit 10
Typical Trucking Maintenance Facility



Source: Stormwater Pollution Prevention Manual for the Trucking Industry ATA, 1993

R0075299

IV.B.2. Truck Washing

Trucks can be washed manually or by using a fixed wash bay system. Dry washing, by using dry rags and a spray bottle, can be an option for manual truck washing. Manual washing includes hand-held wash systems, hand-held wand systems, and hand brushing with soap. Fixed bay washing operations involve fixed equipment, such as drive-through wash racks or gantry wash systems. Typically, wash bay systems include chemical storage facilities. chemical and water application arches, water reclamation systems, and waste water treatment systems.

IV.B.3. Tank Truck Cleaning

Tank trucks typically haul a wide range of liquid and dry bulk commodities. including food-grade products such as milk and corn syrup, and industrial process chemicals. Many aspects of transportation and labeling, as well as spills and releases of these materials, are regulated by the Research Special Programs Administration (RSPA) of the DOT. Because the material being transported is loaded directly into a tank truck without any sort of container. these trucks require special cleaning to remove residual cargo. Washing, rinsing, and drying methods vary depending on the facility's equipment, the last cargo carried, and the next cargo to be carried. Some cargoes may require only a water rinse, while others may need a series of wash and rinse cycles using different wash solutions.

Prior to tank cleaning, residual cargo, or heel, is removed. Heel volume from tank trucks is typically five to ten gallons (EPA Office of Water and *Preliminary Data Summary for the Transportation Equipment Cleaning Industry*, U.S. EPA, 1989, and EPA Office of Water, Engineering Analysis Division, 1995). Heel can be sent to an off-site Treatment Storage and Disposal Facility (TSDF) or can be treated on site if it is an aqueous solution. If organic, it may be put into containers for later treatment as a hazardous waste.

Tank truck washing is performed either manually with hand-held sprayers, or automatically with high pressure spinner nozzles or "butterworths." With automatic washing, high pressure spinner nozzles are inserted through the main tank hatch, and wash solution and rinse water is automatically sprayed onto the tank surface at 100-600 p.s.i. while rotating around vertical and horizontal axes.

Washing solution may consist of detergent solution, caustic solution, organic solvents, or steam. Any wash solution can be used with either the manual or automatic washing method, although worker safety is a concern when manually spraying solvent and caustic wash solutions. Some facilities have the capability to recycle washing solutions within a closed system, and periodically change to fresh water solutions. Tanks can be rinsed with hot or cold water, and dried with passive or forced air.

IV.B.4. Transport Operations

Transport operations refer to all operations performed by a truck while on the road. These operations include loading and unloading cargo, running the truck engine, and fuel consumption. Commercial trucking transportation operations consumed approximately 36 billion gallons of oil in 1993, or about 63 percent of total U.S. consumption. This figure, according to the ATA, includes 23 billion gallons of diesel fuel and 13 billion gallons of gasoline.

IV.C. Raw Material Inputs and Pollution Outputs

IV.C.1. Truck Terminals and Maintenance

Materials Spills and Releases

In truck terminals, spills and releases of hazardous material shipments are the main environmental issue of concern. Hazardous waste transportation is a highly regulated and specialized segment of the trucking industry, covered by extensive EPA (40 CFR) and DOT (49 CFR) regulations while the waste is in transit. Due to the additional insurance and safety requirements, the majority of general freight trucking companies do not have the authority nor desire to transport hazardous waste.

Truck Maintenance

Maintenance facilities handle vehicle fluids that are used during normal trucking operations, including oil, transmission fluid, brake fluid, and antifreeze. The quantities of waste materials vary depending on the size of the facility and the types of maintenance activities that are performed.

Oil, transmission fluid, and other liquids that are replaced, must be collected and stored for later disposal. The storage, disposal, and transportation of used oil is regulated by EPA and is a primary environmental concern in the trucking industry. Generators of used oil must meet on-site management standards for storage prior to shipment off-site or burning on-site for energy recovery. Storage containers must be in good condition without leaks and clearly labeled with the words "USED OIL." If a release occurs (spill or leak), the generator must stop and contain the release, clean up and properly manage the released used oil, and repair or replace any leaking containers.

Fluids such as antifreeze must be evaluated for hazardous waste characteristics and dealt with accordingly if spilled or released. Antifreeze consists of water and ethylene glycol. Neither of these ingredients demonstrates hazardous waste characteristics, however, as a result of use, the antifreeze may become hazardous based on metals or benzene content.

Sludge that accumulates in the maintenance facility floor drains can contain oil, grease, solvents, and dirt from routine operations. The hazardous/non-hazardous nature of the sludge will determine the applicable disposal regulations.

Truck Repair

Repair activities typically produce several types of waste materials in addition to the parts themselves (i.e., batteries, brake parts, etc.), including oil, coolants, and solvents. Oil rags can be considered a "used oil" waste. Shop rags which are used to wipe up a hazardous waste (i.e., paint thinner) may be a hazardous waste.

Spent lead-acid batteries are exempt from regulation as a hazardous waste provided they are recycled. Generators of spent lead-acid batteries may store and/or transport those batteries without waste activity notifications or permits as long as the batteries are ultimately reclaimed. In some States, a new battery cannot be purchased without the return of a used battery.

Used tires are a significant waste produced at truck maintenance facilities. Old tires are not acceptable for landfill disposal unless they have been shredded or quartered. Tires can be returned to a central location for processing or recycling. Used truck tires are usually retreaded or recycled. Used tires otherwise ready to be scrapped might be categorized as hazardous waste.

Parts Washing

Parts washing solvents and residual liquids such as petroleum distillates, mineral spirits, and naphtha are all considered hazardous wastes due to ignitability. Filters removed from parts whose units may also be hazardous due to toxicity (presence of metals and/or benzene) and ignitability. Even filters which are not hazardous may still not be acceptable for landfill disposal due to hydrocarbon content.

Air emissions occur when the solvent is sprayed onto parts and when parts are improperly drained of solvent. Many air quality control districts specify that equipment cannot be designed so as to provide a fine spray mist (which leads to high evaporation rates) and that parts must be properly drained before removal from the washer. For washers in which the solvent bath is always exposed to the atmosphere (i.e., wash tanks), the lid must be kept closed whenever the tank is not in use.

Fueling Operations

Fueling operations may result in fuel spills or releases. Waste diesel fuel may be a hazardous waste because its flash point ranges from 120°F to 160°F and because it may contain concentrations of heavy metals and benzene in excess of regulatory limits. Diesel fuel spills and releases – both underground and above ground – are a significant concern in the trucking industry in terms of stormwater run-off and land contamination.

IV.C.2. Truck Washing

The waste streams generated by vehicle washing operations are variable. If vehicles are washed often, they enter the washing operation relatively clean, and the waste wash water generated is cleaner thana waste stream generated from washing vehicles that are washed only occasionally. The technology used to wash the vehicle will also affect the waste stream. For example, if a two-step acid-detergent wash is used, acid or salts will be found in the waste stream that would not be present if the vehicle was steam cleaned. Season and location can also affect the waste stream generated, for example, vehicles in the northeast often bring in heavy mud and road salt in the winter months.

Vehicle washing is a regulated maintenance activity under the NPDES program. Wastewater from vehicle washing and floor drain discharge is considered industrial waste. The hazardous or nonhazardous nature of the wastewater determines the applicable disposal regulations.

IV.C.3. Tank Cleaning

The primary pollutant output from tank cleaning operations is wastewater contaminated with tank residues and cleaning solutions. Specific outputs include: spent cleaning fluids, fugitive volatile organic compound (VOC) emissions, water treatment system sludges, and tank residues. The quantities of these outputs vary widely from facility to facility depending on the type of cargo and cleaning methods. For example, an independent owner/operator tank truck cleaning facility serving a large number of different users will generate wastewater containing many ore contaminants than a shipper operated facility serving trucks all carrying the same cargo.

Tank heels from a shipment of hazardous waste greater than 0.3 percent of weight of the tank capacity continue to be regulated by RCRA after the discharge of the waste at a TSDF. Under current regulation, the use of solvents to further rinse out tanks is not considered treatment; however, certain State RCRA programs regulate these processes more stringently and should be contacted to determine if a treatment permit is required.

IV.C.4. Transport Operations

Transport operations have the potential to generate three types of waste: the release or spill of a hazardous waste during loading and unloading operations; the spill or release of vehicle fluids such as oil or antifreeze during travel; and, most significant, the emissions generated during fuel combustion. As discussed above, engines, especially those of heavy duty trucks, generate several forms of air pollution. Among common substances released to the air from truck engines are hydrocarbons, carbon monoxide, oxides of nitrogen, sulfur compounds, and particulate matter. A description of each of these pollutants follows, while more information about EPA regulations governing emissions is provided in Section VII.

Hydrocarbons: Although hydrocarbon emissions are not problematic when they leave the vehicle, some hydrocarbons react in the atmosphere to promote the formation of photochemical smog. Ozone concentration is generally used to measure the extent of this photochemical reaction. Hydrocarbon emission standards have been set to meet the National Ambient Air Quality Standard (NAAQS) for ozone.

Exhibit 11
Hydrocarbons Emission Sources

Hydrocarbons Emissions Source	Percentage of Total Emissions
Stationary Fuel Combustion	3.1%
Industrial Processes	13.3%
Passenger Cars - Gasoline Engine	17.8%
Light-Duty Trucks - Gasoline Engine	6.4%
Heavy-Duty Vehicles - Gasoline Engine	0.8%
Diesel Engine Vehicles	1.8%
Other	56.8%

Source: ATA

Carbon Monoxide: Carbon monoxide (CO) is a byproduct of incomplete fuel combustion. The chemical is a colorless, tasteless, odorless gas that displaces oxygen in the body. At high concentration in confined areas, CO can be injurious to health. EPA has set a NAAQS and a vehicle emission standard for CO.

Exhibit 12
Carbon Monoxide Emission Sources

Carbon Monoxide Emissions Source	Percentage of Total Emissions
Stationary Fuel Combustion	7.1%
Industrial Processes	5.7%
Passenger Cars - Gasoline Engine	44.0%
Light-Duty Trucks - Gasoline Engine	14.5%
Heavy-Duty Vehicles - Gasoline Engine	2.9%
Diesel Engine Vehicles	1.9%
Other	23.8%

Source: ATA

Nitrogen Oxides: Emissions of nitrogen oxides (NO_X) are a significant contributor to the creation of nitrogen dioxide, and are ingredients in the formation of smog, although they play an ambiguous role in the process; at times No_x appear to promote smog, while at other times they seem to inhibit smog in urban areas.

Exhibit 13
Nitrogen Oxides Emission Sources

Nitrogen Oxides Emissions Source	Percentage of Total Emissions
Stationary Fuel Combustion	50.6%
Industrial Processes	3.8%
Passenger Cars - Gasoline Engine	15.2%
Light-Duty Trucks - Gasoline Engine	4.9%
Heavy-Duty Vehicles - Gasoline Engine	0.8%
Diesel Engine Vehicles	11.4%
Other	13.2%

Source: ATA

Sulfur Compounds: Sulfur compounds are oxides that aggravate the respiratory system and may cause respiratory disease. Very dense smog is generally attributed to the buildup of SO and particulates during periods of little air movement. Motor vehicles of all types, including passenger cars, contribute only 4.2 percent of ambient sulfur compounds.

Particulates: Particulates are particles of solid material that are products of incomplete combustion, such as soot and fly ash. Small particles may remain suspended in the air for long periods of time, while larger particles return to the ground as dust. Suspended particles cause reduced visibility and increased health hazards from other contaminants by providing a surface to carry chemicals into human lungs.

Exhibit 14 summarizes the pollution outputs from those operations in the trucking industry discussed in this document.

Exhibit 14
Process Material Input/Pollutant Output from Trucking Operations

Activity	Material Input	Air Emissions	Process Wastes
Truck Terminals and Maintenance Facilities	Motor oil, brake fluid, transmission fluid, coolants, solvents, parts cleaning solutions, lubricants, truck cargo	Possible CFC and VOC emissions	Used oil, used automotive fluids, solvents, coolants, used rags, used cleaning solutions, spilled or released truck cargo
Vehicle Exterior Washing	Detergent, caustic solution, organic solvents, steam	VOC emissions	Oil and grease, suspended solids, detergents, pH, metals
Tank Cleaning	Residuals from shipments, cleaning fluids – detergent, caustic solution, organic solvents, steam	VOC emissions	Spent cleaning fluids, water treatment system sludges, tank residues
Transport Operations	Gas and diesel fuels, alternative fuels, motor oil, brake fluid, transmission fluid, coolant, truck cargo	Hydrocarbons, carbon monoxide, oxides of nitrogen, sulfur compounds, particulates	Used oil, used automotive fluids, spilled or released truck cargo

Page 36 intentionally left blank.

V. PIPELINES

V.A. Characterization of Pipelines

V.A.1. Industry Characterization

The history of oil and gas pipelines as they are used today begins with the first commercial oil well, drilled in 1859. The first oil pipeline – 109 miles long, with a diameter of six inches – was laid from Bradford to Allentown, Pennsylvania, in 1879. Since the late 1920s, virtually all oil and gas pipelines have been welded steel, a departure from the early versions made from wrought iron. Although the first cross-country pipeline was laid in 1930, connecting Chicago, Minneapolis, and other cities, it was not until World War II, with frequent disruptions in coastal tanker traffic, that large-scale pipelines were laid connecting different regions of the country. In the 1960s, larger-diameter pipelines proved their economic advantage when a line consisting of 32, 34, and 36 inch diameters was built from Houston to New York, and a 40-inch pipeline was constructed connecting Louisiana to Illinois. Discovery of oil on Alaska's North Slope precipitated the construction of the country's largest pipeline, the 48-inch diameter Trans-Alaskan Pipeline, or Alyeska (*Oil and Gas Pipeline Fundamentals*, Kennedy, 1994).

By 1994, U.S. interstate pipeline mileage totaled nearly 410,000 miles, of which over 250,000 miles transported gas and over 158,000 shipped liquid oil and petroleum. Natural gas is delivered to U.S. consumers through a network of 1.2 million miles of buried pipe and 429 underground storage reservoirs that are linked to more than 1,200 local gas distribution companies.

Throughout this section, distinctions are made between gas and oil pipelines. Although the fundamental design and purpose of these two systems are similar, there are differences in their conveyance systems. Distinctions are also made for product pipelines and breakout tanks which are defined below.

Oil Pipelines

Crude oil must undergo refining before it can be used as product. Once oil is pumped from the ground, it travels through pipes to a tank battery. One or more tank batteries may be installed in a single field, each serving a number of individual wells. A typical tank battery contains a separator to separate oil, gas, and water; a fired heater to break water/oil emulsions to promote removal of water from the oil; and tanks for storing the oil until it is shipped as crude oil by truck or, more commonly, by a gathering line connected to storage tanks. From these tanks, the oil is moved through large diameter, long-distance trunk lines to refineries or to other storage terminals.

R0075308

Trunk lines rely on pumps to initiate and maintain pipeline pressure at the level required to overcome friction, changes in elevation, or other pressure-decreasing factors. Pumps are required at the beginning of the line and are spaced along the pipeline to adequately propel the oil along.

Gas Pipelines

The purpose of gas-gathering and gas transmission pipelines is similar to that of crude-gathering and crude trunk lines, but operating conditions and equipment are quite different. Gas pipelines operate at higher pressures than do crude lines, and use compressors instead of pumps to force the gas along. Unlike oil, gas does not undergo refining, and transmission lines connect directly to utility companies that distribute the gas to consumers via small, metered pipelines. Gas is often treated in scrubbers or filters to ensure it is "dry" prior to distribution.

Gas-well flowlines connect individual gas wells to field gas-treating and processing facilities or to branches of a larger gathering system. The gas is processed at the treating facility to remove water, sulfur, acid gases, hydrogen sulfide, or carbon dioxide. Most field gas processing plants also remove hydrocarbon liquids from the produced as stream. From field processing facilities, the dried, cleaned natural gas enters the gas transmission pipeline system, analogous to the oil trunk line system.

Products Pipelines

Once oil is refined, product pipelines transport it to storage and distribution terminals. Refined oil products include automotive gasoline, diesel, home heating oils, ammonia, and other liquids. Other products pipelines transport liquefied petroleum gases (LPG) and natural gas liquids (NGL) from processing plants, where oil and gas are produced, to refineries and petrochemical plants.

Breakout Tanks

Breakout tanks are above ground tanks used to relieve surges in a hazardous liquid pipeline systems or to receive and store hazardous liquid transported by a pipeline for reinjection and continued transportation by the pipeline.

V.A.2. Industry Size and Geographic Distribution

Variation in facility counts occur across data sources due to many factors, including reporting and definition differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source. The Bureau of the Census segregates economic data depending on whether an establishment maintains a payroll. In the transportation industry, many owners/operators are independent businesses with no employees, while others, including companies involved with pipelines, hire contracted employees who are reported under other entities' payrolls. The following data is available only for establishments with payrolls.

Industry Size

According to the Census Bureau, the pipeline industry consists of approximately 4,900 establishments and employs nearly 170,000 people. Exhibit 15 illustrates the facility size distribution for the industry based on 1992 U.S. Census Bureau data.

Exhibit 15
Facility Size Distribution of Pipeline Industry*

Industry	SIC Code	Total Employees	Total Number of Facilities	Employees per Facility
Crude Petroleum Pipelines	4612	10,355	405	25.6
Refined Petroleum Pipelines	4613	5,578	358	15.6
Pipelines, NEC**	4619	846	81	10.4
Natural Gas Transmission	4922	12,928	515	25.1
Natural Gas Transmission and Distribution	4923	69,311	1,648	42.1
Natural Gas Distribution	4924	65,239	1,734	37.6
Mixed, Manufactured, or Liquefied Petroleum Gas Production and/or Distribution	4925	445	71	6.3
Gas and Other Services Combined	4932	4,459	124	36.0
Total		169,161	4936	34.3

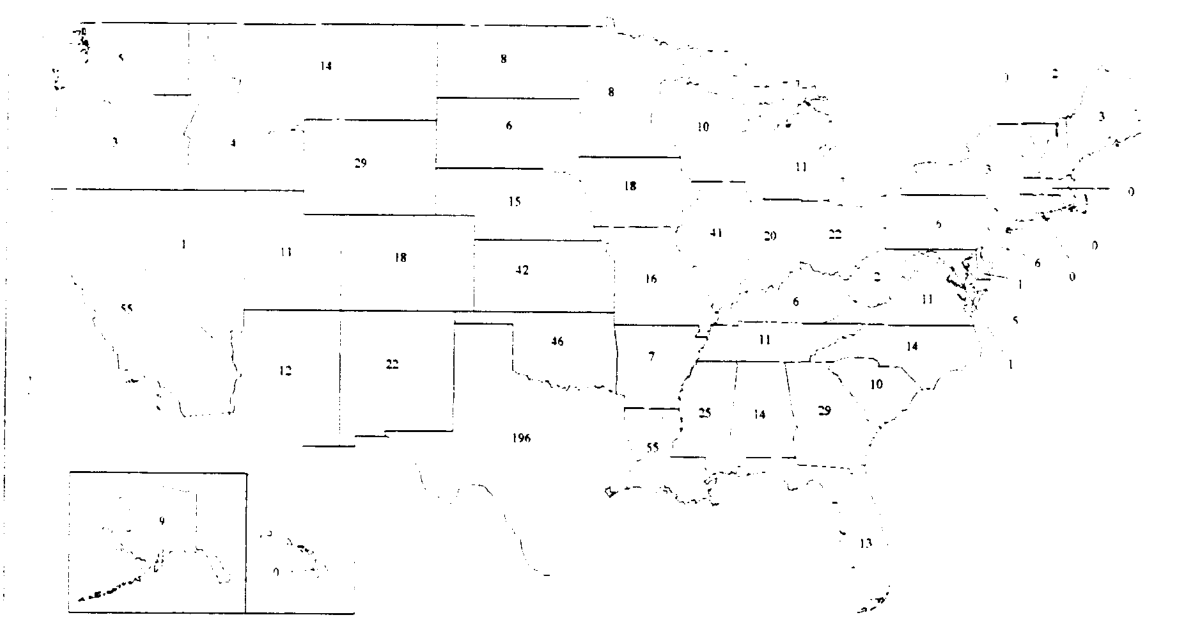
Source: Compiled from official 1992 statistics of the U.S. Bureau of the Census.
**Facilities with Payrolls only*
***Not Elsewhere Classified*

Geographic Distribution

State data is available only for those facilities with payrolls, as discussed above. Because the Census Bureau does not segregate data for the natural gas sectors covered by this profile, State-by-State information is available only for oil pipelines. The oil pipeline industry is anchored in the Southwest, with Texas, Louisiana, and Oklahoma accounting for over one-third of all reported establishments. California, with 55 pipeline facilities, and Illinois, with 41, have the next highest numbers of oil lines.

Exhibit 16 illustrates the number of oil pipeline establishments per State as recorded by the U.S. Census for 1992.

Exhibit 16
Geographic Distribution of Oil Pipelines*



Source: Compiled from official 1987 statistics of the U.S. Bureau of the Census.
**Establishments with payroll only.*

V.A.3. Economic Trends

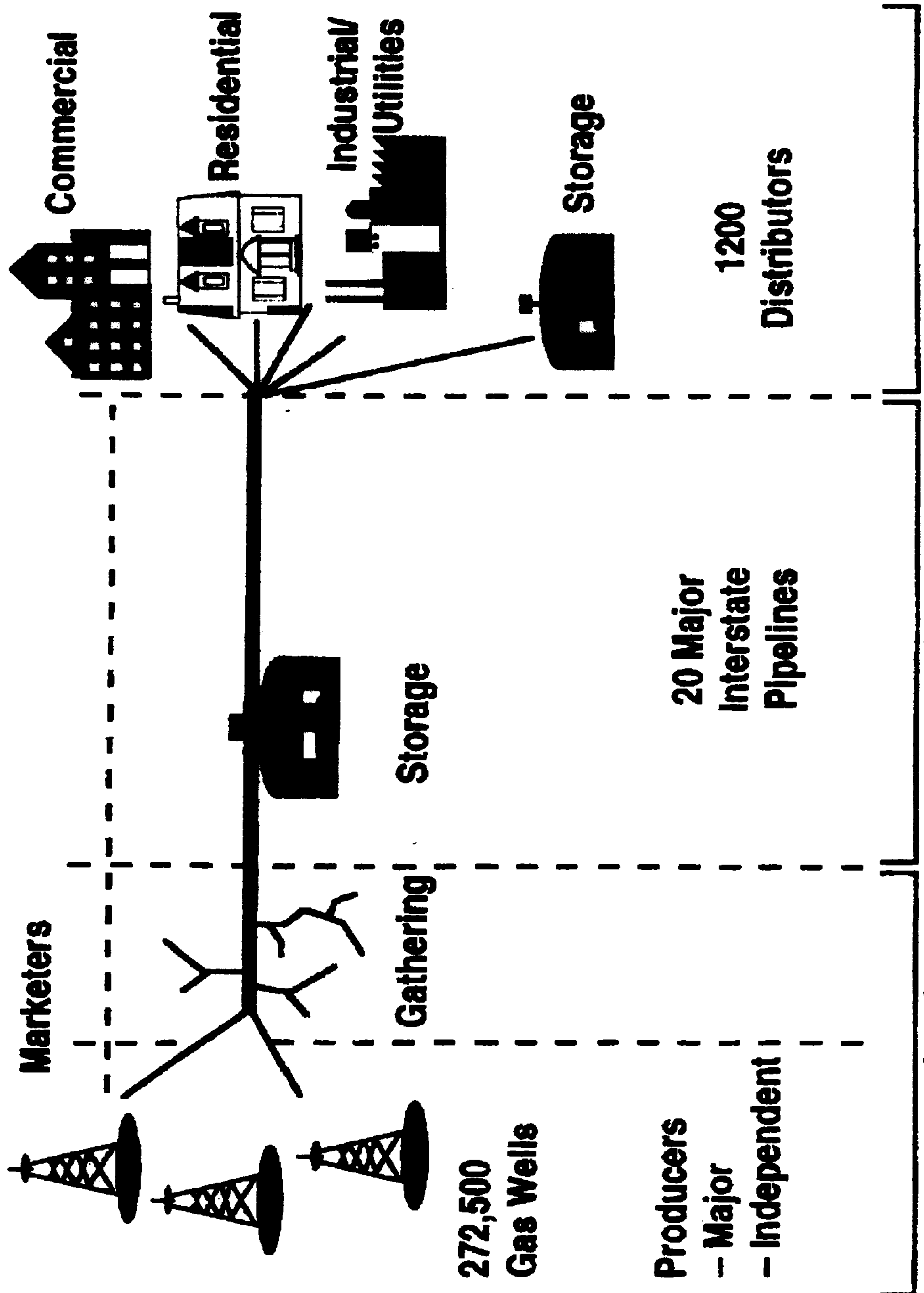
Most gathering and long-distance pipelines in the U.S. are owned by pipeline companies whose sole function is to operate a pipeline system. Historically, natural gas in the U.S. was purchased by the pipeline company from the producer, transported to market, then resold to a local distribution company. Now, most gas is sold directly to the local distribution company the producer, and pipeline companies provide only a transportation service. Oil, on the other hand, has traditionally been transported in the U.S. via pipeline by a shipper/owner, who is generally a refiner as well (Kennedy).

Annual reports filed for 1994 with the Federal Energy Regulatory Commission (FERC) show that both natural-gas and petroleum liquids pipeline companies increased their net incomes in 1994 despite declining operating figures. The ongoing shift of natural gas pipelines to primarily transportation providers was reflected by an increase in volumes of gas moved for others while volumes sold declined. Liquids pipelines moved nearly the same number of barrels in 1994 as in 1993, but showed an increase in barrel-miles, a measure of heightened efficiencies (Oil and Gas Journal, November 1995).

The nearly 410,000 miles of pipeline in the U.S. in 1994 represents a 2.2 percent, 9,000 mile, decline from the previous year. All pipeline mileage operated to move natural gas in interstate service declined nearly 4,000 miles, while mileage used in deliveries of petroleum liquids fell more than 5,000 miles. Transmission pipeline mileage showed little change from 1993 to 1994. Transmission mileage accounted for 77.5 percent of all natural gas mileage reported to FERC. The more than 128,000 miles of crude oil and product trunk lines represented more than 80 percent of all liquids mileage operated.

Natural gas companies have completed the shift from being marketers to being transporters that began when the FERC began implementing a series of regulatory orders that increased efficiency and heightened competition by establishing open-access transportation. This allowed traditional pipeline customers to buy gas from other sellers and have the pipelines provide transportation only. A final piece of regulatory restructuring occurred in 1992 with the release of FERC Order 636, requiring pipelines to offer gas sales, transportation, and storage services separately. In 1994, gas pipeline companies moved nearly 20 times as much gas for other companies as they sold from their own systems. Exhibit 17 demonstrates the relationship between pipelines, marketers, producers, and users of natural gas.

Exhibit 17
Natural Gas Delivery Infrastructure



U.S. crude oil and product oil trunk line traffic also increased in 1994. Crude oil traffic increased by 33 percent, while product traffic saw a modest rise of nearly three percent.

A solid measure of the profitability of oil and natural gas pipeline companies is the portion of operating income that is net income. For liquid pipeline companies in 1994, income as a portion of operating revenues was 29.5 percent, up from 25.4 percent in 1993. Income as a portion of revenues for natural gas companies was 14.3 percent, a marked increase from the 9.1 percent level reported in 1993.

Available information concerning future construction for the gas pipeline industry indicates a slow growth rate. Based on filings during the 12 months ending June 30, 1995, 725 new miles of land pipeline were proposed, and nearly 78,000 horsepower of new or additional compression were applied for.

The world oil price (the average cots of imported crude oil for U.S. refiners) is not expected to move significantly in 1996 from its current level of approximately $16 per barrel. Despite the continued rise in world oil demand over the forecast period, expected to exceed one million barrels per day per year, world oil production capacity increases should accommodate the demand growth in a balanced manner, keeping average prices relatively flat.

V.B. Operations in the Pipeline Industry

Gas and oil pipelines are essentially similar, with the greatest operational difference resulting from the varying needs of transporting gas versus liquid. Oil pipelines require pumps to propel their liquid contents, while gas lines rely on compression to force the resource through the pipe. In both pump and compressor stations, corrosion of piping and vessels must be monitored constantly to prevent failure.

Most pipelines fall into three groups: gathering, trunk/transmission, or distribution. One type of gathering pipeline is flowlines. Flowlines are small-diameter pipelines that are owned by the producer and connect individual oil or gas wells to central treatment, storage, or processing facilities in the field. Another gathering system made up of larger-diameter lines, normally owned by a pipeline company rather than an oil or gas producer, connects these field facilities to the large-diameter, long-distance trunk or transmission line. In some cases, individual wells are connected directly to the pipeline company's gathering system. Crude trunk lines move oil from producing areas to refineries for processing. Gas transmission lines carry natural gas from producing areas and treatment/processing facilities to city utility companies and other customers. Through distribution networks of small pipelines and metering facilities, utilities distribute natural gas to commercial, residential, and industrial users.

Refined liquids and products, such as gasoline, kerosene, fuel oil, and jet fuel are transported thousands of miles throughout the U.S. in product pipelines. Efficient long distance transport by pipeline requires high operating pressures, typically 500-1200 psi. Liquefied petroleum gases such as propane, butane, and their mixtures, are usually liquids under normal line operating pressures, so the pipelines transporting them are classified as liquid lines. Pump stations are needed on liquid lines at line friction, and elevation changes. Storage structures, such as tank farms for liquids and, increasingly, underground salt caverns for propane, are also used as buffers in transmission network operations and to distribution points of contact. Common pipeline operations are discussed below.

V.B.1. Pigging

Pipeline pigs are used for multiple purposes in both liquid and natural gas pipelines. A mechanical pig consists of a steel body with rubber or plastic cups attached to seal against the inside of the pipeline and to allow pressure to move the pig through the line. Brushes and scrapers are attached to the pig to facilitate cleaning or other functions. Pigs and spheres are forced through the pipeline by the pressure of the flowing fluid.

Mechanical pigs have traditionally been used to clean or segregate fluids within liquid pipelines. Mechanical pigs are most often used in gas pipelines to clean the line and maintain maximum efficiency. Downstream of compressor stations, lubricating oil from the compressors needs to be removed from the gas lines. On the intake side of both compressor and pump stations, cleaning pigs are used to prevent unwanted materials from contaminating the pumps or compressors. Recently, the use of pigs has increased as sophisticated instruments are used to monitor pipeline conditions and detect potential problems.

Large amounts of debris can be removed by a pig run over a long distance. For example, assume a pig is run in a 24-inch diameter pipeline that is 100 miles long and removes 0.016 inches of wax material from the wall of the pipeline. After 100 miles, the pig would be pushing a plug of wax about 1,450 feet long (Kennedy). Several sweeps by the pig may be required to effectively clean the line. Both brush and scraper pigs contain holes that allow fluid to bypass the pig, preventing buildups in front of the machine that could cause plugging.

V.B.2. Pipeline Leaks

Pipeline leaks are considered either small, medium, or large. Small leaks are below the limits of current computational pipeline monitoring leak detection capabilities. They can be detected with chemical sensing cables or by finding small pools of leaking product or dead vegetation on the pipeline right of way. They result from small, stable fractures or small corrosion holes that result in leak rates usually less than one percent of flow. Many vendor- and company-developed systems can detect leaks as small as 0.1 percent flow in field tests, but pipeline operators are not counting on this capability and are continuing with visual inspections (US DOT/RSPA/Volpe Center 1995). Small leaks can stay small and go unnoticed for weeks.

Medium leaks are detectable with some inferential leak detection methods, but are not large enough to cause a loss of working line pressure. Spill rates as high as 100 bbls per hour have gone undetected for up to a day on large lines without the use of sophisticated detection systems. Medium leaks are caused by fractures that remain narrow and by worn gaskets and valve stem packings.

Large leaks result in a rapid loss of working line pressure, which will generate an alarm to the dispatcher, even without a leak detection system (LDS). They are caused by third party damage and by unstable fractures that can grow many feet in length. Many high carbon steels used before 1`970 are prone to unstable fracture. Hydrogen gas, generated by cathodic protection systems with excessively high voltage, and hydrogen sulfide, found in sour crude oil, can make steel brittle and more prone to such fractures.

Improvements in materials, construction technologies, and inspection and monitoring techniques have reduced the incidence of damage to pipelines. In Western Europe, for example, gas leaks have dropped by 30 percent in the past 20 years, despite an aging pipeline system.

V.B.3. Pipeline Inspections

More than half of the gas transmission pipeline capacity in the U.S. will be over 40 years old by the year 2000. It is becoming increasingly important to guarantee the structural integrity of these pipelines through structural monitoring and periodic inspections. In addition, pipelines in unstable terrain must be monitored using geotechnical instruments such as inclinometers and pezometers, as well as by direct measurement of pipeline deformations, using strain gauges. Over the past 50 years, methods for performing these tasks have steadily improved.

Leak detection methods may be divided into two categories, direct and inferential. Direct methods detect leaking commodity outside the pipeline. Inferential methods deduce a leak by measuring and comparing the amount of product moving through various points on a line.

Traditionally, pipelines have been inspected visually by walking along this line or patrolling the pipeline route from the air. Today, leak detection ha become more thorough, in part to meet environmental and safety regulations. A thorough inspection program requires both systematic periodic controls (e.g., patrolling the line or cathodic protection measurements) and specific occasional controls (e.g., in-line inspection or hydrostatic retesting). Inspection programs must address the needs of the pipeline, requiring a detailed knowledge of construction characteristics, past and present service conditions, the local environment, and maintenance history. Factors influencing the rate of detection include the type of fluid, the accuracy of measuring systems, line size, pipe thickness, length of the line, analytical equipment, and the experience of the personnel involved.

One successful inspection technology is the instrument internal inspection device, commonly referred to as the smart pig. Growing out of earlier technology (mechanical pigs used for cleaning), smart pigs carry detection and logging tools that store data on the state of the pipeline including data on metal loss, pits, gouges, and dents while moving through the pipeline system. The smart pig is launched from a pig launcher (a spur off the mainline), run through the pipeline segment, trapped, and removed from the pipeline. The data is then downloaded from the start pig data storage unit and analyzed.

The smart pig technology is based on the use of a single "sensor," called magnetic flux leakage, or MFL. MFL pigs can detect metal loss, usually the result of corrosion. Based on limited data, smart pigs are able to detect approximately 60 percent of pipe defects. They cannot detect stress corrosion cracking, longitudinal cracks, small defects, or gouges and dents caused by excavation damage. An emerging technology called ultrasonic sensor technology can detect smaller cracks and defects. However, sensors currently require liquid to serve as a contact between the sensor and the material being inspected. Research is underway to develop ultrasonic sensors that can function in a dry natural gas pipeline. One of the most difficult inspection hurdles is the many miles of pipes that cannot be inspected using pigs. Design constraints such as intrusive valves, varying pipe diameters, and sharp turns make internal pipe inspection difficult.

Another inspection practice is to measure the amount of pressure and volume in a pipeline. This is done through metering. Metering measures the amount of flow in and out of a pipeline segment. This approach is effective using both simple and complex leak detection systems. The detection of small leaks can be enhanced by sophisticated instrumentation and the use of computer models.

Natural gas pipelines can be inspected for leaks with surface-sampling instruments by the flame-ionization principle. These units are made up of a sampling probe with a pump to draw an atmospheric sample to a detection cell. In the cell, the sample envelops a small hydrogen flame and carbon ions flow to a collector plate, causing an imbalance in the circuit that deflects the indicating meter. Because natural gas weighs less than air, it rises to the ground surface as it progresses through the atmosphere. Leaks in liquid natural gas pipelines are not as easily detected, and the soil around the line must be tested for constituents like propane and butane. Exhibit 18 shows some of the practices used to monitor pipelines and the types of damage they can reveal.

Exhibit 18
Methods of Monitoring Pipelines

PRACTICES / CONDITIONS	R-O-W PATROL: Aerial Patrols	R-O-W PATROL: Ground Systems	CORROSION CONTROL: CP Measurements	CORROSION CONTROL: Close Interval	CORROSION CONTROL: Coupons Monitors	IN-LINE INSPECTION: MFL Pigs	IN-LINE INSPECTION: Geometry Pigs	IN-LINE INSPECTION: Mapping Pigs	IN-LINE INSPECTION: Cameras	BELLHOLES: Visual Inspection	BELLHOLES: NDE Examination	TESTS: Hydrostatic Retesting
OUTSIDE FORCES												
3rd party damage	X	X					X		X	X		
Earth movements	X	X					X	X				
METAL LOSS												
External corrosion			X	X		X				X	X	X
Internal corrosion					X	X	X					X
Gouges						X				X	X	X
GAS LEAKAGE	X	X								X		
COATING			X	X						X		
CRACKS												
Seam weld										X	X	X
Girth weld										X	X	X
Stress corrosion											X	X
Fatigue										X		
Selective corrosion										X	X	X
GEOMETRY												
Ovality, buckles							X		X	X		
Obstructions, dents							X		X	X		
Ovality, wrinkles							X		X	X		
Bend radius							X	X				
Pipeline movement								X				
METALLURGICAL												
Inclusions						X					X	X
Hard spots						X					X	X
Laminations											X	

Source: Natural Gas Technologies, 1993.

R0075319

V.B.4. Glycol Dehydration Units

Glycol dehydration units are commonly used to remove water vapor from natural gas. Glycol dehydration of natural gas streams helps prevent corrosion and the formation of hydrates in pipelines. Up to 40,000 glycol dehydration units may be operating in the U.S. Approximately 17 to 18 trillion cubic feet per year of natural gas is currently dehydrated in North America, with a large fraction of that amount being treated in the United States.

During the water removal process, the glycol picks up other compounds from the natural gas that can become part of waste streams. The most significant issue is air emissions from the reboiler still vent. Increasing regulatory pressure has made emissions of benzene, toluene, ethylbenzene, the xylene isomers (BTEX), and volatile organic compounds (VOC) from the reboiler still vent of glycol dehydration units a major concern of the natural gas industry.

Varying amounts of water accompany the production of natural gas, depending on the temperature and pressure of the gas and the age of the field. In addition to the produced water, most natural gas is saturated with water vapor at the production temperature and pressure. The water vapor content of saturated natural gas can be estimated given the temperature and pressure of the gas. For example, at 800 psig and 80°F, natural gas may contain as much as 38 pounds of water per million standard cubic feet (MMSCF). In addition, sour natural gas (i.e., gas containing significant concentrations of hydrogen sulfide and carbon dioxide) will have a higher water content than sweet gas.

As the pressure and temperature vary in the gas pipeline, water can combine with the natural gas molecules (e.g., methane, ethane, and propane) to form solid hydrates that can block or plug a pipeline. Hydrates are crystalline structures composed primarily of water and hydrocarbons; methane can form hydrate cells with up to 136 molecules of water. Hydrates may also incorporate other gases such as hydrogen sulfide, ammonia, carbon dioxide, acetylene, and bromine into their structure.

Initially, small hydrate crystals will form in the flowing gas when free liquid water is present at the proper temperature and pressure. These small crystals become condensation nuclei, and, as they collide and stick together, larger crystals are formed. They will also accumulate on obstructions such as valves, orifice meters, or sharp objects where pressure and flow rate changes occur. Eventually, these crystals can grow to become a solid block of hydrates that can completely close off a pipeline or other equipment at high pressure.

Water also increases the corrosivity of the acid gases in the natural gas. Upon cooling, water may condense in the pipeline and cause slug flow, resulting in increased pipeline corrosion, erosion, and pressure drop.

To prevent the formation of hydrates at pipeline pressures and to limit corrosion, natural gas must be dehydrated before it is sent to the pipeline. In the U.S., the typical pipeline specification for the water content of the gas is 7 lb/MMSCF of natural gas.

V.C. Pollution Outputs and Causes of Pipeline Leaks

Unlike the other pollution output sections in the document, this section reflects the importance of determining the causes of pipeline ruptures, rather than focusing on the material released. By definition, most pollution outputs associated with pipelines are the oil and gas resources and products that the pipelines convey.

The Federally-regulated pipeline system has consistently improved its safety record over the last 25 years. However, there are still about 20 large (1,000 barrels or more) spills on the DOT's Office of Pipeline Safety (OPS) regulated liquids lines each year (US DOT/RSPA/Volpe Center 1995). Between 1988 and 1994, the OPS received 1,401 reports of hazardous-liquid spills on U.S. pipelines in which operators claimed a total of 1.2 million barrels of lost product and $220 million in property damage, as well as a number of injuries and fatalities.

Large crude and other viscous product spills are difficult and expensive to clean up. Lighter products, such as gasoline and highly volatile liquids pose less of a cleanup problem, but the risk of fire and explosion is significant. Much of the improvement in the pipeline safety record over the last 25 years has resulted from technical developments such as those in pipeline components, construction, inspection, and corrosion control.

V.C.1. Pipeline Failures

According to the DOT, for gas pipelines, 40 percent of leak/spill incidents are due to outside force or third-party damage; 21 percent are due to corrosion; 16 percent to material construction defects, and 23 to operational causes. For oil pipelines, only 18 percent of incidents are due to outside force or third-party damage; 20 percent due to corrosion, 16 percent due to material construction defect, and 45 percent to operational incidents (US DOT National Pipeline Safety Summit 1994, Data prepared by the NJ Institute of Technology). Exhibits 19 and 20 provide more specific breakdowns of the causes of pipeline leaks for hazardous liquid pipelines and natural gas pipelines as well as a breakdown of the resulting damage.

Exhibit 19
Hazardous Liquid Pipeline Incident Summary by Cause - 1994

Cause	Number of Incidents	Percent of Total Incidents	Property Damage	Percent of Total Damages	Deaths	Injuries
Internal Corrosion	9	3.69	$282,000	0.50	0	0
External Corrosion	38	15.57	$1,833,043	3.25	0	0
Defective Weld	21	8.61	$4,320,680	7.65	0	0
Incorrect Operation	8	3.28	$15,600	0.03	0	0
Defective Pipe	11	4.51	$2,154,000	3.82	0	0
Outside Damage	57	23.36	$35,593,513	63.05	0	1,853
Malf.. of Equipment	22	9.02	$1,159,517	2.05	0	1
Other	78	31.97	$11,095,251	19.65	1	4
Total	244	100	$56,453,604	100	1	1,858

Source: DOT Office of Pipeline Safety, 1995.

Exhibit 20
Natural Gas Pipeline Incident Summary by Cause - 1994

Cause	Number of Incidents	Percent of Total Incidents	Property Damage	Percent of Total Damages	Deaths	Injuries
Internal Corrosion	20	25.0	$2,632,812	583	0	0
External Corrosion	13	16.25	$2,028,835	4.49	0	1
Damage from Outside Forces	23	28.75	$32,127,680	71.13	0	16
Construction/ Material Defect	9	11.25	$342,647	0.76	0	2
Other	15	18.75	$8,038,319	17.8	0	0
Total	80	100	$45,170,293	100	0	19

Source: DOT Office of Pipeline Safety, 1995.

V.C.2. Glycol Dehydration - Inlet Separator

The inlet separator removes liquid water, heavy hydrocarbons, brine solution, and particulate matter such as sand, pipeline scale, and rust, or iron sulfide from the incoming natural gas. The vessel is typically sized on the basis of operating pressure and gas throughput to ensure that adequate separation occurs and carryover is prevented. The liquid level must be regulated or checked regularly so that plugs or upsets do not result in carryover; one way to do this is to install a high-liquid-level shutdown. The liquid drain line should be protected from freezing; if this line is frozen or plugged, the separator will not remove any liquids. A mist eliminator in the top of the separator is usually sufficient to reduce or prevent the carryover of liquid droplets and particulate matter, although a filter may be required if aerosols or compressor oils are present in the gas stream.

The inlet separator is considered by many to be the most important part of a glycol unit, because a properly designed inlet separator can eliminate many downstream problems. If the inlet separator is undersized or poorly designed, contaminants may be carried over into the absorber, resulting in the following problems in downstream equipment:

- Free liquid water may enter the absorber and overload the glycol in the absorber, which may prevent the gas from being dried to pipeline specifications.
- Hydrocarbon contamination of the glycol may cause foaming.
- Heavy hydrocarbons may foul the heat exchange surfaces in the reboiler, resulting in poor heat transfer, localized thermal degradation of the glycol, inadequate glycol regeneration, and eventual fire tube failures.
- Sodium chloride and calcium chloride may enter the system. Sodium chloride often precipitates in the reboiler, calcium chloride precipitates in the coldest portions of the system such as the absorber. Salt contamination may ultimately necessitate replacement of the glycol.

V.C.3. Breakout Tank Leakage

Leaking above ground storage tanks pose several environmental problems. First, leaking above ground tanks can seriously contaminate groundwater, often making it impossible to ever return the groundwater to drinking water standards. Groundwater is a source of drinking water for over half the country; in rural areas, nearly all residents drink water from groundwater wells. Pipeline-related facilities are frequently located in populated areas that may rely on groundwater for drinking. Leaking tanks can also pose health and fire hazards to nearby buildings or infrastructures such as sewers, since gaseous components can migrate into these enclosed areas and concentrate to toxic or combustible levels.

Page 54 intentionally left blank.

VI. POLLUTION PREVENTION/WASTE MINIMIZATION

VI.A. Introduction

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways, such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be implemented feasibly. In the waste management hierarchy, if source reduction is not feasible the next alternative is recycling of wastes, followed by energy recovery, and waste treatment as a last alternative.

In order to encourage these approaches, this section provides both general and company-specific descriptions of pollution prevention activities that have been implemented within the pharmaceutical industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can be, or are being, implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must be examined to determine how each option affects air, land and water pollutant releases.

VI.B. Rail Transportation

VI.B.1. Water Discharge

At locomotive maintenance facilities, eliminating water from the clean up processes may enable a facility to seal off the floor drains and attain zero discharge. Spent solvents and cleaning solutions are often toxic and/or hazardous and should be disposed of in an environmentally safe manner rather than by pouring them into the storm drain or waste water line. If hazardous cleaning agents (e.g., solvents) are used, care should be taken to wear protective safety gear and follow good housekeeping practices (e.g., clear labeling of all chemicals and wastes to avoid misuse and potential injury or contamination).

If a discharge is going to a wastewater treatment facility, it should be pretreated. Pretreatment means reducing the amount of pollutants in a discharge before it proceeds to a municipal wastewater treatment plant. If waste water is discharged directly or indirectly (i.e., via percolation or injection wells) into a stream, a facility must obtain and comply with the terms of an NPDES or State permit.

When disposing of wastewater, the following activities will foster pollution prevention:

- If a municipal treatment plant is not available, or it will not accept the waste, route the waste to a tank or container for proper accumulation, treatment, and disposal.

- Keep wastewater from service bays out of storm drains by constructing berms around hazardous material storage areas to keep spills from leaving the storage area.

- Do not discharge industrial wastes to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers. Facilities that use these types of disposal systems may be in violation of Federal, State, or local requirements.

- If there is a floor drain in the facility, it should be plumbed to an oil/water separator or appropriate wastewater treatment facility.

- Alternatives to water cleaning include recycled solvents in self contained solvent sinks. Dry cleaning can include cleaning by wire brush or bake oven.

Waste minimization in equipment cleaning may be achieved by reducing the amount of water used to clean large equipment. A reduction in water usage will translate into a reduction in the volumes of generated waste waters.

Axle protective coatings can be removed with 140 solvent or a similar non-hazardous or aqueous solvent to avoid hazardous waste generation. The use of hazardous cleaning compounds in outdoor large equipment cleaning can also be avoided by using a detergent/water mixture or steam. In these processes, waste waters must be channeled properly for treatment or disposal.

For small cleaning operations, it is possible to switch from hazardous organic-based to non-hazardous aqueous-based solvents. This will reduce the amount of hazardous waste generated from cleaning operations. Solvent recycling can also decrease hazardous waste production from small parts cleaning.

Spent solvents can be cleaned and recycled with a solvent still. Spent solvent, if hazardous, must be treated and disposed of as hazardous waste, unless recycled properly. Solvents should not be poured down sewer drains, mixed with used oil, or stored in open containers that allow them to evaporate. Certain aqueous parts washers can use detergents instead of solvents.

VI.B.2. Oil

Most facilities in the rail industry recycle used oil. Recycling used oil requires equipment like a drip table with a used oil collection bucket to collect oil dripping off parts. Drip pans can be placed under locomotive or rail cars awaiting repairs in case they are leaking fluids. Some facilities use absorbent materials (e.g., pigmat) to catch drips or spills during activities where oil drips might occur. One facility has established a reuse system for its waste oil: waste oil is transported to another facility where it is used for fuel. This method decreased disposal and heating costs while reducing landfill waste loads. Used oil burning of this nature has permitting implications that a facility needs to follow. Used oil burning can also occur in on-site space heaters under certain circumstances. Recycling used oil by sending it to a commercial recycling facility saves money and protects the environment. To encourage recycling, the publication "How To Set Up A Local Program To Recycle Used Oil" is available at no cost from the RCRA/Superfund Hotline at 1-800-424-9346 or 1-703-412-9810.

Another pollution prevention alternative some railroads have initiated is the use of retention tanks on locomotives. Locomotive retention tanks catch leaking oil from the engine compartment. The tanks are subsequently drained to an appropriate waste treatment facility during routine maintenance and servicing.

Spent petroleum-based fluids and solids should be sent to a recycling center wherever possible. Solvents that are hazardous waste must not be mixed with used oil, or, under RCRA regulations, the entire mixture may be considered hazardous waste. Non-listed hazardous wastes can be mixed with waste oil, and as long as the resulting mixture is not hazardous, can be handled as waste oil. All used drip pans and containers should be properly labeled.

A Material Safety Data Sheets (MSDS) logbook should be kept in a central location and be easily accessible during an emergency. Along with MSDS's, an emergency response plan should posted at all times and each employee should know where it is and what procedures are included in it. All employees should be aware of and understand the properties and potential adverse effects of the materials they handle.

Facilities should conduct audits of the spill possibilities at their facilities. Spills can be avoided by determining those locations and situations where spill events are likely to take place and making employees aware of them. Some facilities have posted signs at likely spill locations or conducted training with their employees on spill awareness and preparedness. In addition, MSDS sheets can be centralized for easy access in case of a spill event. A folder or binder can be used for this purpose and should be maintained by a designated MSDS collection person.

VI.B.3. Waste from Maintenance and Repair Operations

Batteries may be recycled through suppliers. Batteries should be stored in an open rack or in a water tight, secondary containment area like a concrete bin with sealer on the floor and walls. Batteries should be inspected for leaks and/or cracks as they are received at the facility. Acid residue from cracked or leaking batteries is likely to be hazardous waste under RCRA because it is likely to demonstrate the characteristic of corrosivity, and may contain lead and other metals. Many waste batteries must therefore be handled as hazardous waste. Lead acid batteries are not considered a hazardous waste as long as they are recycled. Facilities have many battery disposal options: recycling on site, recycling through a local rail facility, recycling through a supplier, or direct disposal. Facilities should explore all options to find one that is right for the facility. In general, recycling batteries may reduce the amount of hazardous waste stored at a facility, and thus the facility's responsibilities under RCRA. The following best management practices are recommended when sorting used batteries:

- Palletize and label them by battery type (e.g., lead acid, nickel, and cadmium)
- Protect them from the weather with a tarp, roof, or other means
- Store them in an open rack or in a water tight secondary containment unit to prevent leaks
- Inspect and document them for cracks and leaks as they come in to your storage program. If a battery is dropped, treat it as if it is cracked
- Avoid skin contact with leaking or damaged batteries
- Neutralize acid spills and dispose of the resulting waste as hazardous if it still exhibits a characteristic of a hazardous waste.

Coolants for locomotives are not glycol based, but are a nitrate-based corrosion inhibitor in water. These type of waste coolants can be disposed to most POTWs. Though much of the activities associated with vehicles takes place at off-site service centers, some maintenance is performed on this type of equipment, where coolants from maintenance vehicles and fleet vehicles should be collected and recycled and not mixed with locomotive coolant. Solvents containing chlorinated hydrocarbons should be stored in separate containers and disposed of properly. When possible, coolant should be discharged when the locomotive has stopped and is at a location where the coolant can be collected and managed. Locomotive operators should be familiar with the spill reporting requirements of the States in which they operate, and act accordingly when a coolant discharge takes place.

Metal scrap from old machine parts that is likely to be contaminated with oil (e.g., wheel truing scrap), should be stored under a roof or covered with tarpaulin to protect it from the elements. This scrap metal should also be protected from rain water to eliminate the potential of contaminated runoff. Metal scrap can be recycled if sorted and properly stored. Labeled recycling containers can be placed around the shop for easy access and later sorting.

Liquid drum containers, if stored outdoors, should be in a berm and on a paved impermeable surface or in a secondary containment unit to prevent spills from running into water bodies.

Metal filings from parts machining should be collected and recycled if possible. In no case should the filings be allowed to fall into a storm drain.

VI.B.4. Paint

To reduce the amount of wastes created by painting operations, all paint should be used until containers are completely empty. "Empty" containers of latex paint may be disposed of as solid waste. Used containers of hazardous substances may need to be disposed of as hazardous wastes, if they are not completely empty. To prevent environmental problems, it is possible to switch from hazardous organic-based to non-hazardous aqueous-based paints. Also, paint may be purchased in recyclable and/or returnable containers to reduce disposal costs.

VI.B.5. Fueling

Self-locking fueling nozzles minimize the risk of both fuel spillage and air pollution by ensuring a secure seal between the fuel source and tank. During locomotive fueling, personnel should look for fuel drippage and spillage. Catchment pans on either side of and between the rails will collect fuel spills and prevent soil contamination. These pans should be drained to an oil-water separator or retention tank. These pans can be cleaned periodically by railroad personnel to remove fuel debris and accumulated wastes for proper disposal. In case of a spill, facilities should keep the following on hand: absorbent booms, pads, or blankets to help contain spills and soak up pooling liquid; rubber gloves and boots; and a shovel.

VI.C. Trucking

VI.C.1. Truck Terminal and Maintenance Facilities

Trucks require regular changing of fluids, including oil, coolant, and others. To minimize releases to the environment, these fluids should be drained and replaced in areas where there are no connections to storm drains or municipal sewers. Minor spills should be cleaned prior to reaching drains. Used fluids should be collected and stored in separate containers. Automotive fluids can often be recycled. For example, brake fluid, transmission gear, and gear oil are recyclable. Some liquids are able to be legally mixed with used motor oil which, in turn, can be reclaimed.

During the process of engine and parts cleaning, spills of fluids are likely to occur. The "dry shop" principle encourages spills to be cleaned immediately, without waiting for the spilled fluids to evaporate into the air, be transmitted to land, or to contaminate other surfaces. The following techniques help prevent spills from happening:

- Collect leaking or dripping fluids in designated drip pans or containers. Keep all fluids separated so that they may be properly recycled.
- Keep a designated drip pan under the truck while unclipping hoses, unscrewing filters, or removing other parts. The drip pan prevents splattering of fluids and keeps chemicals from penetrating the shop floor or outside area where the maintenance is taking place.
- Immediately transfer used fluids to proper containers. Never leave drip pans or other open containers unattended.

Radiator fluids are often acceptable to antifreeze recyclers. This includes fluids used to flush out radiators during cleaning. Reusing the flushing fluid minimizes waste discharges. If a licensed recycler does not accept the spent flushing fluids, consider changing to another brand of fluid that can be recycled.

If the maintenance facility services air conditioners, special equipment must be used to collect the Freon or other refrigerant because it is not permissible to vent the refrigerant to the atmosphere. Reusing the refrigerant on site is less costly than sending the refrigerant to an off site recycler.

VI.C.2. Vehicle Washing

Vehicle washing has become a major environmental compliance issue for most companies that operate a fleet of vehicles. The following pollution prevention activities will help ensure that a facility is addressing potential sources of pollution:

- Waste water discharge can be prevented by dry washing vehicles using a chemical cleaning and waxing agent, rather than detergent and water. The dry washing chemical is sprayed on and wiped off with rags. No waste water is generated. Dry washing is labor intensive and creates solid waste that must be disposed of properly.

- Waste water can be contained by washing at a low point of the facility, blocking drains from the facility using a containment dike or blanket, or washing on a built-in or a portable containment pad.

- Waste water can be disposed of by evaporation from the containment area, or by discharging the waste water to a sanitary sewer system. (Pretreatment of waste wash water generated from manual washing before disposal to the sanitary sewer is not usually required for vehicle exterior (no undercarriages or engines) washing. Permission must be obtained from the sewer district before waste wash water can be drained, pumped, or vacuumed to a sanitary sewer connection.

VI.C.3. Stormwater Pollution Prevention

Under the Clean Water Act NPDES requirements, discussed in more detail below, truck maintenance facilities must maintain a stormwater pollution prevention plan. The following information is taken from *Stormwater Pollution Prevention Plan for the Trucking Industry*, American Trucking Associations, 1993.

An effective pollution prevention plan for trucking facilities strives to prevent pollution at the source, before it enters the environment. This is best done by properly addressing the following potential sources of pollution:

- Underground and above ground storage tanks of petroleum fuel

- Drips, spills, and releases from fueling operations

- Routine maintenance, including tire, battery, fluids, and oil changes

- Containers of antifreeze, solvents, used oil, and other liquid wastes

- Management of shop drains (sometimes connected to an oil-water separator) which may accumulate oil, grease, and other shop wastes

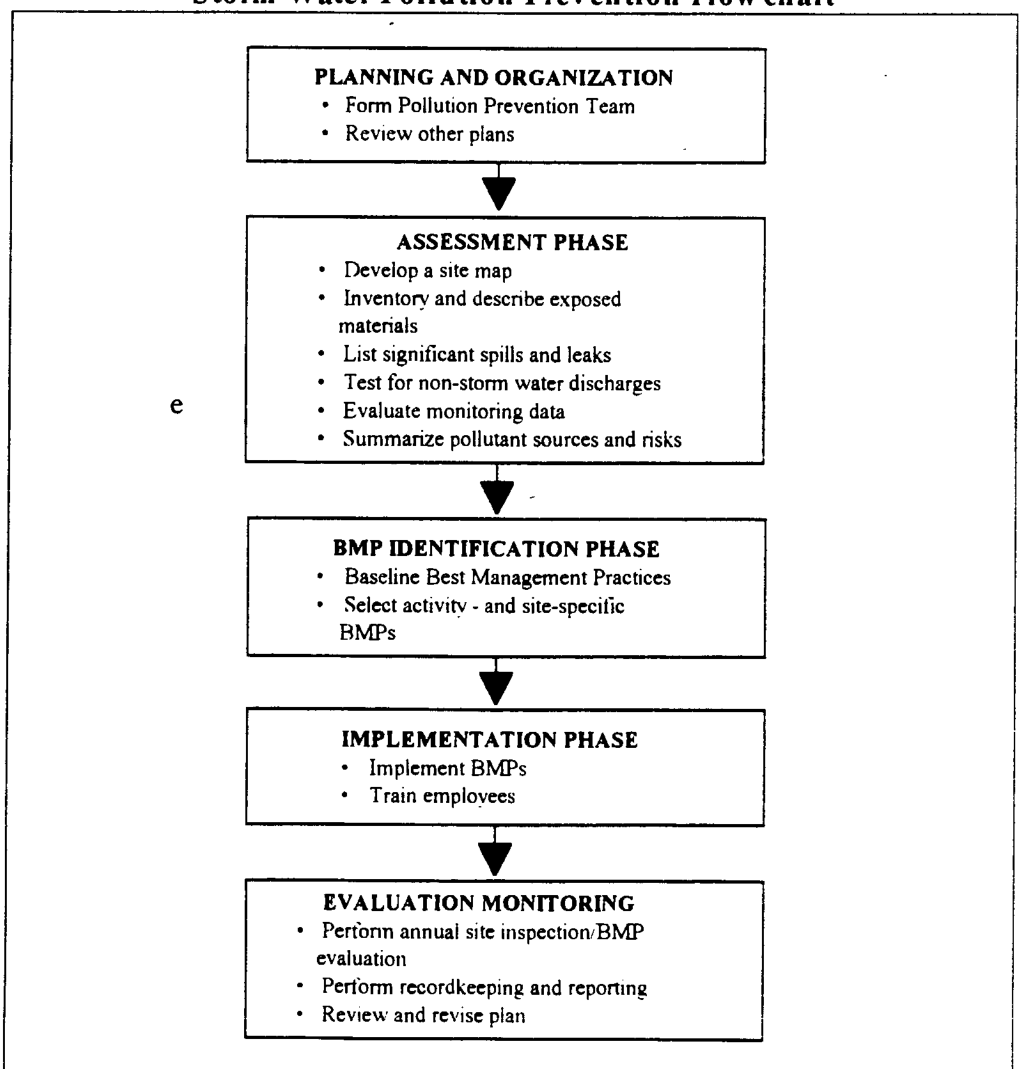
- Vehicle washing operations

- Storage of scrap tires and batteries.

The American Trucking Associations has developed a flowchart, duplicated as Exhibit 21, that directs the attention of facility managers to the sources of environmental contamination, and alerts them to the practices that best ensure

Exhibit 21
Storm Water Pollution Prevention Flowchart

EXHIBIT 21
Storm Water Pollution Prevention Flow chart



Source: Stormwater Pollution Prevention Manual for the Trucking Industry, ATA, 1995.

VI.C.4. Alternatively-Fueled Vehicles

One way to reduce vehicle emissions from the trucking industry is to switch to alternative fuels. Natural gas vehicles, for example, are a viable alternative to gasoline-and diesel-powered transportation. Almost any gasoline- or diesel-powered vehicle can be converted to run on natural gas including, light-duty trucks and vans, medium-duty trucks, and even heavy-duty trucks such as semi-tractors. Converting a gasoline-powered vehicle to run on natural gas involves installing a natural gas fuel system and storage tanks without removing any existing equipment. Diesel conversions are somewhat more complicated because they also involve reducing compression and adding a sparked-ignition system. Other fuels suitable for trucks can include methanol, ethanol, and propane.

Some of the momentum to switch to alternative fuels such as natural gas is coming from legislation. Over the past few years, Congress has passed even stricter clean-air laws, as well as incentives to encourage the use of alternative fuels. Federal (and in some areas State) tax deductions for Alternative Fuel Vehicles (AFVs) and related refueling equipment are available. The maximum tax deductions range from $2,000 to $50,000 for each AFV and up to $100,000 on refueling stations. Deductions on vehicles, including original equipment manufactured vehicles or after-market conversions, apply to the incremental cost of an AFV over the cost of its gasoline or diesel counterpart. The deduction for AFVs can be taken by either an individual or a business, but the deduction on refueling equipment applies only to businesses.

VI.D. Pipelines

VI.D.1. Direct Leak Detection Enhancements

Direct leak detection is typically performed by line patrols who inspect the pipeline right-of-way for pools of leaking product and dead vegetation. Section 195.412 of the Federal pipeline safety regulation requires that hazardous liquid pipelines be patrolled 26 times each year. A new technology for direct leak detection is chemical sensing cable buried along the pipeline right of way. Some cable systems can detect the presence and location of hydrocarbon vapors. Other cables locate leaks by absorbing liquids, which results in a loss in the cables' electrical conductivity at an identifiable location. Sensing cables can offer superior detection times, sensitivity, and location accuracy, especially in gathering lines, where the flows can be too irregular for other methods. These cables must be buried close to the pipeline to work well, and some liquid sensing cables must be dug up and replaced after every detection. New burying methods are being developed for these cables to lower their operating cost.

VI.D.2. Supervisory Control and Data Acquisition (SCADA) Systems

The traditional inferential method of leak detection is called line balance, where one measures the volume of product sent into the pipeline and compares it with the volume that comes out the other end. Enhancement of this method and others are used by SCADA and LDS systems to provide the dispatcher with information that suggests a possible leak. SCADA systems give pipeline dispatchers the ability to effectively monitor pipeline conditions and control a pipeline's operation from a central location. SCADA systems include pipeline sensing devices, a communications network, a centralized or distributed data processing system, and a user interface for the dispatcher.

SCADA systems continuously monitor, transmit, and process pipeline information for the control room dispatcher. Monitoring is conducted using Remote Terminal Units (RTUs), which are placed at intervals along the pipeline and at associated facilities, such as pump stations and delivery terminals. RTUs periodically collect data from field instruments, which measure pressure, temperature, flow, and product density. RTUs can also receive information from vapor detectors and tank level gauges in pipeline system routing and storage areas. RTUs process this information to varying degrees and transmit it for analysis to a central computer through a communications network. Information from RTUs may be transmitted by company-owned lines, by a commercial telephone service, or by using ground- or satellite-based microwave or radio communication.

The leak detection capabilities of most SCADA systems can be enhanced with additional leak detection software and user interfaces. Field instruments specifically designed for leak detection are also available for SCADA systems, such as acoustic sensors and hydrocarbon cables.

VI.D.3. Hydrostatic Testing

Pipeline and utility companies test the pipes that comprise their system both before they are buried and when they suspect that a section of pipe may need maintenance. Hydrostatic testing is the process of filling a section of pipe with water and pressurizing it to a level above normal operating levels. This verifies the integrity of the pipeline.

Depending on the location of the pipeline, the water used in a hydrostatic test is drawn from a local river, stream, or lake; taken from municipal supplies; or trucked to the site. After air is bled from the pipeline, a pump raises the pressure inside the pipe to the pre-determined testing level, where it is maintained and monitored during the test period. Precision measurement instruments are used to monitor pressures, and a record is maintained to chart the results.

VI.D.4. Cathodic Protection

Corrosion in pipelines is a common phenomenon, and must be controlled to effectively prevent pipeline leaks or structural problems. Although modern pipes are constructed of high quality steel, this will nevertheless corrode over time. Corrosion results from an electrical current that naturally flows from a pipe into the surrounding soil. As this occurs, metal loss, or corrosion, results.

One way to impede this process is to insulate the metal from the soil. This occurs in the manufacturing process, when the pipe is coated. The coating is rechecked at the construction site using a detector that looks for imperfections or gouges that could occur during transportation. New coating is then applied at the welded joints between pipe sections, first by sandblasting the weld, and then applying the new coat.

To further protect the pipeline from corrosion, anodes or "ground beds" are constructed at strategic points along the pipeline. These groundbeds provide cathodic protection by inducing a very small electrical charge into the soil. impeding the flow of electrons to the pipe.

The rectifier that induces the current into the ground bed is regularly checked by pipeline personnel, who ensure that the system is applying sufficient current to maintain cathodic protection to the pipeline. A single 200 foot ground bed can protect as much as 50 miles of pipeline, but the low voltages used does not harm animals or plants in the vicinity.

VI.D.5. Smart Pigs

Surveying a working pipeline for damage or corrosion can be disruptive to consumers if sections of the pipeline must be taken out of service. One nondestructive method of evaluation is a device called a smart pig. Smart pigs are designed for use inside larger operating pipelines (as opposed to smaller distribution lines) to identify possible corrosion defects or abnormalities. Smart pigs are self-contained units consisting of three to five sections held together by universal joints, allowing them to negotiate bends in the line. A typical pig will have a recorder section for storing survey data, a magnetic section that creates the magnetic field used to measure pipeline flaws, and a drive section holding the battery power for the unit. Around the perimeter of the pig are the transducers that measure the fluctuations in the magnetic field indicating possible wall abnormalities.

The smart pig is placed into the pipeline at a pig launcher, which is a spur off the mainline. Once the pig has been loaded, the launcher is pressurized so that the pig enters the mainline. The pig will travel between five to ten miles per hour while collecting data about the pipeline. To enable the pig to record its location while gathering data, devices called above ground markers (AGMs) are placed at regular intervals along the surveyed pipeline.

The pig is removed from service at a pig trap or receiver. Crews prepare the receiving site with a catch pan to collect pipeline liquids pushed ahead of the pig. After removing the pig and placing it back into a holding trough, survey personnel remove the tape recorder and download its records. The tape is placed onto a special playback machine that feeds the data into instruments that analyze the information and print out a log revealing information like the location of potential corrosion sites or other anomalies not recognizable by above-ground inspection methods.

VI.D.6. Breakout Tanks

To prevent spills and leaks, above ground tanks should have secondary containment underneath tank bases and piping (or move piping above ground for daily visual inspection) to capture any releases before soil or groundwater is contaminated. Corrosion protection should be added to tank bottoms. Regular groundwater water monitoring should be employed and baseline measurements should be taken at the time of installation.

VI.D.7. Proper Training

In a DOT study of remote control spill reduction technology, most pipeline operators interviewed felt that the critical link in reducing the number of incidents and the volume of pipeline spills lies with dispatcher training. They frequently indicated that there was no substitute for a well-trained dispatcher, especially not a software unit designed to automatically shut down the pipeline. The dispatcher is often the final decision-maker in the process of leak detection and pipeline shutdown. If dispatchers fail to recognize a problematic situation and fail to intervene, unchecked spills are likely to be large.

VII. Summary of Applicable Federal Statutes and Regulations

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section VII.A contains a general overview of major statutes
- Section VII.B contains a list of regulations specific to this industry
- Section VII.C contains a list of pending and proposed regulations.

The descriptions within Section VII are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarification of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other State or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VII.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities must obtain a permit either from EPA or from a State agency which EPA has authorized to implement the permitting program if they store hazardous wastes for more than 90 days before treatment or disposal. Facilities may treat hazardous wastes stored in less-than-ninety-day tanks or containers without a permit. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 States and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

Identification of Solid and Hazardous Wastes (40 CFR Part 261) lays out the procedure every generator must follow to determine whether the material in question is considered a hazardous waste, solid waste, or is exempted from regulation.

Standards for Generators of Hazardous Waste (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

Land Disposal Restrictions (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet LDR treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

Used Oil Management Standards (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil), additional tracking and paperwork requirements must be satisfied.

RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities that store such waste, including large quantity generators accumulating waste prior to shipment off-site.

Underground Storage Tanks (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that must be met by December 22, 1998.

Boilers and Industrial Furnaces (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law known commonly as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National

Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as removals. EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

EPCRA §302 requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

EPCRA §304 requires the facility to notify the SERC and the LEPC in the event of a release equaling or exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

EPCRA §311 and §312 require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

EPCRA §313 requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, known commonly as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The National Pollutant Discharge Elimination System (NPDES) program (CWA §502) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized 42 States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set the conditions and effluent limitations on the facility discharges.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated the NPDES storm water permit application regulations. These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing, 32 (except 323)-stone, clay, glass, and concrete, 33-primary metals, 3441-fabricated structural metal, and 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national pretreatment program (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities that could reasonably be expected to discharge oil in harmful quantities prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR §112.20) and for PCB transformers and PCB-containing items were revised and finalized in 1995.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, volatile organic compounds (VOCs), ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under section 110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and may go into effect as early as late 1997.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title I, section 112(c) of the CAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV of the CAA establishes a sulfur dioxide nitrous oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs) and chloroform, were phased out (except for essential uses) in 1996.

EPA's Clean Air Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities (www.epa.gov ttn then select Directory and then CATC).

R0075348

VII.B. Industry Sector Specific Regulations

The transportation industry is regulated by several different Federal, State, and local agencies. As noted earlier, several government entities regulate specific transportation sectors. For example, the Department of Transportation's (DOT's) Research and Special Program Administration is designed to ensure the safe, reliable and environmentally sound operation of the nation's pipeline transportation system. The DOT has traditionally established national standards that are not affected by local or State laws.

EPA has traditionally relied on delegation to States to meet environmental standards, in many cases without regard to the methods used to achieve certain performance standards. This has resulted in States with more stringent air, water, and hazardous waste requirements than the Federal minimums. This document does not attempt to discuss State standards, but rather highlights relevant Federal laws and proposals that affect the rail, trucking, and pipeline industries.

VII.B.1. Rail Transportation

RCRA

Railroad facilities produce a variety of RCRA regulated wastes in the course of normal operations and utilize underground storage tanks for product and fuel storage. Many railroad facilities qualify as hazardous waste generators under RCRA law. Under RCRA, it is the facility's responsibility to determine whether or not a waste is hazardous. See 40 CFR 261.31 - 261.33 for a full list of EPA hazardous wastes.
Some examples of hazardous wastes produced during railroad operations include solvent residues from parts cleaning and spent nickel cadmium batteries. Used oil is currently not listed as a hazardous waste under RCRA; however, if used oil meets one of the hazardous waste characteristics (e.g., ignitable) or is mixed with a listed hazardous waste, it must be stored and disposed of as a hazardous waste. Most waste oil generated by a railroad (e.g., spilled diesel fuel, motor oil) is not a hazardous waste, but cutting oil, hydraulic oils, and any oil containing heavy metals may require hazardous waste handling.

Potential RCRA hazardous wastes generated during railroad operations include:

- Absorbent materials contaminated with hazardous substances
- Aerosol cans, still pressurized
- Cutting oils, hydraulic oils, and oil with heavy metals contamination
- Grit blast wastes
- Ignitable paint thinners
- Lead-based or ignitable paint and related wastes
- Lead acid batteries, non-recycled
- Nickel cadmium, nickel iron, and carbonaire batteries
- Oil filters constructed with "terne"metal (a lead-tin alloy)
- Solvents and solvent sludge.

Clean Water Act

The CWA is set up to regulate two types of water pollution: one from a point source (e.g., an outflow pipe from a parts-washing basin), the other from a non-point source (e.g., non-drained ground where oil has dripped). The CWA applies to a variety of railroad operations. Any railroad operation that produces a wastewater (e.g., locomotive, rail car, and small parts washing) or deposits substances on the ground that may be carried away by stormwater (e.g., fuel and oil spills), will trigger CWA requirements.

The CWA requires the following from railroads:

- NPDES or POTW permits
- Stormwater discharge permits
- Spill prevention control and countermeasure (SPCC) plans and spill reporting.

Exhibit 22
Clean Water Act Requirements Applicable to Railroads

NPDES Permits	Stormwater Discharge Permits	SPCC Plans and Spill Reporting
• Sets limits on volume and nature of discharge • Sets limits on quantity of certain pollutants • Contains monitoring and reporting requirement • *Note: facilities discharging to POTW's do not require NPDES permits.*	• For certain industrial facilities, required if stormwater drains to a municipal separate storm sewer system or directly to receiving water • Required for facilities involved in vehicle maintenance or equipment cleaning • Site maps, drainage and discharge structures, and other information required by permit applications	• Triggered by oil or petroleum product storage in excess of 660 gallons in a single tank or 1,320 gallons in aggregate at facility • Local environmental representatives to be contacted in case of discharge • Documentation of storage vessels, types of containment, emergency equipment available, etc.

The CWA also requires facilities to develop SPCC plans for petroleum products, such as oil, if they are stored in large quantities at a particular railroad. SPCC plans document the location of storage vessels, types of containment, dangers associated with a major release of material from the tanks, types of emergency equipment available at each site, and procedures for notifying the appropriate regulatory and emergency agencies. No SPCC plan is considered complete until it has been reviewed and certified by a Registered Professional Engineer.

Clean Air Act

The CAA establishes two major categories for air pollution regulation: mobile sources (e.g., automobiles, locomotives) and stationary sources (e.g., power boilers, solvent-based cleaning stations). Possible air pollution sources for the railroad industry include boilers, incinerators, forges, foundries, painting or refinishing operations, shop blasting and dust collection control systems, degreasers, and the filling and maintaining of fuel storage tanks.

The CAA regulations on chlorofluorocarbons (CFCs) and asbestos-containing materials also affect railroad operations. Equipment containing CFCs, such as refrigeration units or air conditioning systems, are common. In addition, many old railroad facilities have asbestos-containing materials in floor tiles, ceiling tiles, siding, or thermal system insulation.

Title II of the 1990 CAA Amendments deals with "mobile sources" and seeks to phase in a new set of limits on emissions between 1994 and 1998. If necessary, the EPA has discretion to implement an additional round of mobile source emission limits in 2003.

Section 213(a)(5) of the CAA requires EPA to regulate emissions from locomotives. EPA is expecting to propose locomotive emission regulations in the latter part of 1996 and issue final regulations in the latter part of 1997. The final regulations are expected to impose emission limits on remanufactured and new locomotives.

TSCA

Railroad operations may be affected by TSCA with respect to electrical equipment, such as transformers, containing PCBs. TSCA regulations require proper use, inspection, labeling and marking, recordkeeping, storage, reporting, transportation, management, and disposal of all equipment containing PCBs.

CERCLA

Under CERCLA, incidents must be immediately reported when any spill or release exceeds the Reportable Quantity (RQ). Such a release must be reported if it:

- Occurs on a railroad's property.
- Occurs during transport
- Occurs at a mechanical fixed facility like repair shops or engineering operations.

EPCRA

EPCRA requires companies to identify their facilities to enforcement agencies and provide certain data about the chemicals used at those facilities. EPCRA does not require the reporting of spills that are confined to the boundaries of a facility. All railroads with fixed facilities should maintain Material Safety Data Sheets (MSDSs) for the materials used or stored at the facility. Hard copies should be kept at the facility's site or be available by computer or fax. The transportation of hazardous materials and storage incident to such transportation is exempted from EPCRA requirements.

FIFRA

FIFRA regulations are applicable to railroad operations where herbicides are used to control weeds and brush, or when pesticides and rodenticides are used for pest control in company buildings. FIFRA can also apply to the field application of creosote when bridge timbers or switch ties are installed.

Railroad operations should only apply herbicides, both general and restricted use, according to label instructions. Certification is required for use of restricted use herbicides. Railroads often use outside contractors to apply these products. The National Railroad Contractors Association, an organization comprised of railroad weed control contractors, provides training for restricted use herbicide applicators.

Oil Pollution Act of 1990

See page 84.

VII.B.2. Trucking

Clean Water Act - NPDES Requirements

As discussed above under the general description of the Clean Water Act, EPA published storm water regulations on November 16, 1990, which require certain dischargers of storm water to waters of the U.S. to apply for NPDES permits. According to the final rule, facilities with a "storm water discharge associated with industrial activities" are required to apply for a storm water permit." The rule states that transportation facilities classified as SIC 40, 41, 42 (except 4221-4225), 43, 44, and 5171 which have vehicle maintenance shops, equipment cleaning operations, or airpost deicing operations are considered to have a storm water discharge associated with industrial activity. However, only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airpost deicing operations, or which are otherwise identified under paragraphs (b)(14)(I)-(xi) of section 122.26 are considered to be associated with industrial activity.

Storm water discharges associated with industrial activity that reach waters of the U.S. through municipal separate storm sewer systems (MS4s) are also required to obtain NPDES storm water permit coverage. Discharges of storm water to a combined sewer system or to a POTW are excluded.

The storm water regulation presents two options for storm water discharges associated with industrial activity. The first option is to submit an individual application consisting of NPDES Forms 1 and 2F. The second option is to file a Notice of Intent (NOI) to be covered under a general permit. Regardless of which permit option a facility selects, the resulting storm water discharge permit will most likely contain a requirement to develop and implement a Storm Water Pollution Prevention Plan. Trucking companies which store petroleum products in quantities over 1320 gallons in above ground tanks are also required to develop a Spill Prevention Control and Countermeasures plan (SPCC).

Clean Air Act - Emissions Standards

The most significant CAA regulations under the CAA that affect the trucking industry address mobile source air emissions from truck engines. EPA has set limits on exhaust emissions from new heavy-duty engines. EPA considers heavy-duty truck engines to be those in vehicles weighing at least 8500 pounds gross vehicle weight rating (GVWR). In 1994, the regulations required all heavy-duty truck engines to reduce the emission of nitrogen oxides (NOx) from 5.0g/bhp-hr to 4.0 g/bhp-hr by 1998. Emissions standards are also set for hydrocarbons (HC), carbon monoxide (CO), and particulates (PM). Exhibit 23 displays the past, current, and future emission standards for heavy-duty truck engines.

Exhibit 23
Heavy-Duty Truck Engine Emission Standards
(g/bhp-hr measured during EPA heavy-duty engine test)

Model Year	NOx	HC	CO	PM
1991	6	1.3	15.5	0.6
1994	5	1.3	15.5	0.25
1998	4	1.3	15.5	0.1

Source: Motor Trucking Engineering Handbook. 1994.

CAA regulations mandate the use of alternate fuels for fleets of vehicles in the 8500-26,000 pound class that operate in 22 of the country's most polluted areas. These fleets will be required to purchase 50 percent of their new or replacement vehicles as clean fuel vehicles in any one of the covered areas. Alternative fuels are defined by their ability to reduce NOx and non-methane hydrocarbon emissions by a combined 50 percent from diesel baseline levels. although a 30 percent reduction is permitted if 50 percent is unattainable.

In large part due to the 1993 introduction of congressionally mandated low-sulfur, limited aromatic diesel fuel, manufacturers of diesel engines have been able to closely approach the 1994 emission limits and to focus their efforts on controlling particulates. New engine designs have been used to achieve more efficient and cleaner combustion (*Motor Trucking Engineering Handbook*, James W. Fitch, 1994).

Truck maintenance facilities may face CAA issues for vapor recovery systems on underground fuel tanks, waste oil to energy shop heaters, vehicle painting operations, or CFC recycling and recovery systems.

RCRA

Hazardous waste transportation is a highly regulated and specialized segment of the trucking industry, covered by extensive EPA and DOT regulations. The majority of general freight trucking companies do not transport hazardous waste. Nevertheless, RCRA issues at trucking facilities include several non-transportation activities.

Some fluids used in truck maintenance are considered hazardous waste, requiring specific storage treatment, and disposal. Waste accumulated or generated during trucking maintenance may cause facilities to be considered small or large quantity generators depending on the volume waste. The primary RCRA issues for maintenance facilities are used oil, lead-acid motor vehicle batteries, vehicle maintenance fluids, and scrap tire disposal.

EPCRA

Most trucking companies do not store listed chemicals for use in their facilities. The only exception is diesel fuel or gasoline, which when stored at facilities in quantities slightly over 10,000 gallons, requires reporting to Local Emergency Response Commissions (LERCs) and State Emergency Response Commissions (SERCs). Chemicals in transition are exempt from inventory reporting under EPCRA. This includes all hazardous materials shipments in packages or bulk quantities.

OPA

OPA imposes contingency planning and readiness requirements on certain facilities defined to include rolling stock and motor vehicles. These requirements may affect some trucking establishments.

VII.B.3. Pipelines

Almost all of the petroleum feed stock and products used in the U.S. are, at some point, transported through a Federally-regulated pipeline. The Office of Pipeline Safety (OPS), part of the DOT's Research and Special Programs Administration, regulate essentially all of the approximately 155,000 miles of hazardous liquid pipelines in the U.S., as well as the approximately 255,000 miles of gas transmission lines.

RCRA

Natural gas pipelines do not generate significant quantities of listed hazardous waste. Typical pipeline wastes include condensate, cleaning solvents, and used oil. Each gas pipeline compressor station typically produces an average of 20,000 gallons of used oil each year. This figure depends on the amount of maintenance performed on engines, how often the engines are running, and how much oil is drained from the engines. Under RCRA, used oil is not necessarily a hazardous waste and most gas pipeline companies sell it to refiners.

Water contaminated with constituents of crude oil and petroleum can be regulated under RCRA. Oil pipelines generate hazardous waste when hydrocarbons are mixed with water through pressure testing during installation or through settling in tank bottoms. Oil pipelines can also generate hazardous sludge that results from pigging operations. At pig receipt sites, scraper and cleaning pigs deposit waste materials that often contain hazardous levels of benzene and/or metals.

With regard to storage tanks, RCRA covers hazardous wastes (rather than products) stored in tanks, and such tanks must have secondary containment. EPA has the authority to issue administrative orders requiring cleanup or product releases causing "imminent and substantial endangerment to health or the environment."

OPA

Under the Oil Pollution Act (OPA), the owner or operator of an oil pipeline is liable for removal costs and damages caused by the discharge of oil onto a U.S. shoreline or into navigable waters. The OPA also imposes requirements on affected facilities concerning contingency planning and readiness. Under previous EPA regulations, facilities with the potential to discharge oil were required to have spill prevention, control, and countermeasure (SPCC) plans. Under new requirements, facilities that could be reasonably expected to cause "substantial harm" to the environment by a discharge of oil into navigable waters may be required to adopt such plans.

The DOT's Office of Pipeline Safety (OPS) is responsible for implementing OPA requirements as they apply to onshore oil pipelines that could reasonably be expected to cause significant and substantial harm to the environment by discharging oil into the navigable waters of the U.S. and adjoining shorelines. The OPA applies to all oil pipelines, whether or not they are currently exempt from existing Federal regulations or statutes.

Storage tank facilities that could cause significant and substantial harm to the environment by discharging to navigable water must develop facility response plans and submit them to the Federal government for approval. The act includes extensive liability provisions for spills to navigable waters.

Pipeline Safety Act

Congress passed the Pipeline Safety Act in 1992. The most far-reaching effect of the Act is the expansion of OPS' traditional safety mission to include environmental protection. Major provisions in the Act relate to excess flow valves, cast iron pipelines, gathering lines, customer-owned service lines, underwater inspection and burial, underwater abandoned pipeline facilities, low internal stress pipelines, and emergency flow restricting devices, and contain increased inspection requirements including use of "smart pigs," and operator qualification testing. The Act also provides a statutory basis for the DOT's Research and Special Programs Administration (RSPA), which had been initially established by the Secretary of Transportation in 1977. The RSPA Administrator is to be appointed by the President and confirmed by the Senate.

Natural Gas Pipeline Safety Act and the Hazardous Liquid Pipeline Safety Act

The Natural Gas Pipeline Safety Act (NGPSA) of 1968 provides for Federal safety regulation of pipeline facilities used in the transportation of natural gases. The Hazardous Liquid Pipeline Safety Act (HLPSA) of 1979 provides for safety regulation of pipeline facilities used in the transportation of hazardous liquids. Both provide a framework for promoting pipeline safety through exclusive Federal regulation of interstate pipeline facilities, and Federal delegation to the States for all or part of the responsibility for intrastate pipeline facilities. To provide expertise during development of pipeline safety regulations, NGPSA and HLPSA established two pipeline safety advisory committees, the Technical Pipeline Safety Standards Committee and the Technical Hazardous Liquid Pipeline Safety Standards Committee, respectively. The Committees review proposed regulations for technical feasibility, reasonableness, and practicability. The Committees also provide advice to the DOT on pipeline safety and environmental issues.

TSCA

Some natural gas pipelines used PCBs in their system through the 1980s. PCBs were widely used in transformers, as heat transfer fluids, and in some types of compressor lubricants. In 1989, the Gas Research Institute began a program to deal with the management of PCB residue. The first step involved measuring and analyzing statistical data on PCB contamination of gas transmission pipelines and reviewing remediation programs involving condensate, soil, pipelines, and surface facilities. The Gas Research Institute developed information on physical properties and analytical methods for PCB condensate mixtures, the soil-water partitioning behavior of these mixtures, and an evaluation of the risks associated with typical pipeline operations and PCB abandonment.

CAA

The Clean Air Act affects pipeline system design, operation, and maintenance. Materials such as carbon dioxide, hydrogen sulfide, and mercaptan sulfur are often present in the field gathering systems that move natural gas from wells to processing plants. Pipeline operators must track emissions from compressor and pump stations. Fugitive emissions of benzene from seals on pumps, compressors, valves, meters, and storage tanks must also be evaluated and controlled.

In areas that meet Federal clean air standards, new or modified "major sources" (e.g., tank farms) must install "Best Available Control Technology" (BACT). In areas that do not meet Federal clean air standards, new or modified major sources must utilize "Lowest Achievable Emission Rate" technology, which must be at least as stringent as BACT; existing major sources must utilize designated "Reasonably Available Control Technology," which may be less stringent than BACT. For major sources that emit "Hazardous Air Pollutants," EPA is developing "Maximum Achievable Control Technology" regulations.

CWA

The Spill Prevention Control and Countermeasures (SPCC) program covers petroleum above ground tank facilities that may affect "navigable waters." The SPCC program requires reporting of spills to navigable waters and development of contingency plans that must be kept on-site. EPA has the authority to issue administrative orders requiring cleanup.

SDWA

Regulations promulgated under the Safe Drinking Water Act classify underground injection wells according to the type of operation or substance involved. 40 CFR §144.6(b) describes Class II injection wells as those which inject fluids:

- Which are brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production and may be commingled with waste waters from gas plants which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.
- For enhanced recovery of oil or natural gas; and
- For storage of hydrocarbons which are liquid at standard temperature and pressure.

Many wells associated with the oil and gas industry, including salt water injection wells, enhanced recovery wells, and wells injecting liquid hydrocarbons for storage, are likely to be regulated under the Underground Injection Control (UIC) program.

Under the UIC, wells are required to obtain and adhere to the requirements of operating permits. The permit application must prove to the permitting authority (usually the State) that operation of the underground injection well will not endanger drinking water sources. Class II permits are issued for the life of the well, but can be reviewed every five years.

VII.C. Pending and Proposed Regulatory Requirements

Regulations are currently under development for the transportation equipment cleaning industry. These regulations, when effective, will impact railroads that clean the interior of tank cars, hopper cars, and box cars, and produce wastewater. If a tank car has carried hazardous materials, its car cleaning waste waters may require proper handling under RCRA in addition to that for normal waste waters due to contamination from leftover tank contents or "heel."

In addition there may soon be an effluent guideline on Metal Products and Machinery, which will apply to the rail industry especially for metal machining shops.

VIII. COMPLIANCE AND ENFORCEMENT HISTORY

VIII.A. Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

VIII.B. Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within

the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (April 1, 1992 to March 31, 1997) and the other for the most recent twelve-month period (April 1, 1996 to March 31, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across EPA Regions for certain sectors.[1] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of

[1] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

records for that facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times, e.g., a facility with 3 enforcement actions counts as 3.

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VIII.C. Industry Sector Compliance History

Exhibits 24-31 illustrate recent enforcement activity within the transportation industry. Of the 12,904 inspections conducted at rail, trucking, and oil and gas pipeline facilities over a five year period, 774, or 6 percent, resulted in enforcement actions. Of the three transportation industries addressed by this profile, the pipeline industry has received greater scrutiny from Federal and State inspectors, although certain portions of the trucking industry have also been subject to environmental compliance inspections. While the greatest number of inspections of rail facilities addressed the CWA, the trucking industry had more RCRA inspections while the pipeline industry was subject to the most inspections under the CAA.

Exhibit 24
Five-Year Enforcement and Compliance Summary for Transportation Sectors

	A	B	C	D	E	F	G	H	I	J
	SIC Code	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Rail	4011	434	165	717	36	30	51	74%	26%	0.07
	4013	136	62	328	25	9	13	85%	15%	0.04
Trucking	4212	991	236	987	60	52	147	83%	17%	0.15
	4213	475	205	737	39	34	69	88%	12%	0.09
	4214	195	87	539	22	22	43	81%	19%	0.08
	4215	103	31	60	103	0	0	-	-	-
	4221	219	119	337	39	10	15	73%	27%	0.04
	4222	63	16	52	73	3	6	33%	67%	0.12
	4225	427	151	599	43	25	54	94%	6%	0.09
	4226	479	264	1,828	16	75	182	87%	13%	0.1
	4231	492	180	747	40	28	68	85%	15%	0.09
Oil Pipelines	4612	377	189	780	29	16	85	82%	18%	0.11
	4613	362	193	991	22	16	71	86%	14%	0.07
	4619	45	21	57	47	3	5	100%	0%	0.09
Natural Gas Pipelines	4922	2,942	1,380	4,566	39	88	122	93%	7%	0.03
	4923	190	84	342	33	2	3	100%	0%	0.01
	4924	118	53	210	34	5	7	100%	0%	0.03
	4925	192	112	620	19	12	31	87%	13%	0.05
	4932	30	17	90	20	4	4	100%	0%	0.04
Totals		**7,786**	**3,263**	**12,904**	**36**	**375**	**774**	**84%**	**16%**	**0.06**

R0075365

Exhibit 25
One-Year Enforcement and Compliance Summary for Transportation Sectors

	A	B	C	D	E		F		G	H
	SIC Code	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
					Number	Percent*	Number	Percent*		
Rail	4011	434	73	125	49	67%	6	8%	7	0.06
	4013	136	28	60	23	82%	1	4%	1	0.02
Trucking	4212	991	82	167	87	106%	11	13%	16	0.10
	4213	475	70	126	59	84%	10	14%	16	0.13
	4214	195	43	106	46	107%	9	21%	10	0.09
	4215	103	8	8	5	63%	0	0%	0	-
	4221	219	58	71	24	41%	1	2%	1	0.01
	4222	63	4	6	2	50%	0	0%	0	-
	4225	427	58	95	70	121%	2	3%	2	0.02
	4226	479	152	317	85	56%	17	11%	24	0.08
	4231	492	65	137	45	69%	8	12%	10	0.07
Oil Pipelines	4612	377	114	185	20	18%	2	2%	4	0.02
	4613	362	122	186	32	26%	3	2%	5	0.03
	4619	45	10	45	6	60%	0	0%	0	-
Natural Gas Pipelines	4922	2,942	708	963	159	22%	23	3%	23	0.02
	4923	190	41	66	13	32%	1	2%	2	0.03
	4924	118	29	50	9	31%	2	7%	3	0.06
	4925	192	58	107	16	28%	3	5%	9	0.08
	4932	30	8	13	5	63%	1	13%	1	0.08
Totals		**7,786**	**1585**	**2499**	**681**	**27%**	**85**	**3%**	**103**	**0.04**

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*

R0075366

Exhibit 26
Five-Year Enforcement and Compliance Summary by Statute for Transportation Sectors

	SIC Code	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/EPCRA/Other	
					% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Rail	4011	165	717	51	18%	6%	52%	56%	30%	30%	0%	8%
	4013	62	328	13	30%	8%	56%	54%	13%	31%	1%	8%
Trucking	4212	236	987	147	14%	33%	14%	4%	71%	59%	1%	3%
	4213	205	737	69	13%	17%	11%	4%	74%	78%	1%	0%
	4214	87	539	43	23%	16%	6%	7%	70%	72%	1%	5%
	4215	31	60	0	5%	0%	0%	0%	95%	0%	0%	0%
	4221	119	337	15	88%	87%	1%	0%	9%	7%	1%	7%
	4222	16	52	6	12%	17%	56%	50%	33%	33%	0%	0%
	4225	151	599	54	31%	9%	16%	6%	52%	83%	2%	2%
	4226	264	1,828	182	46%	53%	15%	14%	38%	32%	1%	1%
	4231	180	747	68	17%	7%	11%	13%	71%	78%	1%	1%
Oil Pipelines	4612	189	780	85	79%	71%	8%	5%	13%	25%	0%	0%
	4613	193	991	71	64%	73%	20%	3%	16%	23%	0%	1%
	4619	21	57	5	54%	20%	23%	20%	21%	60%	2%	0%
Natural Gas Pipelines	4922	1,380	4,566	122	92%	86%	3%	3%	5%	6%	0%	5%
	4923	84	342	3	89%	67%	8%	33%	3%	0%	0%	0%
	4924	53	210	7	80%	71%	13%	29%	8%	0%	0%	0%
	4925	112	620	31	71%	72%	12%	13%	17%	9%	0%	6%
	4932	17	90	4	39%	50%	42%	25%	17%	25%	2%	0%
Totals		3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%

Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

R0075367

Exhibit 27
One-Year Enforcement and Compliance Summary for Transportation Sectors

	SIC Code	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
					% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Rail	4011	73	125	7	16%	17%	51%	67%	33%	17%	0%	0%
	4013	28	60	1	30%	0%	50%	100%	20%	0%	0%	0%
Trucking	4212	82	167	16	17%	31%	14%	0%	69%	69%	0%	0%
	4213	70	126	16	12%	19%	10%	0%	78%	81%	0%	0%
	4214	43	106	10	12%	20%	10%	0%	77%	80%	0%	0%
	4215	8	8	0	25%	0%	0%	0%	75%	0%	0%	0%
	4221	58	71	1	82%	0%	0%	0%	18%	100%	0%	0%
	4222	4	6	0	17%	0%	33%	0%	50%	0%	0%	0%
	4225	58	95	2	37%	50%	14%	0%	49%	50%	0%	0%
	4226	152	317	24	48%	42%	12%	17%	39%	38%	0%	4%
	4231	65	137	10	19%	0%	13%	0%	68%	100%	0%	0%
Oil Pipelines	4612	114	185	4	87%	75%	4%	0%	9%	25%	0%	0%
	4613	122	186	5	72%	60%	22%	0%	6%	40%	0%	0%
	4619	10	45	0	50%	0%	8%	0%	42%	0%	0%	0%
Natural Gas Pipelines	4922	708	963	23	94%	96%	3%	0%	4%	4%	0%	0%
	4923	41	66	2	83%	100%	11%	0%	6%	0%	0%	0%
	4924	29	50	3	92%	33%	2%	67%	6%	0%	0%	0%
	4925	58	107	9	79%	100%	8%	0%	12%	0%	0%	0%
	4932	8	13	1	46%	100%	38%	0%	15%	0%	0%	0%
Totals		**1,585**	**2,499**	**103**	**64%**	**46%**	**11%**	**10%**	**26%**	**44%**	**0%**	**1%**

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

VIII.D. Comparison of Enforcement Activity Between Selected Industries

The following exhibits present inspection and enforcement information across numerous manufacturing sector industries including the ground, water, and air transportation industries.

Exhibit 28: Five-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	**7,786**	**3,263**	**12,904**	**36**	**375**	**774**	**84%**	**16%**	**0.06**
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Exhibit 29: One-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	**7,786**	**1,585**	**2,499**	**681**	**43%**	**85**	**5%**	**103**	**0.04**
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*

Exhibit 30: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries											
Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	**3,263**	**12,904**	**774**	**59%**	**41%**	**12%**	**11%**	**29%**	**45%**	**1%**	**3%**
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

R0075372

Exhibit 31: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	**1,585**	**2,499**	**103**	**64%**	**46%**	**11%**	**10%**	**26%**	**44%**	**0%**	**1%**
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

IX. Review of Major Legal Actions

This section provides summary information about major cases that have affected this sector. As indicated in EPA's Enforcement Accomplishments Reports from 1992-1994, several significant enforcement actions were resolved between 1992-1994 involving the rail, trucking, and pipeline industries. Characterizations of the types of enforcement actions taken are provided for each of the cited cases.

IX.A. Review of Major Cases

IX.A.1. Rail

U.S. v. Consolidated Rail Corporation, CAA, 1992

U.S. District Court entered a second amendment to consent order resolving EPA's CAA contempt action against Consolidated Rail Corporation (Conrail). The amendment requires Conrail to pay $165,000 in penalties for past violations. In addition, it allows the company to apply encrusting agents in lieu of water to control fugitive dust. The amendment is based on a consent order EPA and Conrail negotiated in 1986 to resolve violations of Ohio's State Implementation Plan (SIP).

U.S. v. CSX Transportation, CWA, 1993

CSX Transportation signed a consent decree to pay $3.00,000 in civil penalties and perform four Supplemental Environmental Projects (SEPs) valued at $4,000,000 for alleged violations of CWA for exceeding NPDES limits.

Burlington Northern, Multi-media, 1994

EPA Region V sought $279,078 to recover costs incurred consistent with the NCP under CERCLA and OPA, natural resource damages totaling $250,000, and CWA penalties totaling $2,500,000 for three incidents of railroad derailment.

In the matter of Burlington Northern Railroad, EPCRA, 1994

A RCRA consent order was issued for the contamination of groundwater, and a 1993 unilateral administrative order, based on a multimedia inspection, required the defendant to cease discharge of oil and chlorinated waters.

Southern Pacific Transportation Corporation, 1994

A train derailment caused the release of a herbicide into the Sacramento River killing all plant life for 42 miles. The settlement provided for recovery of $36 million in response costs. The decree also required payment of a $500,000 civil penalty (the statutory maximum for the violation). Defendants must also establish a $14 million fund for natural resource damages.

U.S. v. Norfolk & Western Railway Company, 1994

Criminal plea agreement and settlement resulted in the U.S. receiving $500,000 fine and $500,000 restitution. Missouri received $700,000 fine and $1.7 million in restitution, $1 million for creation of a park, and establishment of a $2.2 million environmental awareness program.

IX.A.2. Trucking

U.S. v. The Carborundum Company, et al. , CERCLA, 1994

On March 30, 1994, a consent decree was lodged in the District Court of New Jersey which partially settles Region II's cost recovery claims relating to the Caldwell Trucking Company Superfund site in Fairchild Township, New Jersey. From 1950 through the mid 1970s, Caldwell Trucking hauled septage and other wastes from residential, commercial, and industrial customers and disposed of these wastes in unlined lagoons at the site. The nine settling defendants agreed to pay $2.46 million for EPA's past and future costs and agreed to perform all scheduled remedial and natural resource restoration work at the site, valued at an additional $32 million. New Jersey will also receive its first natural resource damage payment under CERCLA, in the amount of $984,000, and the U.S. Department of the Interior will receive $40,000 for its assessment and monitoring costs.

U.S. v. Gomer's Diesel and Electric Company, RCRA, 1994

Gomer's Diesel and Electric Co., with automotive and truck maintenance facilities located in Belgrade, Great Falls, and Missoula, Montana, was sentenced on March 24, 1994, following a plea of guilty to one-count of unlawful transportation of a hazardous waste in violation of RCRA. The company was placed on supervised probation for two years and fined $100,000, $50,000 of which was suspended in recognition of remediation conducted at its Belgrade facility.

Hamner, Inc., Corpus Christi, CWA, 1994

An administrative Class I complaint was issued against Hamner, Inc. Corpus Christi, Texas, on May 24, 1994, with a proposed penalty of $9,108 for violations of the CWA. The corporation's tanker truck overturned, discharging approximately 24 barrels of petroleum naphtha. The petroleum naphtha entered navigable waters of the U.S. in quantities determined to be harmful. The oil did not enter a major waterway, no drinking water supply was affected, and there were no signs of damage to wildlife or aquatic life. Settlement negotiations are underway.

IX.A.3. Pipelines

U.S. v. Shell Oil Pipeline Corporation, Criminal Enforcement, 1992

Pipeline rupture caused an 860,000 gallon oil spill into the Mississippi, Gasconade, and Missouri rivers. Shell pleaded guilty to violation of the Refuse Act and agreed to pay $8,400,000 in fines, restitution, and settlements.

U.S. v. Texaco, CERCLA, 1993

Texaco entered a consent decree for performance of a remedial design and remedial action at the Pacific Cost Pipeline Superfund site in California. The RA is valued at $4,000,000. Texaco also agreed to reimburse California for response costs, the U.S. for future response costs, and EPA for past RI/FS costs.

U.S. v. Transwestern Pipeline Company, TSCA, 1993

A consent decree was terminated when the defendant met all terms and conditions of settlement (including payment of a penalty of $375,000 and groundwater monitoring). Under the decree, 144,991 tons of PCB contaminated soil and debris were removed and disposed in TSCA landfill.

U.S. v. Tennessee Gas Pipeline Co., CWA, 1993

Court entered final order for dismissal after parties agreed to a penalty of $725,000 for unauthorized discharges of PCBs from a pumping station.

U.S. v. U.S. Oil and U.S. v. Texaco, OPA, 1993

U.S. Oil agreed to pay civil penalties of $425,000 and Texaco agreed to pay $480,000 in penalties. Both were made to acquire and install state-of-the-art spill detection and prevention equipment valued at $800,000 for each company. Both were also required to reimburse for Federal spill response costs of $60,000 and $125,000 respectively. The actions represent the first judicial penalties assessed under OPA.

IX.B. Supplemental Environmental Projects (SEPs)

Below is a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

Exhibit 32 contains a sample of SEPs from the transportation industry. The information contained in the chart is not comprehensive and provides only a sample of the types of SEPs developed for the transportation industry.

Exhibit 32
Supplemental Environmental Projects in the Transportation Industry

Case Name	Statute	Estimated Cost to Company	Environmentally Beneficial Activities
General Chemical Company	CAA	$90,000.	Facility was to purchase and install an Airless Paint Spray Unit and Fanu Robotics Spray Unit in order to reduce total VOC releases to the atmosphere by 10 percent.
Thatcher Chemical Company	EPCRA §304	Not Known	SEP included the construction of a building with scrubbing equipment for enclosing loading products to prevent future releases into the environment to be completed by January 24, 1994.
CSX Transportation	CAA	$ 4,000,000	Company was required to: • Perform NPDES compliance audits at 21 active CSX railroad yards • Conduct multi-media risk assessment audit at 61 inactive facilities • Provide environmental awareness training program for managers • Develop best management practices manual and a seminar on storm water runoff at railroad yards.

X. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. This section of the notebook also contains a listing and description of national and regional trade associations.

X.A. Sector-Related Environmental Programs and Activities

Environmental compliance assurance activities have been conducted by the major trade associations for each of the transportation sectors covered in this report. The following examples represent some of the industry initiatives that promote compliance, or assess methods to reduce environmental contamination.

X.A.1. Rail

Waste Minimization Assessment for a Manufacturer of Rebuilt Railway Cars and Components

U.S. EPA funded a pilot project to assist small- and medium-size manufacturers wishing to minimize their generation of hazardous waste, but lacking the expertise to do so. The Agency established Waste Minimization Assessment Centers (WMACs) at selected universities, adapting procedures from EPA's *Waste Minimization Opportunity Assessment Manual*. The WMAC team at the University of Tennessee inspected a plant that rebuilds approximately 2,000 railway cars each year and that refurbishes wheel assemblies and air brake systems. The team issued a report and made a number of recommendations for minimizing hazardous waste outputs.

X.A.2. Trucking

Consolidated Compliance Reviews

The trucking industry has worked with the Department of Transportation, Federal Highway Administration (FHWA), to develop streamlined processes for conducting compliance reviews. As a result, the FHWA now conducts all record reviews and inspection activities in a "one stop" process.

The original process involved several different inspections. The first type of inspection focused on compliance with ICC rules and operating authority licenses. The second type of inspection focused on safety compliance issues. Additional inspections were conducted to ensure compliance with hazardous materials transportation regulations were added in the 1980's. More recently, driver drug testing was added to the inspection requirements.

DOT-FHWA's compliance review is now conducted with the inspector using a lap-top computer with built in prompters, programs to generate checklists, work sheets, tabulations, and regulations and interpretations. These tools allow the inspector to cover all the components of the inspection in "one stop." The compliance review often occurs at corporate headquarters. The system was developed in 1986; currently, about 200 DOT-FHWA inspectors use the system.

Inspectors receive six weeks of training when they come into the DOT-FHWA, including training on case development, regulations, compliance reviews, and sensitivity. Inspectors do not need permission before entering a facility but usually call in advance so the appropriate staff and records can be available. Unannounced inspections may occur if criminal activity is suspected.

DOT-FHWA inspectors are providing more and more technical assistance to the regulated community. They have education packages on specific issues, such as hazardous materials, and "On Guard" announcements of new safety problems or rules affecting the industry.

Cooperative Hazardous Materials Enforcement Development

The Cooperative Hazardous Materials Enforcement Development (COHMED) program is an outreach activity of the U.S. DOT's Research and Special Programs Administration (RSPA). COHMED works to promote coordination, cooperation, education, and communication for Federal, State, local agencies, and industry having enforcement, response, and management responsibilities for the safe transportation of hazardous materials. Through education and training, COHMED participants are able to improve current programs, and develop new programs to enhance hazardous materials safety.

COHMED conducts semi-annual conferences and hazardous materials seminars. COHMED also publishes a quarterly newsletter, "The Reporter," and the "Bullet" when expedient dissemination of information is required. COHMED participation is open to Federal, State, local agencies, and industry involved in enforcement, emergency response or planning and preparedness. For more information call (202) 366-4900.

CHEMTREC

CHEMTREC is a pubic service organization established by the Chemical Manufacture's Association and its members in 1971 to provide first responders, the transportation industry, medical professionals, and others access to response information and technical assistance from chemical industry experts for incidents involving hazardous materials. The Center is staffed by trained communicators who can contact thousands of chemical manufacturers. shippers, distributors, and carriers. Through these contacts, CHEMTREC can teleconference responders at the scene of an incident with technical experts to provide immediate advice and assistance. CHEMTREC can also immediately provide and transmit, via fax, product Material Safety Data Sheets or other specific product information. The CHEMTREC Center can be reached 24 hours a day, 7 days a week at 1-800-424-9300.

TRANSCAER

TRANSCAER is an outreach program that focuses on assisting communities that do not host a major chemical facility but have major transportation routes within their jurisdiction. TRANSCAER is sponsored by the chemical manufacturing, distribution and transportation industries. TRANSCAER's objectives are to ensure that communities are prepared to handle hazardous materials transportation emergencies and that an ongoing dialogue exists with the public about chemical transportation. The program provides assistance for communities to develop and evaluate their emergency response plan for hazardous material transportation incidents. For more information contact the TRANSCAER Task Group at c/o CMA, 1300 Wilson Blvd., Arlington, VA. 22209.

CMA's Lending Library

Since 1985, the CMA's Lending Library has provided free access to videotape training programs on hazardous materials and handling hazardous materials incidents. Contact the CMA Publication Fulfillment department at (202) 887-1253 for ordering information.

X.A.3. Pipelines

The giant Alaska company Alyeska has undertaken the most expensive corrosion repair program in the industry's history with a campaign to inspect pipelines for corrosion, repair damaged sections, and replace pipe sections as needed. The estimated costs of this effort from 1991-1996 are $600-800 million. External and internal corrosion at some of the 800-mile line's pump stations was discovered with the help of a corrosion detection pig that exceeded Federal standards for corrosion detection and mitigation (U.S. Petroleum Strategies, Bob Williams, 1991).

X.B. EPA Voluntary Programs

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative developed by EPA that focuses on improving environmental performance, encouraging voluntary compliance, and building working relationships with stakeholders. EPA initiated a one year pilot program in 1995 by selecting 12 projects at industrial facilities and federal installations that demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, pollution prevention, community involvement, and mentor programs. In return for participating, pilot participants received public recognition and were given a period of time to correct any violations discovered during these experimental projects.

EPA is making plans to launch its full-scale Environmental Leadership Program in 1997. The full-scale program will be facility-based with a 6-year participation cycle. Facilities that meet certain requirements will be eligible to participate, such as having a community outreach/employee involvement programs and an environmental management system (EMS) in place for 2 years. (Contact: http://es.inel.gov/elp or Debby Thomas, ELP Deputy Director, at 202-564-5041)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Fax-on-Demand Hotline 202-260-8590, Web: http://www.epa.gov/ProjectXL, or Christopher Knopes at EPA's Office of Policy, Planning and Evaluation 202-260-9298)

Climate Wise Program

EPA's ENERGY STAR Buildings Program is a voluntary, profit-based program designed to improve the energy-efficiency in commercial and industrial buildings. Expanding the successful Green Lights Program, ENERGY STAR Buildings was launched in 1995. This program relies on a 5-stage strategy designed to maximize energy savings thereby lowering energy bills, improving occupant comfort, and preventing pollution -- all at the same time. If implemented in every commercial and industrial building in the United States, ENERGY STAR Buildings could cut the nation's energy bill by up to $25 billion and prevent up to 35% of carbon dioxide emissions. (This is equivalent to taking 60 million cars of the road). ENERGY STAR Buildings participants include corporations; small and medium sized businesses; local, federal and state governments; non-profit groups; schools; universities; and health care facilities. EPA provides technical and non-technical support including software, workshops, manuals, communication tools, and an information hotline. EPA's Office of Air and Radiation manages the operation of the ENERGY STAR Buildings Program. (Contact: Green Light/Energy Star Hotline at 1-888-STAR-YES or Maria Tikoff Vargas, EPA Program Director at 202-233-9178 or visit the ENERGY STAR Buildings Program website at http://www.epa.gov/appdstar/buildings/)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program saves money for businesses and organizations and creates a cleaner environment by reducing pollutants released into the atmosphere. The program has over 2,345 participants which include major corporations, small and medium sized businesses, federal, state and local governments, non-profit groups, schools, universities, and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. As of March 1997, participants had lowered their electric bills by $289 million annually. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and an information hotline. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Green Light/Energy Star Hotline at 1-888-STARYES or Maria Tikoff Vargar, EPA Program Director, at 202-233-9178 the)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1997, the program had about 500 companies as members, one third of whom are Fortune 1000 corporations. Members agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports. To member companies, EPA, in turn, provides technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at 1-800-372-9473 or Joanne Oxley, EPA Program Manager, 703-308-0199)

$NICE^3$

The U.S. Department of Energy is administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics ($NICE^3$). By providing grants of up to 45 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, and demonstrate new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the forest products, chemicals, petroleum refining, steel, aluminum, metal casting and glass manufacturing sectors. (Contact: http//www.oit.doe.gov/access/nice3, Chris Sifri, DOE, 303-275-4723 or Eric Hass, DOE, 303-275-4728)

Design for the Environment (DfE)

DfE is working with several industries to identify cost-effective pollution prevention strategies that reduce risks to workers and the environment. DfE helps businesses compare and evaluate the performance, cost, pollution prevention benefits, and human health and environmental risks associated with existing and alternative technologies. The goal of these projects is to encourage businesses to consider and use cleaner products, processes, and technologies. For more information about the DfE Program, call (202) 260-1678. To obtain copies of DfE materials or for general information about DfE, contact EPA's Pollution Prevention Information Clearinghouse at (202) 260-1023 or visit the DfE Website at http://es.inel.gov/dfe.

X.C. Trade Association/Industry-Sponsored Activity

The trade associations that represent the transportation industry are a valuable source of economic and environmental compliance data. The following subsections list major transportation trade organizations and highlight environmental initiatives sponsored by some of these groups.

X.C.1. Railroad Tank Car Safety Research and Test Project

Since 1970 the Railway Progress Institute (RPI) and Association of American Railroads (AAR) have cosponsored the RPI-AAR Railroad Tank Car Safety Research and Test Project. The purpose of the project, initiated following several fatal tank car crashes in the late 1960s, is to identify and understand the causes of tank car punctures and ruptures in accidents and to develop engineering solutions. Results of this continuing project have led to the development and introduction of several devices to improve tank car crash worthiness, including double-shelf couplers and head and thermal protection systems. In addition, the program has produced a database of more than 35,000 records of tank cars damaged over the past 30 years (*Ensuring Railroad Tank Car Safety*, Transportation Research Board, National Research Council, 1994).

The research conducted on tank car safety has resulted in the implementation of regulation to increase the safety of certain hazardous material cars. DOT HM-175 which was finalized in September 1995, covers a wide range of tank car safety related issues, including new tank car specifications for halogenated organic compounds. This effort has resulted in significantly safer tank cars for these materials.

In addition, there have been several improvements in an industry agreement between the AAR, the Chemical Manufacturers Association (CMA), and RPI, including:

- Thicker tank cars made of stronger steel;
- Elimination of bottom outlets, a common source of releases in accidents; and
- A full height head shield to protect the end of the tank from punctures in accidents.

X.C.2. The North American Non-Accident Release Reduction Program

The North American Non-Accident Release Reduction Program was initiated in June 1995 by the rail industry. A "Non-Accident Release" (NAR) is any unintended release of a hazardous commodity from a railroad car not caused by a train accident. Most NAR's involve small quantity releases, but some have been very costly and all have the potential for serious injury. The North American NAP Program is an awareness campaign designed to alert shippers and carriers to repeated instances of NARs of hazardous commodities from rail tank cars and encourage positive action to prevent recurrence.

General oversight of the NAR Program rests with AAR's Hazardous Materials Working Committee and the NAR General Committee, made up of representatives from shippers, carriers, car owners, and industry associations. The NAR Program has two sub-committees, a Technical Subcommittee and a Communications/Regulatory Subcommittee. The Technical group reviews NAR data and attempts to develop technical solutions to identified problems. The Communications/Regulatory group works on program publicity and government (regulatory) relations.

NAR data is collected by carriers and reported to AAR, who enters it into an NAR database, keeping all business data confidential. When a threshold number of releases has been recorded for any given company, AAR prepares an "action package" outlining the details of each release and forwards the information to a designated individual at that company. Recipients of action packages are encouraged to take whatever actions are appropriate to address the causes of the releases, advising AAR of their response. The NAR General Committee has set a goal to reduce the number of NARs from hazardous materials tank cars in North America by 25 percent over a two year period. The North American NAR Program is an expansion of a successful program started in Canada in 1992. NAR's in Canada were reduced 32% over a two year period after implementation of the program.

X.C.3. Environmental Compliance Handbook for Short Line Railroads

As part of its mandate to clarify and communicate environmental regulatory responsibilities to the freight and rail industry, EPA's Freight, Economy, and the Environmental Work Group has worked with the Federal Railroad Administration (FRA) to prepare a handbook on EPA regulations applicable to short line railroads. The handbook is a "plain English" guide to short line railroad environmental responsibilities and the laws that created them. The handbook also provides State and Federal agency contacts and Hotlines.

X.C.4. Environmental Training Publications and Videotapes

The American Trucking Associations (ATA) has developed numerous documents and videotapes to help those in the trucking industry to better understand applicable environmental regulations and to assist them in compliance. Following is a list of some the materials offered by the ATA. For a more complete catalogue listing these and other products, contact the ATA document center at (800) ATA-LINE.

- *Stormwater Best Management Practices: Guidance for Vehicle Maintenance Facilities (video)* - Identifies practical and effective best management practices that can be used in vehicle washing, fueling, and loading areas.

- *Used Oil: A Guidebook to Best Management Practices* - Helps the user determine the company's responsibilities and develop procedures that are productive, cost-efficient, and in compliance with Federal and State guidelines.

- *Hazardous Waste Regulations for the Trucking Industry* - Outlines and explains hazardous waste regulations as they relate to the trucking industry.

- *Stormwater: Pollution Prevention for the Trucking Industry* - Explains how to write a pollution prevention plan and covers the five general phases of a plan in detail.

- *Vehicle Washing Compliance Manual* - Provides a State-by-State review of applicable regulations affecting vehicle washing and a survey of vehicle washing technology.

X.C.5. Pipeline Integrity Programs - Natural Gas and Hazardous Liquid One-Call Systems

More than 60 percent of pipeline accidents are the result of third-party damage. One-call systems were developed to reduce the number of incidents involving accidental pipeline ruptures.

Contractors and homeowners who work in the vicinity of natural gas and hazardous liquid lines can learn of their location via a single telephone number. This number is supplied in 48 of the 50 States and in Canada by various one-call systems, and is usually posted on pipeline markers along the pipe route.

Each one-call system is an organization funded by member underground utilities. The system acts as a computerized link between people digging around pipelines and the operators of these conveyance systems. When a contractor or homeowner calls the toll-free number, the one-call operator takes information regarding the time and location of planned work and immediately notifies all members with underground facilities in the excavation area.

When a member receives notification of planned excavation in its area, its operators are responsible for determining the potential hazards to the line. If the work does have the potential to affect the pipeline, the company will dispatch crews within 24 to 72 business hours to locate and mark the pipeline's route. After determining the direction and width of the pipe, personnel use a series of flags or spray paint to mark the exact location of the system. If the work will cross the pipeline, crews also test for exact pipeline depth.

X.C.6. Summary of Trade Associations

The trade and professional organizations serving the transportation industry are presented below, classified by industry sector.

Rail

Association of American Railroads 50 F Street, NW Washington, D.C. 20001 Phone: (202) 639-2839 Fax: (202) 639-2465	Members: 64 Staff: 607 Budget: $48,800,000

The Association of American Railroads (AAR) is the coordinating and research agency of the American railway industry. Membership is comprised of the larger, Class I, railroads. Focus areas include: railroad operation and maintenance, statistics, medical problems, cooperative advertising and public relations, rates, communication, safety, and testing of railroad equipment. The AAR was founded in 1934 and maintains a library of current and historical volumes and periodicals. The AAR also operates an on-line database of all railcars, trailers, and containers used in North America called Universal Machine Language Equipment Register. Publications include the quarterly *Official Railway Equipment Register*, the biweekly *Rail News Update*, and the annual *Railroad Facts*. The AAR also publishes studies, statistical reports, and general information publications.

National Railway Labor Conference 1901 L Street, NW, Suite 500 Washington, D.C. 20036 Phone: (202) 862-7200 Fax: (202) 862-7230	Members: 150 Staff: 25 Budget: $4,100,000

The National Railway Labor Conference (NRLC), founded in 1963, serves as a management collective bargaining agency for the railroad industry. NRLC represents railroads as well as switching and terminal companies and compiles statistics on the industry.

Trucking

American Trucking Associations 2200 Mill Road Alexandria, VA 22314 Phone: (703) 838-1844 Fax: (703) 838-1992	Members: 4,100 Staff: 300 Budget: $45,000,000

The American Trucking Associations (ATA), founded in 1933, represents motor carriers, suppliers. State trucking associations, and national conferences of trucking companies. The ATA works to influence the decisions of Federal, State, and local governmental bodies to promote increased efficiency, productivity, and competitiveness in the trucking industries. ATA promotes highway and driver safety, supports highway research projects, and studies technical and regulatory problems of the trucking industry. ATA and its affiliated conferences provide extensive educational opportunities and products to assist trucking companies with safety, OSHA, and environmental regulation. In addition, the association provides members with a guide to Federal and State regulations and offers a comprehensive accounting service for carriers of all sizes. An information center containing numerous ATA and other publications is available to members and the public.

Association of Waste Hazardous Materials Transporters 2200 Mill Road Alexandria, VA 22314 Phone: (703) 838-1703 Fax: (703) 519-1866	Members: 75 Staff: 2

The Association of Waste Hazardous Materials Transporters represents carriers that transport PCBs, used oil, and hazardous and radioactive waste by truck and rail.

National Tank Truck Carriers 2200 Mill Road Alexandria, VA 22314 Phone: (703) 838-1960 Fax: (703) 864-5753	Members: 260 Staff: 7 Budget: $1,000,000

The National Tank Truck Carriers (NTTC) was founded in 1945 and represents common or contract tank truck carriers transporting liquid and dry bulk commodities, chemicals, food processing commodities, petroleum, and related products. NTTC promotes Federal standards of construction, design, operation, and use of tank trucks and equipment. NTTC sponsors schools, conducts research, and produces periodicals, including the annual *Cargo Tank Hazardous Materials Regulations* and *Hazardous Commodities Handbook*

R0075388

Regional and Distribution Carriers Conference 2200 Mill Road, Suite 540 Alexandria, VA 22314 Phone: (703) 838-1990 Fax: (703) 836-6870	Members: 375 Staff: 5

The Regional and Distribution Carriers Conference (RDCC) consists of companies participating in trucking for hire, including local cartage and short haul. RDCC was founded in 1943 and represents motor haul carriers rendering distribution services beyond commercial zones. RDCC is affiliated with ATA and conducts an executive management seminar and exhibit. RDCC produces a monthly newsletter and several informational phamplets.

Interstate Truck Carriers Conference 2200 Mill Road, 3rd Floor Alexandria, VA 22314 Phone: (703) 838-1950 Fax: (703) 836-6610	Members: 800 Staff: 7 Budget: $800,000

The Interstate Truck Carriers Conference (ITCC) consists of contract carriers, irregular route common carriers, shippers, and others related to the motor carrier industry. ITCC was founded in 1983 and serves as an industry spokesperson for this part of the trucking industry. ITCC represents their members' interests before Congress, the Interstate Commerce Commission, and the courts. ITCC is affiliated with ATA and has a refrigerated carrier division as well as a political action committee. ITCC conducts a management development seminar at Notre Dame University and produces bulletins and newsletters.

Pipelines

Interstate Natural Gas Association of America 555 13th Street, NW, Suite 300 West Washington, DC 20004 Phone: (202) 626-3200 Fax: (202) 626-3249	Members: 35 Staff: 30

The Interstate Natural Gas Association of America (INGAA) represents transporters of natural gas. INGAA has established committees on issues regarding regulatory and government affairs, policy analysis, and the environment. INGAA produces *Interstate Natural Gas Association of American - Washington Report*, a weekly newsletter that covers legislative

R0075389

and regulatory developments affecting the industry which is available to both members and non-members.

American Petroleum Institute 1220 L Street, NW Washington, DC 20005 Phone: (202) 682-8000 Fax: (202) 682-8030	Members: 300 Staff: 500

The American Petroleum Institute (API) works to ensure cooperation between industry and government on all matters of mutual concern. API conducts research, sets standards, provides information services, and maintains a large library. API was founded in 1919 and represents corporations in the petroleum and allied industries, including producers, refiners, marketers, and transporters of crude oil, lubricating oil, gasoline, and natural gas. API has committees on industry technical issues, health, environment and safety, and government affairs and produces many standards, periodicals, books, and manuals.

Association of Oil Pipe Lines 1101 Vermont Avenue, NW, Suite 604 Washington, DC 20005 Phone: (202) 408-7970 Fax: (202) 408-7983	Members: 80 Staff: 3

The Association of Oil Pipe Lines (AOPL), founded in 1947, consists of oil pipeline companies which are generally regulated carriers. AOPL compiles and presents statistical and other data related to the pipeline industry to Congress, government departments, agencies and commissions, trade associations, and the public. AOPL is affiliated with API and produces several publications, including *Oil Pipelines of the United States: Progress and Outlook*.

R0075390

Page 120 intentionally left blank.

XI. Resource Materials/Bibliography

For further information on selected topics within the transportation industry sectors profiled in this document, a list of publications is provided below:

General Profile

Transportation in America. Eno Transportation Foundation, Inc., 1994.

National Transportation Statistics, U.S. Department of Transportation, 1995.

1992 Census of Transportation, Communications, and Utilities: Geographic Area Series Summary, U.S. Department of Commerce.

1992 Census of Transportation, Communications, and Utilities: Subject Series (Establishment and Firm Size), U.S. Department of Commerce.

1992 Census of Transportation, Communications, and Utilities: Nonemployer Statistics Series Summary, U.S. Department of Commerce.

Encyclopedia of Associations. 27th ed., Deborah M. Burke, ed., Gale Research Inc., Detroit. Michigan, 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Enforcement Accomplishments Report, FY 1994, U.S. EPA, Office of Enforcement , April 1995.

Environmental Sources and Emissions Handbook, No. 2, Marshall Sitig, Noyes Data Corporation. 1975.

McGraw-Hill Encyclopedia of Science & Technology, 7th ed., vol. 8, McGraw-Hill Book Company. New York, New York, 1992.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Industrial Outlook 1994, Department of Commerce.

Rail Profile

Railroad Facts, 1995 Edition, Association of American Railroads, 1995.

Waste Minimization Assessment for a Manufacturer of Rebuilt Railway Cars and Components, F. William Kirsch and Gwen P. Looby, University City Science Center, Philadelphia, Pennsylvania and U.S. Risk Reduction Engineering Laboratory, Cincinnati, Ohio, July, 1991. EPA/600/M-91/017.

Ensuring Railroad Tank Car Safety, Transportation Research Board, National Research Council, 1994.

Association of American Railroads Catalogue of Publications: 1995-1996, AAR.

Railroad Information Handbook, AAR, 1994.

Trucking Profile

Source Assessment: Rail Tank Car, Tank Truck, and Drum Cleaning, State-of-the-Art, Monsanto Research Corporation, Dayton, Ohio, 1978.

One Hundred Years of Infrastructure: 1892-1992. July 1992.

General Pipeline Profile

Oil and Gas Pipeline Fundamentals, Second edition, John L. Kennedy, Pennwell Books, 1993.

"U.S. Interstate Pipelines Ran More Efficiently in 1994," *Oil and Gas Journal*, November 27, 1995.

Gas Pipeline Profile

Natural Gas 1995: Issues and Trends, Energy Information Administration, 1995.

Energy Policy Act Transportation Study: Interim Report on Natural Gas Flows and Rates, Energy Information Administration, 1995.

Natural Gas Technologies: Energy Security, Environment and Economic Development: Conference Proceedings, 1993, International Energy Agency, 1993.

Reporting Requirements of Interstate Natural Gas Pipelines (Report No. 93-1), INGAA, 1993.

Overview of Natural Gas Storage Operations (Report No. 91-6), INGAA, 1991.

Analyses Related to the Impact of Air Quality Regulation on the Natural Gas Transmission Industry, INGAA Foundation, 1992.

New Directions: Natural Gas Supply, Natural Gas Council, 1992.

New Directions: Natural Gas Energy, Natural Gas Council, 1992.

Natural Gas Reliability, Natural Gas Council, 1993.

New Directions: Natural Gas Technology Research and Development, Natural Gas Council, 1993.

Natural Gas Reliability Principles, Natural Gas Council, 1995.

New Directions: Natural Gas, Energy and the Environment, Natural Gas Council, 1993.

America's Natural Gas Pipelines: A Network Built on Safety, INGAA.

Pipeline to Clean Energy: An Introduction to Interstate Natural Gas Association of America Legislative Affairs, 104th Congress, INGAA.

Going the Extra Mile for Safety: America's Interstate Natural Gas Pipelines, INGAA Foundation.

Natural Gas Pipelines: The Safe Route to Energy Security, INGAA.

Factbook: Energy, the Environment, and Natural Gas, AGA, 1983.

Profiles of U.S. and Canadian Natural Gas Pipeline Companies, Third Edition, 1995.

Oil Pipeline Profile

International Petroleum Encyclopedia, Pennwell Publishing Co., 1994.

U.S. Oil Pipelines, George S. Wolbert, Jr., API, 1979.

U.S. Petroleum Strategies in the Decade of the Environment, Bob Williams, Pennwell Publishing Co., 1991.

Modern Petroleum: A Basic Primer of the Industry, Third Edition, Bill Berger and Ken Anderson, Pennwell Books, 1992.

"Regulation of Underground Storage," *Petroleum Supply Monthly*, August, 1991.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.epa.gov/comply/sector/index.html

or use

www.epa.gov/oeca - then select the button labeled Industry and Gov't Sectors and select the appropriate sector from the menu. The Notebook will be listed.

Direct technical questions to the Feedback function at the bottom of the web page or to Shhonn Taylor at (202) 564-2502

EPA

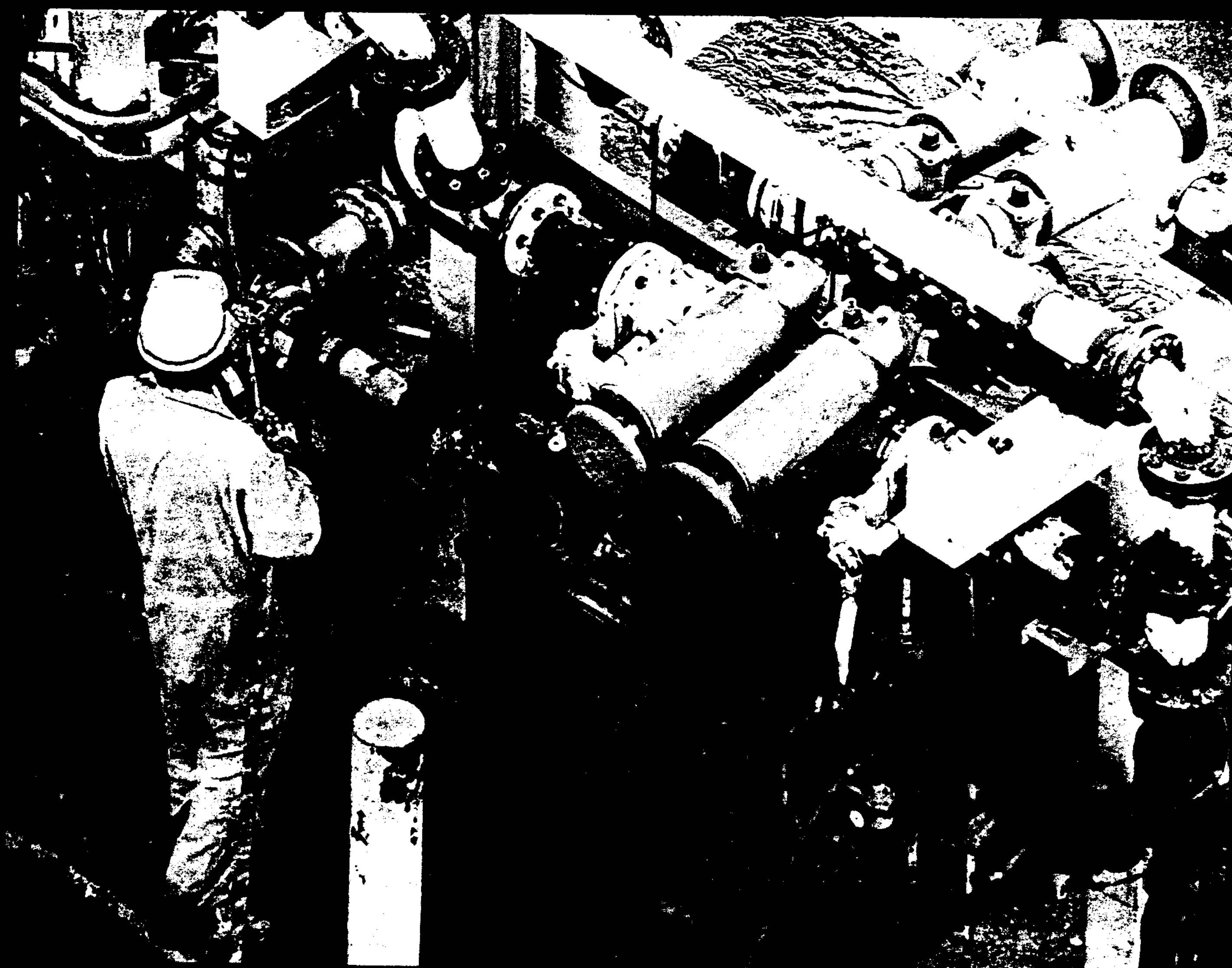
United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States Environmental Protection Agency
Enforcement And Compliance Assurance (2221A)
EPA 310-R-95-004
September 1995

EPA

Profile Of The Inorganic Chemical Industry



EPA Office Of Compliance Sector Notebook Project

SECTOR NOTEBOOKS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-004

EPA Office of Compliance Sector Notebook Project

Profile of the Inorganic Chemical Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048271-2

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., ET, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via the Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, EPA. Photograph courtesy of Vista Chemicals, Baltimore, Maryland. Special thanks to Dave Mahler.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

Industry Sector Notebook Contents: Inorganic Chemicals Manufacturing

Exhibits Index

List of Acronyms

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
DSA -	Dimensionallly stable
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation
NO_X -	Nitrogen Oxide

NPDES -	National Pollution Discharge Elimination System (CWA)
NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SO_X -	Sulfur Oxides
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the

information included. each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete. accurate and up-to-date summaries.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project. 401 M St., SW (2223-A), Washington. DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the EnviroSen$e World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in. procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen. please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE INORGANIC CHEMICALS INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the inorganic chemicals industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The inorganic chemical industry manufactures over 300 different chemicals accounting for about 10 percent of the total value of chemical shipments in the U.S.[1] This industry categorization corresponds to Standard Industrial Classification (SIC) code 281 Industrial Inorganic Chemicals established by the Bureau of Census to track the flow of goods and services within the economy. The 281 category includes alkalies and chlorine (SIC 2812), industrial gases (SIC 2813) (e.g., hydrogen, helium, oxygen, nitrogen, etc.), inorganic pigments (SIC 2816), and industrial inorganic chemicals, not elsewhere classified (SIC 2819). Approximately two-thirds of the value of shipments for the inorganic chemical industry, including over 200 different chemicals, are classified under industrial inorganic chemicals, not elsewhere classified (SIC 2819). The industry does not include those establishments primarily manufacturing organic chemicals, agricultural pesticides, drugs, soaps, or cosmetics. However, the 281 industry group does include a significant number of integrated firms that are engaged in the manufacture of other types of chemicals at the same site. Conversely, many manufacturing facilities not categorized under SIC 281, especially organic chemicals facilities (SIC 286), fertilizer plants (SIC 287), pulp and paper mills (SIC 26), and iron and steel mills (SIC 331), produce and use inorganic chemicals in their processes at the same facility.[2] For example, a significant number of inorganic chemical manufacturing processes are part of very large chemical manufacturing or pulp manufacturing facilities, making characterization strictly by SIC code difficult.

Whenever possible, this notebook describes the entire inorganic chemical industry. In many cases, however, specific details relating to some of the topics covered by the notebook (facility size, economic trends, geographic distribution, pollutant releases, pollution prevention issues, and applicable regulations) vary depending on the type of inorganic chemical manufacturing process. The large number of different industrial processes used in the inorganics industry could not all be covered in this notebook. As a result, most sections of this notebook describe the entire inorganic chemical industry as a whole. These sections are usually augmented with information specific to the largest single industrial process within the industry: chlorine and caustic soda production (SIC 2812). Section III. Industrial Process Description, rather than attempting to describe every inorganic chemical manufacturing process, deals solely with the production of chlorine and caustic soda.

II.B. Characterization of the Inorganic Chemical Industry

II.B.1. Product Characterization

Inorganic Chemicals Industry

The inorganic chemical industry manufactures chemicals which are often of a mineral origin, but not of a basic carbon molecular. Inorganic chemicals are used at some stage in the manufacture of a great variety of other products. The industry's products are used as basic chemicals for industrial processes (i.e., acids, alkalies, salts, oxidizing agents, industrial gases, and halogens); chemical products to be used in manufacturing products (i.e., pigments, dry colors, and alkali metals): and finished products for ultimate consumption (i.e., mineral fertilizers, glass, and construction materials). The largest use of inorganic chemicals is as processing aids in the manufacture of chemical and nonchemical products. Consequently, inorganic chemicals often do not appear in the final products.[3]

Chlor-alkali Sector

The chlor-alkali industry produces mainly chlorine, caustic soda (sodium hydroxide), soda ash (sodium carbonate), sodium bicarbonate, potassium hydroxide, and potassium carbonate. In 1992, chlorine and caustic soda production accounted for about 80 percent of the chlor-alkali industry's value of shipments and, in terms of weight, were the eighth and ninth largest chemicals produced in the U.S., respectively. Chlorine and caustic soda are co-products produced in about equal amounts primarily through the electrolysis of salt (brine).[4]

The majority of domestic chlorine production (70 percent) is used in the manufacturing of organic chemicals including: vinyl chloride monomer, ethylene dichloride, glycerine, glycols, chlorinated solvents, and chlorinated methanes. Vinyl chloride, which is used in the production of polyvinyl chloride (PVC) and many other organic chemicals, accounts for about 38 percent of the total domestic chlorine production. The pulp and paper industry consumes approximately 15 percent of U.S. chlorine production, and about eight percent is used in the manufacturing of other inorganic chemicals. Other major uses are disinfection treatment of water, and the production of hypochlorites. More than two-thirds of all chlorine is consumed in the same manufacturing plant in the production of chemical intermediates.[5]

The largest users of caustic soda are the organic chemicals industry (30 percent) and the inorganic chemicals industry (20 percent). The primary uses of caustic soda are in industrial processes, neutralization, and off-gas scrubbing; as a catalyst; and in the production of alumina, propylene oxide, polycarbonate resin, epoxies, synthetic fibers, soaps, detergents, rayon, and cellophane. The pulp and paper industry uses about 20 percent of total domestic caustic soda production for pulping wood chips, and other processes. Caustic soda is also used in the production of soaps and cleaning products, and in the petroleum and natural gas extraction industry as a drilling fluid.[6]

II.B.2. Industry Size and Geographic Distribution

Inorganic Chemical Industry

The inorganic chemical industry is characterized by a relatively large number of small facilities. The Bureau of the Census identified 665 companies operating 1,429 facilities within SIC 281 in 1992.[a] Most of these facilities were classified under SIC 2819 -- industrial inorganic chemicals, not elsewhere classified -- which are typically smaller facilities producing specialty inorganic chemicals. The Bureau of Census employment data for 1992 (Exhibit 1) indicated that about 63 percent of inorganic chemical facilities employed fewer than 20 people. A significant portion of inorganic chemicals are produced and used within the same plant in the manufacturing of organic chemicals. The number of these facilities and the number of people employed in the inorganic chemical production portion of the industrial processes is not included in this data.

[a] Variation in facility counts occur across data sources due to many factors including, reporting and definition differences. This notebook does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

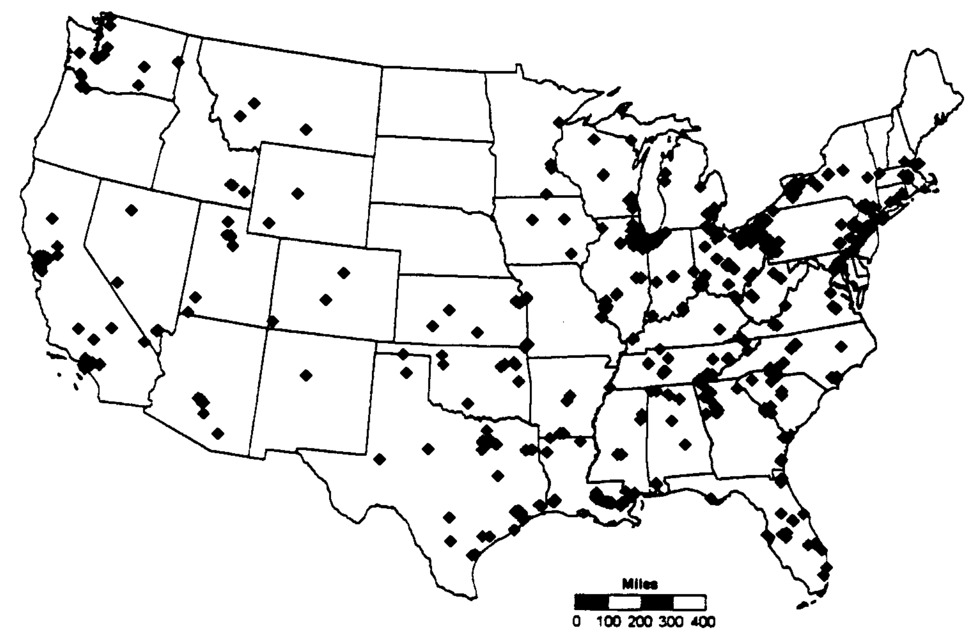
Exhibit 1: Inorganic Chemicals Industry Dominated by a Large Number of Small Facilities

	Inorganic Chemicals		Chlor-alkali	
Employees per Facility	**Number of Facilities**	**Percentage of Facilities**	**Number of Facilities**	**Percentage of Facilities**
1-9	682	48%	12	24%
10-19	212	15%	6	12%
20-49	253	18%	3	6%
50-249	221	15%	23	44%
250-999	51	3%	6	12%
1,000->2,500	10	1%	1	2%
Total	1,429	100%	51	100%

Source: Bureau of the Census, 1992 Census of Manufacturers.

Inorganic chemical facilities are typically located near consumers and to a lesser extent raw materials. The largest use of inorganic chemicals is in industrial processes for the manufacture of chemicals and nonchemical products; therefore, facilities are concentrated in the heavy industrial regions along the Gulf Coast, both east and west coasts, and the Great Lakes region. Since a large portion of inorganic chemicals produced are used by the organic chemicals manufacturing industry, the geographical distribution of inorganic facilities is very similar to that of organic chemicals facilities (Exhibit 2).

Exhibit 2: Inorganic Chemicals Facilities Distribution



(Source: U.S. EPA Toxic Release Inventory Database, 1993)

Chlor-alkali Sector

The alkali and chlorine industry, however, consists of a relatively small number of medium to large facilities. The Bureau of the Census identified 34 companies operating 51 facilities within the SIC 2812 in 1992. According to The Chlorine Institute (an industry trade group), there were 25 companies operating 52 chlorine production plants in 1989. The Bureau of Census employment data for 1992 indicated that about 60 percent of those employed in the chlor-alkali industry worked at facilities with over 50 employees (Exhibit 1).[7,8]

The distribution of the chlor-alkali sector differs from that of the inorganic chemicals industry as a whole. Since chlorine and caustic soda are co-products produced in almost equal amounts, the distribution of the caustic soda manufacturing industry is essentially the same as the chlorine manufacturing industry. Chlorine is difficult to store and transport economically; therefore, chlorine and caustic soda are produced near the

R0075413

chlorine consumers which are primarily chemical manufacturers and pulping operations. Consequently, chlor-alkali facilities are concentrated near the chemical industries along the Gulf Coast, followed by the Great Lakes region as shown in the table below. Other important areas are in the vicinity of the pulp mills of the Southeast and Northwest (Exhibit 3). In 1989, almost half of the chlorine plants in the U.S. (72 percent of domestic chlorine production) were located along the Gulf Coast. Two states, Louisiana and Texas, accounted for two-thirds of the domestic chlorine production.[9]

Exhibit 3: Chlorine Capacity Located Primarily Along Gulf Coast, Southeast, Northwest, and Great Lakes Region

State	Number of Chlorine Plants	Annual Capacity (thousand tons per year)	Percent of Total U.S. Operating Capacity
Louisiana	9	4,068	37%
Texas	5	3,314	30%
New York	4	652	6%
Alabama	5	592	5%
Washington	4	503	5%
West Virginia	2	392	3%
Georgia	3	246	2%
Tennessee	1	230	2%
Other States (14)	19	1,139	10%
U.S. Total	52	11,136	100%

Source: *Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. Vol. 1. 1993.*

Ward's Business Directory of U.S. Private Companies, produced by Gale Research Inc., compiles financial data on U.S. companies including those operating within the inorganic chemicals manufacturing industry. Ward's ranks U.S. companies, whether they are a parent company, subsidiary or division, by sales volume within the 4-digit SIC codes that they have been assigned as their primary activity. Exhibit 4 lists the top ten inorganic chemical manufacturing companies in the U.S. Readers should note that: 1) Companies are assigned a 4-digit SIC that most closely resembles their principal industry; and 2) Sales figures include total company sales, including sales derived from subsidiaries and operations not related to the manufacture of inorganic chemicals. Additional sources of company specific financial information include Standard & Poor's *Stock Report Services*, Dunn & Bradstreet's *Million Dollar Directory*, Moody's Manuals, and annual reports.

Exhibit 4: Top U.S. Companies with Inorganic Chemical Manufacturing Operations

Rank[a]	Company[b]	1993 Sales (millions of dollars)
1	Dow Chemical Co. - Midland, MI	18,800
2	Hanson Industries, Inc. - Iselin, NJ	6,092
3	WR Grace and Co. - Boca Raton, FL	6,049
4	Occidental Chemical Corp. - Dallas, TX	4,600
5	BOC Group, Inc. - Murray Hill, NJ	4,500
6	FMC Corp. - Chicago, IL	3,899
7	Eastman Kadak Co. - Kingsport, TN	3,740
8	Air Products and Chemicals, Inc. - Allentown, PA	2,931
9	ARCO Chemical Co. - Newtown Square, PA	2,837
10	Ethyl Corp. - Richmond, VA	2,575

Note: [a] When *Ward's Business Directory* listed both a parent and subsidiary in the top ten, only the parent company is presented above to avoid double counting sales volumes. Not all sales can be attributed to the companies' inorganic chemical manufacturing operations.
[b] Companies shown listed SICs 2812, 2813, 2816 and 2819 as primary activities.

Source: *Ward's Business Directory of U.S. Private and Public Companies* - 1993.

R0075415

II.B.3. Economic Trends

Inorganic Chemicals Industry

The Bureau of the Census estimated that there were 1,429 facilities in the inorganic chemical industry in 1992. The industry employed 103,000 people and had a total value of shipments of $27.4 billion. The total value of shipments for the inorganic chemicals industry increased about one percent per year between 1992 and 1994. These values do not include inorganic chemicals manufactured for captive use within a facility nor the value of other non-industrial inorganic chemical products manufactured by the same facility. It does, however, include intra-company transfers which are significant in this industry. The inorganic chemical industry's growth rate is expected to continue to increase with the growth of the economy. The U.S. is a net exporter of inorganic chemicals with most exports shipped to the European Community (EC) followed by Canada and Mexico. This positive trade balance increased significantly in 1993 to $1.7 billion and is expected to continue as the European economy improves. By comparison, the 1992 Census of Manufactures for Industrial Organic Chemicals reports a 1992 value of shipments for organic chemicals of $64.5 billion and a total employment of 125,100 people. The 1992 value of shipments for the entire chemical industry (SIC 28) totaled $292.3 billion with an employment of 850,000 people.[10]

Because inorganic chemicals are used in the manufacturing of many products, the industry tends to grow at the same rate as overall industrial production. In the late 1980s, the industry experienced high growth rates and, in the early 1990s, the industry saw little real growth in output, as a reflection of the U.S. economy's recession. The industry has historically had low profit margins which, in recent years, have decreased further with increasing pollution abatement costs.[11]

Chlor-alkali Sector

The Bureau of the Census data for 1992 shows that there were 51 facilities within the inorganic chemicals industry that manufactured alkalies and chlorine. These chlor-alkali facilities employed 8,000 people and had a total value of shipments of $2.8 billion. This was an increase of 1.7 percent from 1991. The chlor-alkali industry as a whole is expected to grow at its past rate of 1.5 times gross domestic product (GDP) growth through the 1990s. Because chlorine and caustic soda are electrolysis co-products, the production of one product can depend on the demand of the other product. The market pull has switched several times between caustic soda and chlorine in the past few decades. Presently, chlorine demand is controlling production: consequently, there is a current excess availability of caustic

R0075416

soda in the U.S. This excess material is typically exported to fill a significant demand outside the U.S. The consumption of caustic soda is growing faster than the consumption of chlorine, however, and domestic caustic soda demand is expected to control production in the coming years.[12]

After reaching record high levels in the late 1970s, chlorine production declined in the early 1980s due in part to the economic recession between 1980 and 1982. Chlorine production increased slowly through the 1980s and, as of 1992, had not reached the record high levels and growth rates of the 1970s. This is due in part to the relative maturity of the chlorine usage industries and more recent environmental pressures aimed at curtailing chlorine use. Regulatory restrictions on the production or disposal of some products which require large amounts of chlorine to manufacture (i.e., chlorofluorocarbons, PVC, and chlorinated solvents) have adversely affected the market. Chlorine's commercial appeal has been further reduced by initiatives such as the International Joint Commission of Great Lakes Water Quality (a Canada-U.S. environmental oversight group) and a number of environmental groups which call for a gradual phaseout or an immediate ban of chlorine and chlorinated compounds as industrial feedstocks.[13]

The production of caustic soda is very dependent on the short term and long term chlorine demand and production because chlorine cannot be stored economically. Increased demand for chlorine must be met immediately by increased chlorine production via electrolysis of brine and, consequently, caustic soda production. Domestic and export demand for caustic soda was very strong in the 1980s with the pick up of the world economy and an increase in pulp and paper production. In the late 1980s, there was a worldwide shortage of caustic soda due to increased demand and lower U.S. chlorine production. The demand for caustic soda is expected to continue to grow in the coming years; however, there are a number of uncertainties that may limit the growth rate. Some industries have begun switching from caustic soda to soda ash where possible to avoid caustic soda shortages. Soda ash, which is extremely plentiful in the U.S., is obtained almost entirely from natural sources of trona ore. Demand for caustic soda may also decrease as pulp mills increase their reclamation of caustic soda from spent pulping liquor.[14]

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the inorganic chemical industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Inorganic Chemical Industry

Chlorine and caustic soda are co-products of electrolysis of saturated aqueous solutions of sodium chloride, NaCl (salt water or brine). In addition, relatively small amounts (by weight) of hydrogen gas are produced in the process. The overall chemical reaction is as follows:

$$2\ NaCl + 2\ H_2O \rightarrow 2\ NaOH + Cl_2 + H_2$$

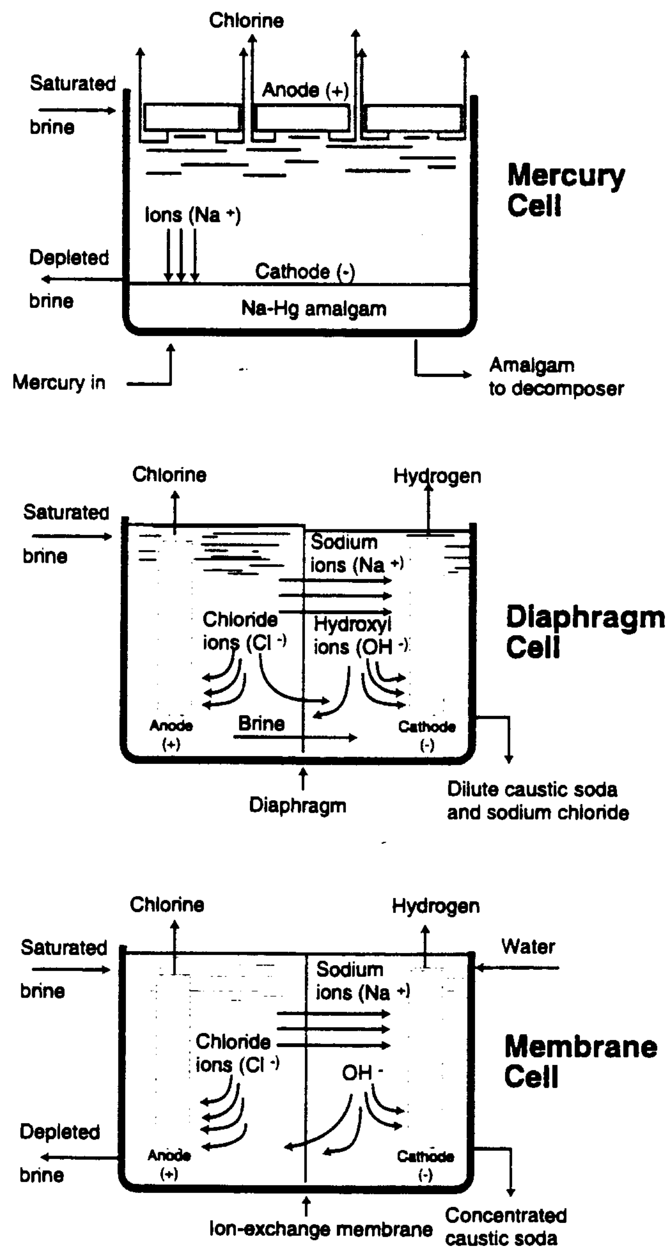
Energy, in the form of direct current (d-c) electricity, is supplied to drive the reaction. The amount of electrical energy required depends on the design of the electrolytic cell, the voltage used, and the concentration of brine used. For each ton of chlorine produced, 1.1 tons of sodium hydroxide and 28 kilograms of hydrogen are produced.

Three types of electrolysis processes are used for the manufacture of chlorine, caustic soda, and hydrogen from brine:

- Mercury Cell Process
- Diaphragm Cell Process
- Membrane Cell Process

Virtually all chlorine produced in the U.S. is manufactured by one of these three electrolysis processes. Each electrolytic cell consists of an anode and cathode in contact with the brine solution. Exhibit 5 shows the basic elements. inputs and outputs of each type of electrolytic cell. The distinguishing feature of each cell type is the method employed to separate and prevent the mixing of the chlorine gas and sodium hydroxide. Consequently, each process produces a different purity of chlorine gas and a different concentration of caustic soda. Exhibit 6 is a summary of the major differences between each cell type. In 1988, diaphragm cells accounted for 76 percent of all domestic chlorine production, followed by mercury cells with 17 percent, and membrane cells with five percent. The industry is moving away from mercury and diaphragm cells and is moving towards the use of membrane cells. Membrane cells are a relatively recent development which have fewer adverse effects on the environment and produce a higher quality product at a lower cost than the other methods.[15,16]

Exhibit 5: Chlorine Electrolysis Cells



(Source: Kirk-Othmer Encyclopedia of Chemical Technology, 4th Edition, 1994.)

R0075420

Exhibit 6: Main Characteristics of the Different Electrolysis Processes			
Component	**Mercury Cell**	**Diaphragm Cell**	**Membrane Cell**
Cathode	Mercury flowing over steel	Steel or steel coated with activated nickel	Steel or nickel with a nickel based catalytic coating
Diaphragm/ Membrane	None	Asbestos or polymer modified asbestos	Ion-exchange membrane
Anode	Titanium with RuO_2 or TiO_2 coating (DSA anode)	Titanium with RuO_2 or TiO_2 coating (DSA anode)	Titanium with RuO_2 or TiO_2 coating (DSA anode)
Cathode Product	Sodium amalgam	10-12% NaOH with 15-17% NaCl and H_2	30-33% NaOH and H_2
Decomposer/ Evaporator Product	50% NaOH and H_2 from decomposer	50% NaOH with 1% NaCl and solid salt from evaporator	50% NaOH with very little salt
Electricity Consumption	3,300 kWh per ton Cl_2	2,750 kWh per ton Cl_2	2,100-2,450 kWh per ton NaOH

Source: Kirk-Othmer Encyclopedia of Chemical Technology, 4th Edition, 1994.

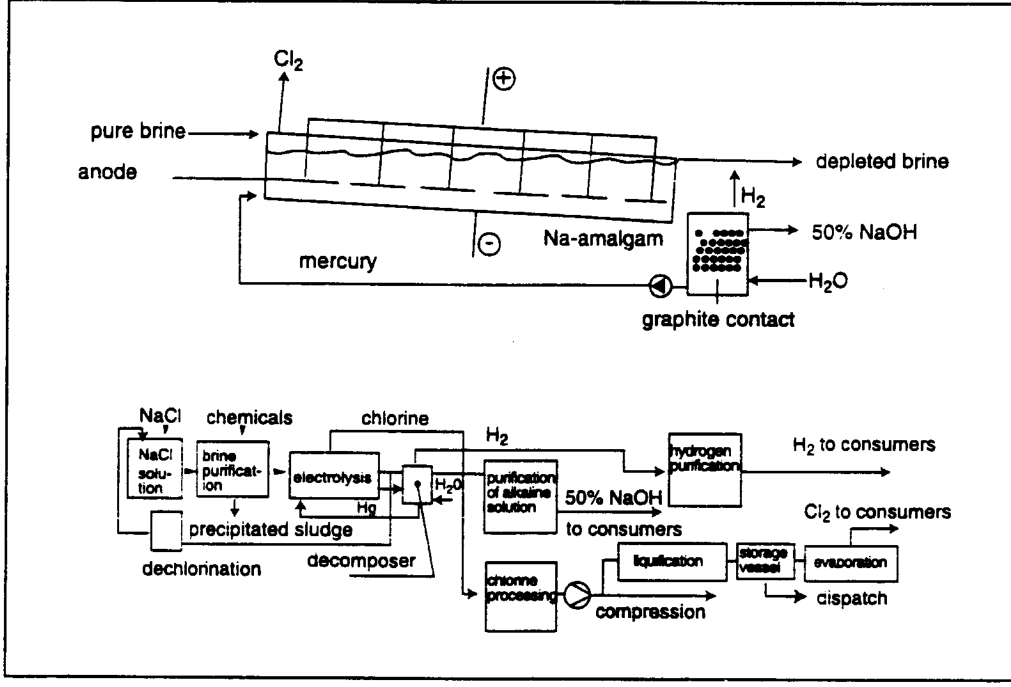
III.A.1. Mercury Cell

The mercury cell process consists of slightly inclined steel troughs through which a thin layer of mercury (about three mm) flows over the bottom (Exhibit 7). The cells are operated at 75 to 85 °C and atmospheric pressure. The mercury layer serves as the cathode for the process and the saturated brine solution (25.5 percent NaCl by weight) flows through the troughs above the mercury. The anodes are usually incorporated into the cell covers and are suspended horizontally in the brine solution. The height of the anodes within the brine is adjusted to the optimal height either manually or through an automatic computer controlled system.[17]

Electrolytic cell anodes were made of graphite until the late 1960s when anodes of titanium coated with ruthenium oxide (RuO_2) and titanium oxide (TiO_2) were developed. The RuO_2 and TiO_2 anodes, termed DSA (dimensionally stable) anodes, are more stable than the graphite anodes (i.e., they do not need to be replaced as frequently) and are more energy efficient.[18]

R0075421

Exhibit 7: Mercury Electrolysis Cell and Flow Diagram



(Source: Industrial Inorganic Chemistry, Büchner, et al., 1989.)

The chlorine gas is produced at the anodes where it moves upward through gas extraction slits in the cell covers. Sodium ions are absorbed by the mercury layer and the resulting sodium and mercury mixture, called the amalgam, is processed in "decomposer" cells to generate sodium hydroxide and reusable mercury. The amalgam entering the decomposer cell has a sodium concentration of approximately 0.2 to 0.5 percent by weight. The decomposer consists of a short-circuited electrical cell where graphite serves as the anode and the amalgam serves as the cathode. The amalgam and water flowing through the cell come into direct contact with the graphite. The hydrolysis of the water on the graphite in the presence of the amalgam results in a strong exothermic reaction generating mercury to be reused in the electrolytic cell, a 50 percent caustic soda solution, and hydrogen gas. Mercury cells are operated to maintain a 21 to 22 percent by weight NaCl concentration in the depleted brine leaving the cell. The dissolved chlorine is removed from the depleted brine solution, which is then resaturated with solid salt and purified for further use. Some facilities purge small amounts of brine solution and use new brine as make-up in order to prevent the build up of sulfate impurities in the brine.[19,20]

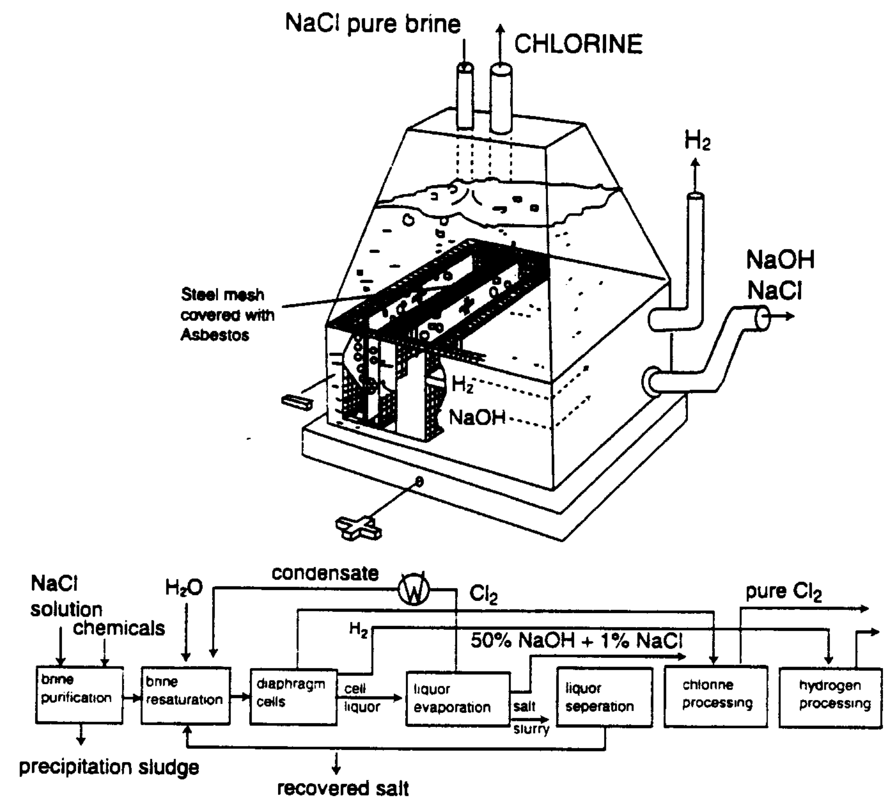
The mercury process has the advantage over diaphragm and membrane cells in that it produces a pure chlorine gas with no oxygen, and a pure 50 percent caustic soda solution without having to further concentrate a more dilute solution. However, mercury cells operate at a higher voltage than diaphragm and membrane cells and, therefore, use more energy. The process also requires a very pure brine solution with little or no metal contaminants. Furthermore, elaborate precautions must be taken to avoid releases of mercury to the environment.

III.A.2. Diaphragm Cell

In the diaphragm cell process, multiple cells consisting of DSA anode plates and cathodes are mounted vertically and parallel to each other (Exhibit 8). Each cell consists of one anode and cathode pair. The cathodes are typically flat hollow steel mesh or perforated steel structures covered with asbestos fibers, which serve as the diaphragm. The asbestos fiber structure of the diaphragm prevents the mixing of hydrogen and chlorine by allowing liquid to pass through to the cathode, but not fine bubbles of chlorine gas formed at the anodes. The diaphragm also hinders the back-diffusion to the anode of hydroxide (OH^-) ions formed at the cathode. The cells are operated at 90 to 95 °C and atmospheric pressure. Brine flows continuously into the anode chamber and, subsequently, through the diaphragm to the cathode. As in the mercury cell process, chlorine gas is formed at the anodes; however, in the diaphragm process, caustic soda solution and hydrogen gas are formed directly at the cathode. The chlorine gas is drawn off from above the anodes for further processing. The hydrogen gas is drawn off separately from the cathode chambers.[21,22]

Two basic types of diaphragm cells are in use today. The first, monopolar cells, have an electrode arrangement in which the anodes and cathodes are arranged in parallel. As a result of this configuration, all cells have the same voltage of about three to four volts; up to 200 cells can be constructed in one circuit. The second basic type of diaphragm cell is the bipolar cell, in which the anode of one cell is directly connected to the cathode of the next cell unit. This type of arrangement minimizes voltage loss between cells; however, since the total voltage across the entire set of cells is the sum of the individual cell voltages, the number of cells per unit is limited. To compensate for the reduced anode and cathode surface area in the bipolar configuration, bipolar units tend to be much larger than monopolar units. Production of chlorine and caustic soda by the diaphragm process is split approximately equally between monopolar and bipolar systems.[23]

Exhibit 8: Typical Diaphragm Electrolysis Cell and Flow Diagram



(Source: Industrial Inorganic Chemistry, Büchner, et al., 1989)

Diaphragm cells are operated such that about 50 percent of the input NaCl is decomposed resulting in an effluent mixture of brine and caustic soda solution containing eight to 12 percent NaOH and 12 to 18 percent NaCl by weight. This solution is evaporated to 50 percent NaOH by weight at which point all of the salt, except a residual 1.0 to 1.5 percent by weight, precipitates out. The salt generated is very pure and is typically used to make more brine. Because the brine and caustic soda solution are mixed in a single effluent, a fresh brine solution (no recycled brine) is constantly entering the system. The diaphragm cell process does not, therefore, require a brine purge to prevent sulfate build up, or treatment to remove entrained chlorine gas, as in the mercury cell process.[24]

Diaphragms are constructed of asbestos because of its chemical and physical stability and because it is a relatively inexpensive and abundant material. Beginning in the early 1970s, asbestos diaphragms began to be replaced by diaphragms containing 75 percent asbestos and 25 percent fibrous polytetrafluoroethylene (PTFE). These diaphragms, trade named Modified Diaphragms, are more stable and operate more efficiently than the fully asbestos diaphragms. Modified Diaphragms are the most common diaphragms currently in use.[25]

Diaphragm cells have the advantage of operating at a lower voltage than mercury cells and, therefore, use less electricity. In addition, the brine entering a diaphragm cell can be less pure than that required by mercury and membrane cells. The chlorine gas produced by the diaphragm process, however, is not pure and must be processed to remove oxygen, water, salt, and sodium hydroxide. Another disadvantage of the process is that the caustic soda produced contains chlorides and requires evaporation to bring it to a usable concentration.[26]

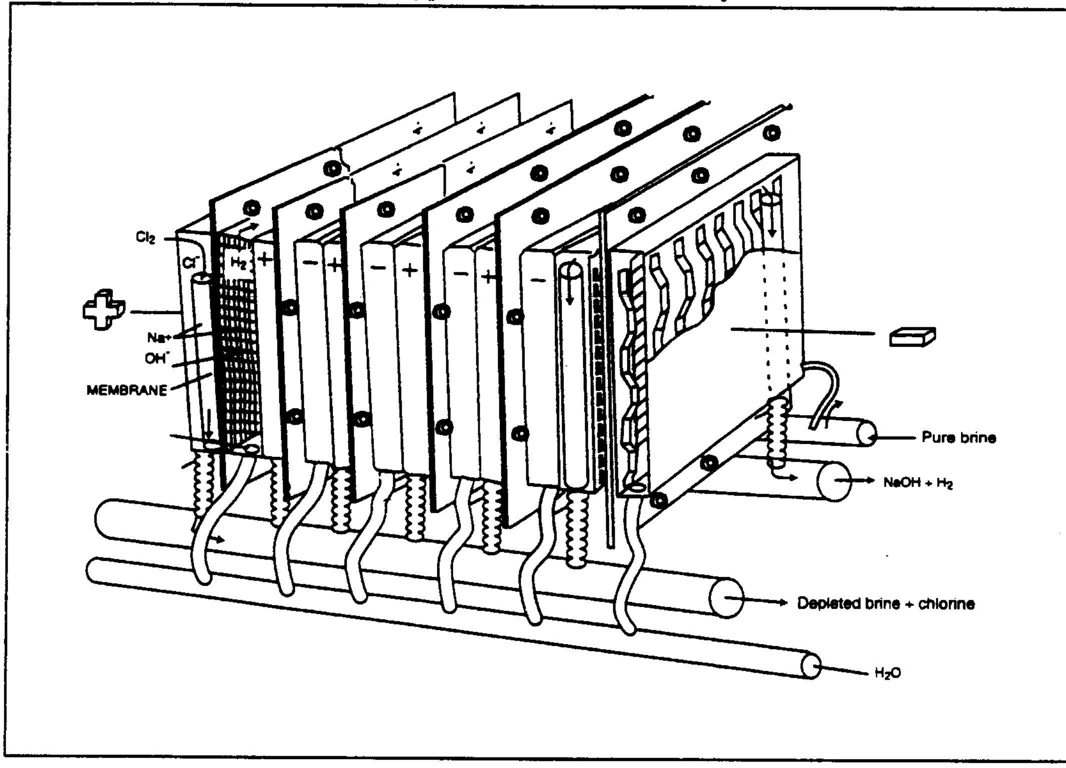
III.A.3. Membrane Cell

In the membrane cell process, the anode and cathode are separated by a water-impermeable ion-conducting membrane (Exhibit 9). Brine solution flows through the anode compartment where chlorine gas is generated. The sodium ions migrate through the membrane to the cathode compartment which contains flowing caustic soda solution. Water is hydrolyzed at the cathode, releasing hydrogen gas and hydroxide (OH^-) ions. The sodium and hydroxide ions combine to produce caustic soda which is typically brought to a concentration of 32 to 35 percent by recirculating the solution before it is discharged from the cell. The membrane prevents the migration of chloride ions from the anode compartment to the cathode compartment; therefore, the caustic soda solution produced does not contain salt as in the diaphragm cell process. Depleted brine is discharged from the anode compartment and resaturated with salt.[27]

The cathode material used in membrane cells is either stainless steel or nickel. The cathodes are often coated with a catalyst that is more stable than the substrate and that increases surface area and electrical conductivity. Coating materials include Ni-S, Ni-Al, and Ni-NiO mixtures, as well as mixtures of nickel and platinum group metals. Anodes are typically of the DSA type.[28]

The most critical components of the membrane cells are the membranes themselves. The membranes must remain stable while being exposed to chlorine on one side and a strong caustic solution on the other. Furthermore, the membranes must have low electrical resistance, and allow the transport of sodium ions and not chloride ions and reinforcing fabric, and a perfluorocarboxlate polymer all bonded together.

Exhibit 9: Typical Membrane Electrolysis Cell



(Source: Industrial Inorganic Chemistry, Büchner, et al., 1989.)

Membrane cells can be configured either as monopolar or bipolar. As in the case of the diaphragm cell process, the bipolar cells have less voltage loss between the cells than the monopolar cells; however, the number of cells connected together in the same circuit is limited.[29]

Membrane cells have the advantages of producing a very pure caustic soda solution and of using less electricity than the mercury and diaphragm processes. In addition, the membrane process does not use highly toxic materials such as mercury and asbestos. Disadvantages of the membrane process are that the chlorine gas produced must be processed to remove oxygen and water vapor, and the caustic soda produced must be evaporated to increase the concentration. Furthermore, the brine entering a membrane cell must be of a very high purity, which often requires costly additional purification steps prior to electrolysis.[30]

III.A.4. Auxiliary Processes

Brine Purification

Approximately 70 percent of the salt used in chlorine gas production is extracted from natural salt deposits; the remainder is evaporated from seawater. Salt from natural deposits is either mined in solid form or is leached from the subsurface. Leaching involves the injection of freshwater into subterranean salt deposits and pumping out brine solution. Brine production from seawater typically occurs by solar evaporation in a series of ponds to concentrate the seawater, precipitate out impurities, and precipitate out solid sodium chloride. Regardless of the method used to obtain the salt, it will contain impurities that must be removed before being used in the electrolysis process. Impurities primarily consist of calcium, magnesium, barium, iron, aluminum, sulfates, and trace metals. Impurities can significantly reduce the efficiency of the electrolytic cells, by precipitating out and subsequently blocking a diaphragm or damaging a membrane depending on the process used. Certain trace metals, such as vanadium, reduce the efficiency of mercury cells and cause the production of potentially dangerous amounts of hydrogen gas. Removal of impurities accounts for a significant portion of the overall costs of chlor-alkali production, especially in the membrane process. [31]

In addition to the dissolved natural impurities, chlorine must be removed from the recycled brine solutions used in mercury and membrane processes. Dissolved chlorine gas entering the anode chamber in the brine solution will react with hydroxide ions formed at the cathode to form chlorate which reduces product yields. In addition, chlorine gas in the brine solution will cause corrosion of pipes, pumps, and containers during further processing of the brine. In a typical chlorine plant, HCl is added to the brine solution leaving the cells to liberate the chlorine gas. A vacuum is applied to the solution to collect the chlorine gas for further treatment. To further reduce the chlorine levels, sodium sulfite or another reducing agent is added to remove the final traces of chlorine. Dechlorinated brine is then resaturated with solid salt before further treating to remove impurities.[32]

Depending on the amount of impurities in the salt and the electrolysis process utilized, different purification steps will be required. Brine solution is typically heated before treatment to improve reaction times and precipitation of impurities. Calcium carbonate impurities are precipitated out through treatment with sodium carbonate; magnesium, iron, and aluminum are precipitated out through treatment with sodium hydroxide; and sulfates are precipitated out through the addition of calcium chloride or barium carbonate. Most trace metals are also precipitated out through these processes. Flocculants are sometimes added to the clarifying equipment to

R0075427

improve settling. The sludges generated in this process are washed to recover entrained sodium chloride. Following the clarification steps, the brine solution is typically passed through sand filters followed by polishing filters. The brine passing through these steps will contain less than four parts per million (ppm) calcium and 0.5 ppm magnesium which is sufficient purification for the diaphragm and mercury cell processes. For brine to be used in the membrane process, however, requires a combined calcium and magnesium content of less than 20 parts per billion (ppb). Brine for the membrane process is, therefore, passed through ion exchange columns to further remove impurities.[33]

Chlorine Processing

The chlorine gas produced by electrolytic processes is saturated with water vapor. Chlorine gas from the diaphragm process also contains liquid droplets of sodium hydroxide and salt solution. The first steps in processing the chlorine to a usable product consists of cooling the chlorine to less than ten degrees centigrade and then passing it through demisters or electrostatic precipitators to remove water and solids. Next the chlorine is passed through packed towers with concentrated sulfuric acid flowing countercurrently. The water vapor is absorbed by the sulfuric acid and the dry chlorine gas is then passed through demisters to remove sulfuric acid mist. If the chlorine is to be liquefied, liquid chlorine is then added to the gas to further purify the chlorine and to prechill it prior to compression. Prechilling is primarily carried out to prevent the temperature from reaching the chlorine-steel ignition point during compression.[34]

Chlorine gas is either used in gaseous form within the facility, transferred to customers via pipeline, or liquefied for storage or transport. Liquid chlorine is of a higher purity than gaseous chlorine and is either used within the facility or is transferred via rail tank car, tank truck, or tank barge. The demand for liquid chlorine has increased in recent years and, in 1987, accounted for about 81 percent of chlorine produced in the U.S.[35]

Chlorine liquefaction processes typically liquefy only about 90-95 percent of the chlorine. This gas and the chlorine gas left inside tank truck tanks, rail car tanks, or barges after removal of liquid chlorine is impure and must be recovered in a chlorine recovery unit. The gas is compressed and cooled using cold water followed by Freon. The chilled gas is fed up through a packed column in which carbon tetrachloride flows downward absorbing the chlorine. The chlorine-rich carbon tetrachloride is fed to a chlorine stripper in which the chlorine and carbon tetrachloride separate as they are heated. The chlorine gas is cooled and scrubbed of carbon tetrachloride using liquid chlorine and the resulting pure chlorine is sent to the chlorine liquefaction system.[36]

Caustic Soda Processing

Caustic soda solution generated from chlor-alkali processes is typically processed to remove impurities and to concentrate it to either a 50 percent or 73 percent water-based solution or to anhydrous caustic soda. The caustic soda from the mercury and membrane processes is relatively pure. Product from the mercury process requires only filtration to remove mercury droplets. The evaporators used to concentrate the caustic soda solution in the diaphragm process are typically multi-stage forced circulation evaporators. The evaporators have salt settling systems to remove precipitated salt. Sodium borohydride is often added to reduce corrosion of the equipment. Evaporators for the membrane process are usually much simpler than those for the diaphragm process because the salt concentration in the membrane cell caustic solution is very low.[37]

Hydrogen Processing

The hydrogen produced in all of the electrolytic processes contains small amounts of water vapor, sodium hydroxide, and salt which is removed through cooling. The hydrogen produced during the mercury cell process also contains small amounts of mercury which must be removed by cooling the hydrogen gas to condense the mercury and treating with activated carbon.[38]

III.B. Raw Material Inputs and Pollution Outputs in the Production Line

Inputs and pollutant outputs of the chlor-alkali industry are relatively small both in number and volume in comparison to the chemical manufacturing industry as a whole. The inputs are primarily salt and water as feedstocks: acids and chemical precipitants used to remove impurities in the input brine or output chlorine and caustic soda; and freon used for liquefying and purifying the chlorine gas produced. The major pollutant outputs from all three electrolytic processes are chlorine gas emissions (both fugitive and point source); spent acids: freon (both fugitive and point source); impurities removed from the input salt or brine; and pollutants originating from electrolytic cell materials and other system parts.

Pollutant outputs have decreased in recent years as the industry moves away from the mercury and diaphragm cell processes to the more efficient (in terms of material and energy inputs and outputs) membrane cell process. In addition, improved cell part materials have been developed, such as DSA anodes and Modified Diaphragms, which are more stable and create less undesirable byproducts.

Inputs and pollutant outputs from the auxiliary processes such as brine purification, chlorine processing, caustic soda processing, and hydrogen processing are described in Section III.B.4.

III.B.1. Mercury Cell

Wastewater streams from mercury cell facilities arise from the chlorine drying process, brine purge, and miscellaneous sources. Small amounts of mercury are found in the brine purge and miscellaneous sources which include floor sumps and cell wash water. Before treatment, mercury concentrations (principally in the form of mercuric chloride, $HgCl_4^{2-}$) typically range from 0 to 20 ppm. Thereby segregating most mercury bearing wastewater streams from non-mercury bearing wastewater streams. Prior to treatment, sodium hydrosulfide is used to precipitate mercuric sulfide. The mercuric sulfide is removed through filtration before the water is discharged.[39]

Air emissions consist of mercury vapor and chlorine gas released in relatively small amounts as fugitive emissions from the cells: and in the tail gases of the chlorine processing, caustic soda processing, and hydrogen processing. Process tail gases are wet scrubbed with caustic soda or soda ash solutions to remove chlorine and mercury vapor. Residual chlorine emissions in tail gases after treatment are less than one kg per 1,000 kg of chlorine produced and mercury emissions are negligible. The tail gas scrubber water is typically reused as brine make-up water.[40]

Solid wastes containing mercury include: solids generated during brine purification; spent graphite from decomposer cells; spent caustic filtration cartridges from the filtration of caustic soda solution; spilled mercury from facility sumps; and mercury cell "butters," which are semisolid amalgams of mercury with barium or iron formed when an excess of barium is used during salt purification. Most mercury bearing solid wastes are shipped off-site to outside reclaimers who recover the mercury. The remaining wastes are disposed of in secure landfills using either chemical or physical methods to recover maximum feasible amount of mercury.[41]

III.B.2. Diaphragm Cell

Wastewater streams from the diaphragm cell process originate from the barometric condenser during caustic soda evaporation, chlorine drying, and from purification of salt recovered from the evaporators. These wastewaters and their treatment are described below in Section III.B.4. The use of lead and graphite anodes and asbestos diaphragms generates lead, asbestos, and chlorinated hydrocarbons in the caustic soda and chlorine processing waste streams. Lead salts and chlorinated hydrocarbons are generated from corrosion of the anodes, and asbestos particles are formed by the degradation of the diaphragm with use. Over the past twenty years, all but a few diaphragm cell facilities have switched from the use of lead and graphite anodes with asbestos diaphragms to DSA anodes and Modified Diaphragms which resist corrosion and degradation. The lead, asbestos, and chlorinated hydrocarbon contaminants are, therefore, no longer discharged in significant amounts from most diaphragm cell chlor-alkali facilities. Those facilities that discharged caustic processing wastewater streams to on-site lagoons may, however, still have significant levels of these contaminants on-site.[42]

Chlorine is released in relatively small amounts as fugitive emissions from the cells and in the process tail gases. Process tail gases are wet scrubbed with soda ash or caustic soda solutions to remove chlorine. Residual chlorine emissions in tail gases after treatment are negligible. The spent caustic solution is neutralized prior to discharge.[43]

Solid wastes generated in the diaphragm process consist primarily of solids generated during brine purification and scrapped cell parts including, cell covers, piping and used diaphragms. Discarded cell parts are either landfilled on-site, as is typically the case for spent diaphragms, or shipped off-site for disposal. Used cathodes and DSA anodes are shipped off-site for recovery of their titanium content.[44]

III.B.3. Membrane Cell

Wastewater from the diaphragm cell process originates from the barometric condenser during caustic soda evaporation, chlorine drying, and wash water from the ion exchange resin used to purify the brine solution. The ion exchange wash water consists of dilute hydrochloric acid with small amounts of dissolved calcium, magnesium, and aluminum chloride. The wastewater is combined with the other process wastewaters and treated by neutralization.[45]

Chlorine is released in relatively small amounts as fugitive emissions from the cells and in the process tail gases. Process tail gases are wet scrubbed with soda ash or caustic soda solutions to remove chlorine. Residual chlorine emissions in tail gases after treatment are negligible. The spent caustic solution is neutralized prior to discharge.[46]

Solid waste generated in the diaphragm process consists primarily of solids generated during brine purification and used cell parts which include membranes, cathodes and DSA anodes. The used membranes are typically returned to the supplier and the used cathodes and DSA anodes are shipped off-site for recovery of their titanium content.[47]

III.B.4. Auxiliary Processes

Brine Purification

Brine solutions are typically treated with a number of chemicals to remove impurities prior to input to the electrolytic cells. In the case of mercury and membrane cell systems, the brine is first acidified with HCl to remove dissolved chlorine. Next, sodium hydroxide and sodium carbonate are added to precipitate calcium and magnesium ions as calcium carbonate and magnesium hydroxide. Barium carbonate is then added to remove sulfates which precipitate out as barium sulfate. The precipitants are removed from the brine solution by settling and filtration. Pollutant outputs from this process include fugitive chlorine emissions and brine muds.[48]

Brine muds are one of the largest waste streams of the chlor-alkali industry. On average, about 30 kilograms (kg) of brine mud are generated for every 1,000 kg of chlorine produced. The volume of mud will vary, however, depending on the purity of the salt used. Some facilities use pre-purified (i.e., chemical grade) evaporated salts which will produce only 0.7 to 6.0 kg of brine mud per 1,000 kg of chlorine produced. Brine mud typically contains magnesium hydroxide, calcium carbonate, and, in most cases, barium sulfate. Mercury cell brine muds usually contain mercury either in the elemental form or as the complex ion, mercuric chloride ($HgCl_4^{2-}$). Mercury- containing brine muds are typically disposed of in a RCRA Subtitle C landfill after treatment with sodium sulfide which converts the mercury to an insoluble sulfide.[49]

Brine muds are usually segregated from other process wastes and stored in lagoons on-site. When the lagoons become filled, the brine mud is either dredged and landfilled off-site, or drained and covered over. Some plants that use brine solution leached from subterranean deposits inject brine muds into the salt cavities that are no longer being used.[50]

Chlorine Processing

The chlorine gas recovered from electrolytic cells is cooled to remove water vapor. The condensed water is usually recycled as brine make-up although some facilities combine this waste stream with other waterborne waste streams prior to treatment. The remaining water vapor is removed by scrubbing the chlorine gas with concentrated sulfuric acid. The chlorine gas is then compressed and cooled to form liquid chlorine. Between six kg and 35 kg of 79 percent sulfuric acid wastewater is generated per 1,000 kg of chlorine produced. The majority of the spent sulfuric acid waste is shipped off-site for refortification to concentrated sulfuric acid or for use in other processes. The remainder is used to control effluent pH and/or is discharged to water or land disposed.[51]

The process of purifying and liquefying impure chlorine gas involves the absorption of the chlorine in a stream of carbon tetrachloride. The chlorine is subsequently removed in a stripping process in which the carbon tetrachloride is either recovered and reused, or is vented to the atmosphere.[52]

Caustic Soda Processing

Caustic soda solution generated from chlor-alkali processes is typically processed to remove impurities and, in the case of the diaphragm and membrane processes, is concentrated to either a 50 percent or 73 percent water-based solution or to anhydrous caustic soda. About five tons of water must be evaporated per ton of 50 percent caustic soda solution produced. The water vapor from the evaporators is condensed in barometric condensers and, in the case of the diaphragm process, will primarily contain about 15 percent caustic soda solution and high concentrations of salt. If sodium sulfate is not removed during the brine purification process, salt recovered from the evaporators is often recrystallized to avoid sulfate buildup in the brine. If the salt is recrystallized, the wastewater from sodium hydroxide processing will also contain sodium sulfates. Significant levels of copper may also be present in the wastewater due to corrosion of pipes and other equipment. Wastewater from the membrane process contains caustic soda solution and virtually no salt or sodium sulfates.[53]

Caustic soda processing wastewater is typically neutralized with hydrochloric acid, lagooned, and then discharged directly to a receiving water or land disposed. The caustic soda generated from the mercury process only requires filtration to remove mercury droplets which are typically recovered for reuse.

Hydrogen Processing

The hydrogen produced in all of the electrolytic processes contains small amounts of water vapor, sodium hydroxide, and salt which is removed through cooling. Condensed salt water and sodium hydroxide solution is either recycled as brine make-up or treated with other waterborne waste streams. The hydrogen produced during the mercury cell process, however, also contains small amounts of mercury which must be removed prior to liquefaction. Most of the entrained mercury is extracted by cooling the gas. The condensed mercury is then returned to the electrolytic cells. Some facilities further purify the hydrogen gas of mercury using activated carbon treatment. Spent activated carbon is typically shipped off-site as a hazardous waste.[54]

III.C. Management of Chemicals In Wastestream

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has increased and the portions treated or managed through treatment on-site have decreased between 1992 and 1995 (projected). While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The PPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 10 shows that the inorganic chemicals industry managed about 1.7 trillion pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 15 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 85 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns E, F and G, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns H, I and J, respectively. The remaining portion of the production related wastes (11 percent), shown in column D, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

Exhibit 10: Source Reduction and Recycling Activity for Inorganic Chemicals Industry (SIC 281) as Reported within TRI

A	B	C	D	On-Site			Off-Site		
				E	F	G	H	I	J
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Released and Transferred[b]	% Released and Disposed[c] Off-site	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated
1992	1,642	16%	12%	42%	0%	42%	<1%	<1%	3%
1993	1,712	15%	11%	45%	0%	40%	<1%	<1%	3%
1994	1,759	---	11%	47%	<1%	39%	<1%	<1%	3%
1995	1,732	---	10%	48%	0%	40%	<1%	<1%	3%

[a] Within this industry sector, non-production related waste is < 1% of production related wastes for 1993.
[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes.
[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

R0075435

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act. TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. TRI is not specific to the chemical industry. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases, please note that in general, toxic chemical releases across all industries have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- include all air emissions from industry activity. Point emission occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Inorganic Chemical Industry

The 1993 TRI data presented in Exhibits 11 and 12 for inorganic chemicals manufacturing covers 555 facilities. These facilities listed SIC 281 (industrial inorganic chemicals) as a primary SIC code. The Bureau of Census identified 1,429 facilities manufacturing inorganic chemicals. More than half of these facilities, however, have fewer than 20 employees, many of which are likely to be below the TRI reporting thresholds of employment (TRI reporting threshold is greater than 10 employees) and/or chemical use and, therefore, are not required to report to TRI.

According to TRI data, in 1993 the inorganic chemical industry released (discharged to the air, water, or land without treatment) and transferred (shipped off-site) a total of 250 million pounds of 112 different chemical toxic chemicals. This represents about 10 percent of the TRI releases and transfers of the chemical manufacturing industry and about three percent of the total releases and transfers of all manufacturers that year. In comparison, the organic chemical industry (SIC 286) produced 438 million pounds that year, almost twice that of the inorganic chemical industry.[55]

The chemical industry's <u>releases</u> have been declining in recent years. Between 1988 and 1993 TRI emissions from chemical companies (all those categorized within SIC 28, not just inorganic chemical manufacturers) to air, land, and water were reduced 44 percent, which is slightly above the average for all manufacturing sectors reporting to TRI.[56]

Because the chemical industry (SIC 28) has historically released more TRI chemicals than any other industry, the EPA has worked to improve environmental performance within this sector. This has been done through a combination of enforcement actions, regulatory requirements, pollution prevention projects, and voluntary programs (e.g. 33/50). In addition, the chemical industry has focused on reducing pollutant releases. For example, the Chemical Manufacturers Association's (CMA's) Responsible Care initiative is intended to reduce or eximinate chemical manufacturers' waste. All 184 members of the CMA, firms that account for the majority of U.S. chemical industry sales and earnings, are required to participate in the program. Participation involves demonstrating a commitment to the program's mandate of continuous improvement in environment, health, and safety. In June of 1994, the CMA approved the use of a third-party verification of management plans to meet these objectives.

Exhibits 11 and 12 present the number and volumes of chemicals released and transferred by inorganic chemical facilities, respectively. The frequency with which chemicals are reported by facilities within a sector is one indication of the diversity of operations and processes. Many of the TRI chemicals are released or transferred by only a small number of facilities which indicates a wide diversity of production processes, particularly for specialty inorganics -- over 70 percent of the 110 chemicals reported are released or transferred by fewer than 10 facilities.

The inorganic chemical industry releases 69 percent of its total TRI poundage to the water (including 67 percent to underground injection and two percent to surface waters), 14 percent to the air, and 17 percent to the land. This release profile differs from other TRI industries which average approximately 30 percent to the water, 59 percent to air, and 10 percent to land. Examining the inorganic chemical industry's TRI reported toxic chemical releases highlights the likely origins of the large water releases for the industry (Exhibit 11).

As presented in Exhibit 11, on-site underground injection of essentially one chemical, hydrochloric acid, accounts for the largest portion, 55 percent, of the inorganic chemical industry's total releases and transfers as reported in TRI. Only five facilities of the 555 identified facilities reported releasing hydrochloric acid through underground injection. Two of these facilities accounted for over 85 percent of the total hydrochloric acid injected to the subsurface, or 42 percent of the inorganic chemical industry's total releases and transfers. Land disposal accounted for the next largest amount, 17 percent, of the industry's total releases. The largest single chemical released to the air by the inorganic chemical industry, carbonyl sulfide, is only emitted by eleven facilities manufacturing certain inorganic pigments.

Discharges to POTWs accounted for 43 percent of the industry's total transfers of TRI chemicals. Ammonia, hydrochloric acid, and sulfuric acid account for over 66 percent of the 70 million pounds transferred off-site. Finally, approximately 22 million pounds, accounting for 31 percent of the total, are transferred off-site for treatment (Exhibit 12).

Exhibit 11: 1993 Releases for Inorganic Chemical Manufacturing Facilities (SIC 281) in TRI, by Number of Facilities Reporting
(Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
SULFURIC ACID	311	47,743	538,584	7,482	5	29,520	623,334	2,004
HYDROCHLORIC ACID	167	29,428	1,420,262	3,748	120,745,708	213,351	122,677,352	734,595
AMMONIA	152	1,984,440	2,726,774	1,885,475	0	1,162,987	7,759,676	51,051
CHLORINE	121	52,954	3,017,393	6,105	0	0	3,076,452	25,425
PHOSPHORIC ACID	72	4,673	417,181	500	5	0	422,359	5,866
NITRIC ACID	71	13,211	56,538	250	5	0	70,004	986
ACETONE	54	40,304	19,261	0	0	0	59,565	1,103
ZINC COMPOUNDS	53	39,171	72,705	104,180	0	86,384	302,440	5,706
CHROMIUM COMPOUNDS	41	4,294	13,008	33,935	0	19,036,934	19,088,171	465,565
COPPER COMPOUNDS	33	2,317	15,238	1,827	0	428	19,810	600
NICKEL COMPOUNDS	29	1,253	20,000	8,872	5	34,289	64,419	2,221
METHANOL	28	105,224	878,239	77,887	0	0	1,061,350	37,905
BARIUM COMPOUNDS	27	2,279	8,176	5,629	0	353,000	369,084	13,670
DICHLORODIFLUOROMETHANE	26	741,761	54,302	0	0	0	796,063	30,618
LEAD COMPOUNDS	26	1,370	12,730	287	0	58,053	72,440	2,786
MANGANESE COMPOUNDS	26	124,003	146,393	87,548	0	7,672,768	8,030,712	308,874
HYDROGEN FLUORIDE	24	93,040	84,932	5	0	10	177,987	7,416
COBALT COMPOUNDS	21	1,001	2,018	996	0	33,460	37,475	1,785
ETHYLENE GLYCOL	20	543	765	505	0	702	2,515	126
TOLUENE	20	84,679	11,313	0	0	4	95,996	4,800
ANTIMONY COMPOUNDS	16	2,010	11,439	273	0	1	13,723	858
XYLENE (MIXED ISOMERS)	16	9,608	7,998	0	0	52	17,658	1,104
PHOSPHORUS (YELLOW OR	14	1,200	4,137	5	0	323,749	329,091	23,507
PROPYLENE	14	14,451	2,215	0	0	0	16,666	1,190
AMMONIUM NITRATE	13	697	8,858	496,400	0	599,028	1,104,983	84,999
AMMONIUM SULFATE	11	1,613	4,935	0	0	0	6,548	595
CARBONYL SULFIDE	11	380	9,676,486	0	0	0	9,676,866	879,715
GLYCOL ETHERS	11	4,028	40,640	0	0	0	44,668	4,061
TITANIUM TETRACHLORIDE	11	7,900	4,492	0	0	0	12,392	1,127
ETHYLENE OXIDE	10	428	19,890	0	0	0	20,318	2,032
COPPER	9	523	1,250	83	0	0	1,856	206
MOLYBDENUM TRIOXIDE	9	1,155	12,291	3,749	5	500	17,700	1,967
FORMALDEHYDE	8	493	11,703	0	0	0	12,196	1,525
ZINC (FUME OR DUST)	8	255	6,476	0	0	0	6,731	841
ARSENIC COMPOUNDS	7	260	264	391	0	504	1,419	203
MERCURY	7	5,903	1,597	215	0	1,519	9,234	1,319
1,1,1-TRICHLOROETHANE	7	1,200	505	0	0	0	1,705	244
ASBESTOS (FRIABLE)	6	0	1	0	0	0	1	0
CARBON TETRACHLORIDE	6	25,632	259,791	0	0	2	285,425	47,571
CHROMIUM	6	260	520	86	0	267,786	268,652	44,775
DICHLOROTETRAFLUOROETHANE	6	709,950	5	0	0	0	709,955	118,326
ETHYLENE	6	527	5,287	0	0	0	5,814	969
METHYL ETHYL KETONE	6	10,205	2,601	0	0	41	12,847	2,141
NAPHTHALENE	6	819	33,652	741	0	5	35,217	5,870
CADMIUM COMPOUNDS	5	431	4,237	21	0	124	4,813	963
DICHLOROMETHANE	5	53,174	9,322	0	0	0	62,496	12,499
DIETHANOLAMINE	5	3,325	750	0	0	0	4,075	815
ACETONITRILE	4	2,085	1,696	0	0	0	3,781	945

R0075441

Exhibit 11 (cont.): 1993 Releases for Inorganic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
CARBON DISULFIDE	4	70,006	4,334	250	0	0	74,590	18,648
CHLOROFORM	4	13,282	27,017	360	0	0	40,659	10,165
CYANIDE COMPOUNDS	4	5	5	0	0	0	10	3
NICKEL	4	38	880	5	0	250	1,173	293
PHTHALIC ANHYDRIDE	4	250	250	0	0	0	500	125
SELENIUM COMPOUNDS	4	10	270	87	0	0	367	92
TRICHLOROFLUOROMETHANE	4	307,250	1,205	0	0	0	308,455	77,114
1,2,4-TRIMETHYLBENZENE	4	1,110	1,290	250	0	5	2,655	664
ALUMINUM (FUME OR DUST)	3	42	660	0	0	0	702	234
BENZENE	3	505	5	0	0	0	510	170
ETHYLBENZENE	3	505	250	0	0	0	755	252
FREON 113	3	30,954	67	0	0	0	31,021	10,340
HYDRAZINE	3	330	0	33	0	0	363	121
MANGANESE	3	250	316	34	0	1,180,335	1,180,935	393,645
MONOCHLOROPENTAFLUOROEHTANE	3	402,000	7,721	0	0	0	409,721	136,574
TRICHLOROETHYLENE	3	255	35,305	5	0	0	35,565	11,855
ACETALDEHYDE	2	6	3,100	0	0	0	3,106	1,553
ACRYLONITRILE	2	255	5	0	0	0	260	130
CHLORINE DIOXIDE	2	86	176	0	0	0	262	131
COBALT	2	13	251	0	0	5	269	135
CRESOL (MIXED ISOMERS)	2	276	510	0	0	0	786	393
CYCLOHEXANE	2	255	5	0	0	0	260	130
HYDROQUINONE	2	0	0	0	0	0	0	0
LEAD	2	76	0	9	0	8,500	8,585	4,293
METHYL ISOBUTYL KETONE	2	250	303	0	0	0	553	277
METHYL TERT-BUTYL ETHER	2	790	5	0	0	0	795	398
PHENOL	2	264	145	0	0	0	409	205
SILVER COMPOUNDS	2	0	5	0	0	0	5	3
TETRACHLOROETHYLENE	2	400	305	0	0	0	705	353
ACRYLIC ACID	1	250	5	0	0	0	255	255
ARSENIC	1	5	0	0	0	0	5	5
BARIUM	1	0	0	0	0	0	0	0
BROMOTRIFLUOROMETHANE	1	34,000	0	0	0	0	34,000	34,000
CAPTAN	1	5	0	0	0	0	5	5
CHLOROBENZENE	1	250	5	0	0	0	255	255
CHLOROETHANE	1	522	0	0	0	0	522	522
CHLOROMETHANE	1	501	0	0	0	0	501	501
CREOSOTE	1	250	5	0	0	0	255	255
CUMENE	1	750	750	0	0	0	1,500	1,500
DI(2-ETHYLHEXYL) PHTHALATE	1	250	5	0	0	0	255	255
DIBUTYL PHTHALATE	1	250	5	0	0	0	255	255
DIMETHYL PHTHALATE	1	10	0	0	0	0	10	10
DIMETHYL SULFATE	1	0	0	0	0	0	0	0
ETHYL ACRYLATE	1	250	5	0	0	0	255	255
HYDROGEN CYANIDE	1	0	30	0	0	0	30	30
ISOPROPYL ALCOHOL	1	250	250	0	0	0	500	500
MALEIC ANHYDRIDE	1	250	5	0	0	0	255	255
MERCURY COMPOUNDS	1	250	250	0	0	0	500	500

R0075442

Exhibit 11 (cont.): 1993 Releases for Inorganic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
METHYL METHACRYLATE	1	250	5	0	0	0	255	255
N-BUTYL ALCOHOL	1	250	250	0	0	0	500	500
O-XYLENE	1	5	0	0	0	0	5	5
P-XYLENE	1	5	0	0	0	0	5	5
PERACETIC ACID	1	10	2,100	42	0	0	2,152	2,152
POLYCHLORINATED BIPHENYLS	1	0	0	0	0	0	0	0
SELENIUM	1	5	250	0	0	0	255	255
SILVER	1	750	250	0	0	0	1,000	1,000
STYRENE	1	250	250	0	0	0	500	500
THIOUREA	1	0	0	0	0	0	0	0
VINYL ACETATE	1	5	0	0	0	0	5	5
VINYL CHLORIDE	1	0	0	0	0	0	0	0
1,1,2-TRICHLOROETHANE	1	250	5	0	0	0	255	255
1,2-DICHLOROETHANE	1	5	0	0	0	0	5	5
1,2,4-TRICHLOROBENZENE	1	5	0	0	0	0	5	5
1,4-DIOXANE	1	5	0	0	0	0	5	5
TOTAL	555	5,366,356	19,737,660	2,728,270	120,745,733	31,064,296	179,642,315	323,680

Exhibit 12: 1993 Transfers for Inorganic Chemical Manufacturing Facilities (SIC 281) in TRI, by Number of Facilities Reporting
(Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFERS PER FACILITY
SULFURIC ACID	311	11,146	250,434	1,025,242	6,820,665	0	8,107,487	26,069
HYDROCHLORIC ACID	167	528	4,598,609	0	10,423,062	0	15,022,199	89,953
AMMONIA	152	22,101,429	371,669	528,230	65,300	0	23,066,628	151,754
CHLORINE	121	5	610	0	270	0	885	7
PHOSPHORIC ACID	72	3,913	2,130	23,218	132,065	0	161,326	2,241
NITRIC ACID	71	10	250	0	438,614	0	438,874	6,181
ACETONE	54	1,655	23	15,726	11,249	84,368	113,021	2,093
ZINC COMPOUNDS	53	7,382	509,395	159,713	30,265	0	706,755	13,335
CHROMIUM COMPOUNDS	41	4,078	121,569	47,843	51,452	0	224,942	5,486
COPPER COMPOUNDS	33	4,228	321,517	576,642	7,733	0	910,120	27,579
NICKEL COMPOUNDS	29	9,840	86,370	278,630	106,692	0	481,532	16,605
METHANOL	28	16,209	4,000	291,354	175	1,802,765	2,114,503	75,518
BARIUM COMPOUNDS	27	5,080	370,288	0	123,560	0	498,928	18,479
DICHLORODIFLUOROMETHANE	26	0	0	20,600	16	0	20,616	793
LEAD COMPOUNDS	26	1,301	89,660	1,153,211	1,087,669	0	2,331,841	89,686
MANGANESE COMPOUNDS	26	1,446	1,694,840	7,300	2,206,411	0	3,909,997	150,385
HYDROGEN FLUORIDE	24	185	230,250	77,587	38,700	0	346,722	14,447
COBALT COMPOUNDS	21	3,996	13,580	8,050	10,598	0	36,224	1,725
ETHYLENE GLYCOL	20	3,951	0	30,912	2,248	13,852	50,963	2,548
TOLUENE	20	1,375	203	25,347	32,384	217,979	277,288	13,864
ANTIMONY COMPOUNDS	16	3,735	52,815	16,000	7,171	0	79,721	4,983
XYLENE (MIXED ISOMERS)	16	0	73	250	5,127	188,093	193,543	12,096
PHOSPHORUS (YELLOW OR	14	0	1	0	26,000	0	26,001	1,857
PROPYLENE	14	0	0	0	0	0	0	0
AMMONIUM NITRATE	13	1,923,495	160	603,440	0	0	2,527,095	194,392
AMMONIUM SULFATE	11	6,506,733	8,247	0	6,092	0	6,521,072	592,825
CARBONYL SULFIDE	11	0	0	0	0	0	0	0
GLYCOL ETHERS	11	628	506	0	37,387	13,405	51,926	4,721
TITANIUM TETRACHLORIDE	11	0	16	0	489	86	591	54
ETHYLENE OXIDE	10	0	0	0	0	0	0	0
COPPER	9	46	938,477	0	55,261	0	993,784	110,420
MOLYBDENUM TRIOXIDE	9	7,652	52,424	61,220	0	0	121,296	13,477
FORMALDEHYDE	8	255	250	0	362	0	867	108
ZINC (FUME OR DUST)	8	250	1,710	250	0	0	2,210	276
ARSENIC COMPOUNDS	7	5	59,900	250	904	0	61,059	8,723
MERCURY	7	0	3,486	5,222	1,010	0	9,718	1,388
1,1,1-TRICHLOROETHANE	7	0	0	250	5	0	255	36
ASBESTOS (FRIABLE)	6	0	33,070	0	0	0	33,070	5,512
CARBON TETRACHLORIDE	6	0	1,400	0	34,107	0	35,507	5,918
CHROMIUM	6	0	48,930	2,763	37,765	0	89,458	14,910
DICHLOROTETRAFLUOROETHA	6	0	0	0	0	0	0	0
ETHYLENE	6	0	0	0	0	0	0	0
METHYL ETHYL KETONE	6	0	92	0	443	33,567	34,102	5,684
NAPHTHALENE	6	0	48	0	880	250	1,178	196
CADMIUM COMPOUNDS	5	35	585	5	4,061	0	4,686	937
DICHLOROMETHANE	5	0	0	5,147	5	0	5,152	1,030
DIETHANOLAMINE	5	450	0	0	0	0	450	90
ACETONITRILE	4	0	0	0	5	22,239	22,244	5,561

R0075444

Exhibit 12 (cont.): 1993 Transfers for Inorganic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFERS PER FACILITY
CARBON DISULFIDE	4	250	10	0	0	500	760	190
CHLOROFORM	4	0	7,700	0	72,311	0	80,011	20,003
CYANIDE COMPOUNDS	4	1	0	0	4	0	5	1
NICKEL	4	97	505	23,670	0	0	24,272	6,068
PHTHALIC ANHYDRIDE	4	5	0	0	5	2,412	2,422	606
SELENIUM COMPOUNDS	4	2	27	0	295	0	324	81
TRICHLOROFLUOROMETHANE	4	0	0	3,100	1,705	0	4,805	1,201
1,2,4-TRIMETHYLBENZENE	4	0	0	0	1,854	3,188	5,042	1,261
ALUMINUM (FUME OR DUST)	3	0	0	0	0	0	0	0
BENZENE	3	0	0	0	5	0	5	2
ETHYLBENZENE	3	0	0	0	5	0	5	2
FREON 113	3	0	0	0	1,500	0	1,500	500
HYDRAZINE	3	0	0	0	0	0	0	0
MANGANESE	3	0	183,412	0	0	0	183,412	61,137
MONOCHLOROPENTAFLUOROE	3	0	0	0	0	0	0	0
TRICHLOROETHYLENE	3	0	0	0	1,305	0	1,305	435
ACETALDEHYDE	2	0	0	0	0	0	0	0
ACRYLONITRILE	2	0	0	0	5	0	5	3
CHLORINE DIOXIDE	2	130	0	0	0	0	130	65
COBALT	2	4	5	2,300	0	0	2,309	1,155
CRESOL (MIXED ISOMERS)	2	0	0	0	5	0	5	3
CYCLOHEXANE	2	0	0	0	5	0	5	3
HYDROQUINONE	2	500	0	0	0	0	500	250
LEAD	2	0	750	0	66	0	816	408
METHYL ISOBUTYL KETONE	2	0	0	0	5	820	825	413
METHYL TERT-BUTYL ETHER	2	0	0	0	5	0	5	3
PHENOL	2	0	0	0	5	0	5	3
SILVER COMPOUNDS	2	5	5	0	0	0	10	5
TETRACHLOROETHYLENE	2	0	0	0	5	0	5	3
ACRYLIC ACID	1	0	0	0	5	0	5	5
ARSENIC	1	0	0	0	70,761	0	70,761	70,761
BARIUM	1	0	26,217	0	0	0	26,217	26,217
BROMOTRIFLUOROMETHANE	1	0	0	0	0	0	0	0
CAPTAN	1	0	0	0	0	0	0	0
CHLOROBENZENE	1	0	0	0	5	0	5	5
CHLOROETHANE	1	0	0	0	0	0	0	0
CHLOROMETHANE	1	0	0	0	0	0	0	0
CREOSOTE	1	0	0	0	5	0	5	5
CUMENE	1	0	0	0	1,000	0	1,000	1,000
DI(2-ETHYLHEXYL)	1	0	0	0	5	0	5	5
DIBUTYL PHTHALATE	1	0	0	0	5	0	5	5
DIMETHYL PHTHALATE	1	0	0	0	0	0	0	0
DIMETHYL SULFATE	1	0	0	0	0	0	0	0
ETHYL ACRYLATE	1	0	0	0	5	0	5	5
HYDROGEN CYANIDE	1	0	0	0	0	0	0	0
ISOPROPYL ALCOHOL	1	0	0	0	5	0	5	5
MALEIC ANHYDRIDE	1	0	0	0	5	0	5	5
MERCURY COMPOUNDS	1	5	1,525	0	5	0	1,535	1,535

R0075445

Exhibit 12 (cont.): 1993 Transfers for Inorganic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFERS PER FACILITY
METHYL METHACRYLATE	1	0	0	0	5	0	5	5
N-BUTYL ALCOHOL	1	0	0	0	5	0	5	5
O-XYLENE	1	0	0	0	0	0	0	0
P-XYLENE	1	0	0	0	0	0	0	0
PERACETIC ACID	1	0	0	0	110	0	110	110
POLYCHLORINATED	1	0	0	0	0	0	0	0
SELENIUM	1	0	0	0	1,450	0	1,450	1,450
SILVER	1	0	0	1,011	0	0	1,011	1,011
STYRENE	1	0	0	0	5	0	5	5
THIOUREA	1	0	0	0	0	0	0	0
VINYL ACETATE	1	0	0	0	0	0	0	0
VINYL CHLORIDE	1	0	0	0	0	0	0	0
1,1,2-TRICHLOROETHANE	1	0	0	0	5	0	5	5
1,2-DICHLOROETHANE	1	0	0	0	0	0	0	0
1,2,4-TRICHLOROBENZENE	1	0	0	0	0	0	0	0
1,4-DIOXANE	1	0	0	0	0	0	0	0
TOTAL	555	30,622,040	10,087,743	4,994,483	21,958,678	2,383,524	70,046,468	126,210

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 13: Top 10 TRI Releasing Inorganic Chemicals Facilities[b]

Rank	Facility	Total TRI Releases in Pounds
1	Du Pont Delisle Plant - Pass Christian, MS	58,875,734
2	Du Pont Johnsonville Plant - New Johnsonville, TN	51,215,700
3	Cabot Corp. Cab-O-Sil Div. - Tuscola, IL	13,926,440
4	American Chrome & Chemicals Inc. - Corpus Christi, TX	12,113,360
5	Occidental Chemical Corp. - Castle Hayne, NC	6,705,795
6	Chemetals Inc. - New Johnsonville, TN	5,684,893
7	Kaiser Aluminum & Chemical Corp. - Mulberry, FL	4,876,348
8	Kerr-McGee Chemical Corp. - Henderson, NV	2,333,175
9	SCM Chemicals Americas Plant II - Ashtabula, OH	2,238,400
10	Louisiana Pigment Co. L.P. - Westlake, LA	1,465,753

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

[b] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075447

Exhibit 14: Top 10 TRI Releasing Facilities Reporting Inorganic Chemical SIC Codes to TRI[c]

Rank	SIC Codes Reported in TRI	Facility	Total TRI Releases in Pounds
1	2819, 2873, 2874	IMC-Agrico Co., Faustina Plant - Saint James, LA	127,912,967
2	2819, 2869	Cytec Industries, Inc., Fortier Plant - Westwego, LA	120,149,724
3	2819, 2874	IMC-Agrico Co., Uncle Sam Plant - Uncle Sam, LA	61,807,180
4	2816	Du Pont Delisle Plant - Pass Christian, MS	58,875,734
5	2816	Du Pont Johnsonville Plant - New Johnsonville, TN	51,215,700
6	2819, 2823	Courtaulds Fibers, Inc. - Axis, AL	42,658,865
7	2819, 2869, 2841, 2879	Monsanto Co. - Alvin, TX	40,517,095
8	2819, 2869, 2865	Sterling Chemicals, Inc. - Texas City, TX	24,709,135
9	2819, 2873, 2874	Arcadian Fertilizer L.P. - Geismar, LA	22,672,961
10	2812, 2813, 2869	Vulcan Chemicals - Wichita, KS	17,406,218

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of Selected Chemicals Released

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), and the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, the National Cancer Institute, and the National Institute for Occupational Safety and Health.[d] HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure

[c] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

[d] Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory).

potential, exposure standards and regulations, monitoring and analysis methods, and additional references. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 800-231-3766.

Hydrochloric Acid (CAS: 7647-01-1)

Sources. Hydrochloric acid is one of the highest volume chemicals produced by the inorganic chemical industry. Some of its more common uses are as a pickling liquor and metal cleaner in the iron and steel industry, as an activator of petroleum wells, as a boiler scale remover, and as a neutralizer of caustic waste streams. The largest release of hydrochloric acid by the inorganic chemical industry is in the form of underground injection of spent hydrochloric acid used to manufacture chlorosulfonic acid and other products.[57]

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Chromium and Chromium Compounds (CAS: 7440-47-3; 20-06-4)

Sources. Chrome pigments, chromates, chromic acid, chromium salts, and other inorganic chromium compounds are some of the larger volume products of the inorganic chemicals industry. Chrome is used as a plating element for metal and plastics to prevent corrosion, and as a constituent of certain steels and inorganic pigments. Most chromium wastes released to the environment by the inorganic chemicals industry are land disposed in the form of chromium containing sludges.

Toxicity. Although the naturally-occurring form of chromium metal has very low toxicity, chromium from industrial emissions is highly toxic due to strong oxidation characteristics and cell membrane permeability. The majority of the effects detailed below are based on Chromium VI (an isomer that is more toxic than Cr III). Exposure to chromium metal and insoluble chromium salts affects the respiratory system. Inhalation exposure to chromium and chromium salts may cause severe irritation of the upper respiratory tract and scarring of lung tissue. Dermal exposure to chromium and chromium salts can also cause sensitive dermatitis and skin ulcers.

Ecologically, although chromium is present in small quantities in all soils and plants, it is toxic to plants at higher soil concentrations (i.e., 0.2 to 0.4 percent in soil).

Carcinogenicity. Different sources disagree on the carcinogenicity of chromium. Although an increased incidence in lung cancer among workers in the chromate-producing industry has been reported, data are inadequate to confirm that chromium is a human carcinogen. Other sources consider chromium VI to be a known human carcinogen based on inhalation exposure.

Environmental Fate. Chromium is a non-volatile metal with very low solubility in water. If applied to land, most chromium remains in the upper five centimeters of soil. Most chromium in surface waters is present in particulate form as sediment. Airborne chromium particles are relatively unreactive and are removed from the air through wet and dry deposition. The precipitated chromium from the air enters surface water or soil. Chromium bioaccumulates in plants and animals, with an observed bioaccumulation factor of 1,000,000 in snails.

Carbonyl Sulfide (CAS: 463-58-1)

Sources. Carbonyl sulfide is the largest volume chemical released to the air by the inorganic chemicals industry. Carbonyl sulfide is primarily generated by a relatively small number of facilities hydrolyzing ammonium or potassium thiocyanate during the manufacturing of inorganic pigments and dyes.[58]

Toxicity. Exposure to low to moderate concentrations of carbonyl sulfide causes eye and skin irritation and adverse central nervous system effects such as giddiness, headache, vertigo, amnesia, confusion, and unconsciousness. If ingested, gastrointestinal effects include profuse salivation, nausea, vomiting and diarrhea. Moderate carbonyl sulfide poisoning also causes rapid breathing and heartbeat, sweating, weakness, and muscle cramps. Exposure to very high concentrations of carbonyl sulfide causes sudden collapse, unconsciousness, and death from sudden respiratory paralysis. Recovery from sublethal exposure is slow, but generally complete. Degradation products of carbonyl sulfide (especially hydrogen sulfide) can result in toxic symptoms and death.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released to soil or surface waters, carbonyl sulfide will rapidly volatilize. It is not expected to adsorb to soil sediments or organic matter nor is it expected to bioconcentrate in fish and aquatic organisms. Carbonyl sulfide is hydrolyzed in water to carbon dioxide and hydrogen sulfide. Carbonyl sulfide is expected to have a long residence time in the atmosphere. Atmospheric removal of carbonyl sulfide may occur by slow reactions with other gases, and may also occur through adsorption by plants and soil microbes.

Manganese and Manganese Compounds (CAS: 7439-96-5; 20-12-2)

Sources. Manganese is both a product and chemical intermediate of the inorganic chemical industry. Manganese is used as a purifying and scavenging agent in metal production, as an intermediate in aluminum production and as a constituent of non-ferrous alloys to improve corrosion resistance and hardness.[59]

Toxicity. There is currently no evidence that human exposure to manganese at levels commonly observed in ambient atmosphere results in adverse health effects. However, recent EPA review of the fuel additive MMT (methylcyclopentadienyl manganese tricarbonyl) concluded that use of MMT in gasoline could lead to ambient exposures to manganese at a level sufficient to cause adverse neurological effects in humans.

Chronic manganese poisoning bears some similarity to chronic lead poisoning. Occurring via inhalation of manganese dust or fumes, it primarily involves the central nervous system. Early symptoms include languor, speech disturbances, sleepiness, and cramping and weakness in legs. A stolid mask-like appearance of face, emotional disturbances such as absolute detachment broken by uncontrollable laughter, euphoria, and a spastic gait with a tendency to fall while walking are seen in more advanced cases. Chronic manganese poisoning is reversible if treated early and exposure stopped. Populations at greatest risk of manganese toxicity are the very young and those with iron deficiencies.

Ecologically, although manganese is an essential nutrient for both plants and animals, in excessive concentrations manganese inhibits plant growth.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Manganese is an essential nutrient for plants and animals. As such, manganese accumulates in the top layers of soil or surface water sediments and cycles between the soil and living organisms. It occurs mainly as a solid under environmental conditions, though may also be transported in the atmosphere as a vapor or dust

Ammonia (CAS: 7664-41-7)

Sources. Ammonia is used in many chemical manufacturing processes and is the building block for all synthetic nitrogen products. Its prevalence and its volatile and water soluble characteristics allow it to be readily released to the air and water. In the inorganic chemical manufacturing industry, ammonia can be either a feedstock or a by-product. Some of the more common inorganic chemical industry processes using or producing ammonia include the manufacturing of: ammonium chloride, ammonium hydroxide, ammonium thiosulfate, ammonium nitrate, hydrazine, and hydrogen cyanide.

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system. Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters. Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

IV.C. Other Data Sources

In addition to chemicals covered under TRI, many other chemicals are released. For example, the EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., VOCs. SO_x, NO_x, CO. particulates) from many chemical industry sources.

The EPA Office of Air's Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 15 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM_{10}), total particulate (PT), sulfur dioxide (SO2) and volatile organic compounds (VOCs).

Exhibit 15: Pollutant Releases (short tons/year)

Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
Metal Mining	5.391	28.583	39.359	140.052	84.222	1.283
Nonmetal Mining	4.525	28.804	59.305	167.948	24.129	1.736
Lumber and Wood Production	123.756	42.658	14.135	63.761	9.419	41.423
Furniture and Fixtures	2.069	2.981	2.165	3,178	1.606	59.426
Pulp and Paper	624.291	394.448	35.579	113.571	541.002	96.875
Printing	8.463	4.915	399	1,031	1.728	101.537
Inorganic Chemicals	**166,147**	**103,575**	**4,107**	**39,062**	**182,189**	**52,091**
Organic Chemicals	146.947	236,826	26,493	44,860	132.459	201,888
Petroleum Refining	419.311	380.641	18,787	36,877	648.155	369.058
Rubber and Misc. Plastics	2.090	11.914	2.407	5.355	29.364	140.741
Stone. Clay and Concrete	58.043	338,482	74.623	171.853	339.216	30.262
Iron and Steel	1.518.642	138.985	42.368	83.017	238.268	82.292
Nonferrous Metals	448.758	55.658	20.074	22.490	373.007	27.375
Fabricated Metals	3.851	16.424	1.185	3.136	4.019	102.186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4.854
Motor Vehicles. Bodies. Parts and Accessories	35.303	23.725	2,406	12.853	25.462	101.275
Dry Cleaning	101	179	3	28	152	7.310

Source: U.S. EPA Office of Air and Radiation. AIRS Database. May 1995.

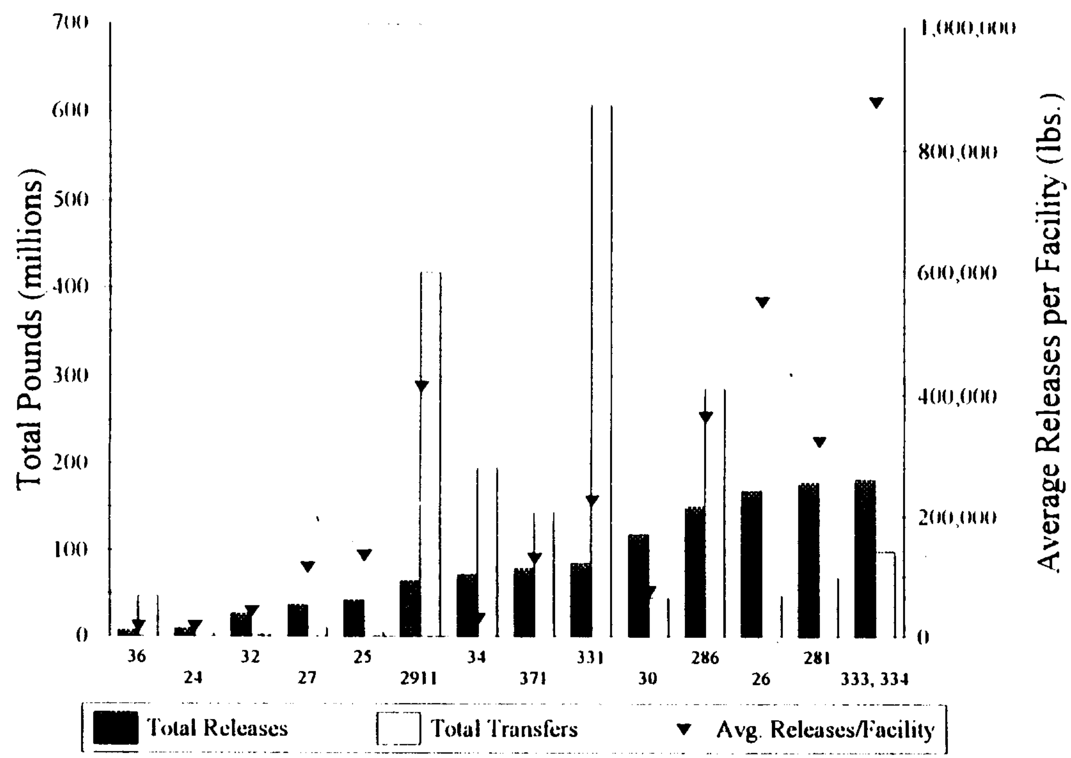
IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 16 is a graphical representation of a summary of the 1993 TRI data for the inorganic chemicals industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 17 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the inorganic chemicals, the 1993 TRI data presented here covers 555 facilities. These facilities listed SIC 2812-2819 (inorganic chemicals) as a primary SIC code.

R0075455

Exhibit 16: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0075456

Exhibit 17: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	1993 TRI Releases: Total Releases (million lbs.)	1993 TRI Releases: Average Releases per Facility (pounds)	1993 TRI Transfers: Total Transfers (million lbs.)	1993 TRI Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	42,000	2.2	4,000	28.8	46,000
Lumber and Wood Products	24	491	8.4	17,000	3.5	7,000	11.9	24,000
Furniture and Fixtures	25	313	42.2	135,000	4.2	13,000	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	32,000	46.7	147,000
Electronic Equip. and Components	36	406	6.7	17,000	47.1	116,000	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	75,000	45	29,000	163.4	104,000
Motor Vehicles, Bodies, Parts, and Accessories	371	609	79.3	130,000	145.5	239,000	224.8	369,000
Pulp and Paper	2611-2631	309	169.7	549,000	48.4	157,000	218.1	706,000
Inorganic Chem. Mfg.	**2812-2819**	**555**	**179.6**	**324,000**	**70**	**126,000**	**249.7**	**450,000**
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72	30,000	195.7	83,000	267.7	123,000
Iron and Steel	331	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,000	98.2	472,000	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting.						
Nonmetal Mining	14	Industry sector not subject to TRI reporting.						
Dry Cleaning	7216	Industry sector not subject to TRI reporting.						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimize environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitute toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the inorganic chemical manufacturing industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section also provides the context (in terms of type of industry and/or type of process affected) in which the pollution prevention technique can effectively be used.

There have been numerous cases have where the chemical industry has simultaneously reduced pollutant outputs and operating costs through pollution prevention techniques. In the inorganic chemicals manufacturing sector, however, economically viable pollution prevention opportunities are not as easily identified as in other sectors. The relatively small size and limited resources of a typical inorganic chemical facility limits the number of feasible pollution prevention options. The limited resources available to the industry eliminates many pollution prevention options that require significant capital expenditures such as process modifications and process redesign. In addition, the inorganic chemicals industry's products are primarily commodity chemicals for which the manufacturing processes have been developed over many years. Commodity chemical manufacturers redesign their processes infrequently so that redesign of the reaction process or equipment is unlikely in the short term. In addition, the industry's process equipment has been amortized over long periods of time making cost-effective process equipment improvements scarce. As a result, pollution prevention in the inorganic chemicals industry is somewhat restricted to the less costly options, such as minor process modifications, operational changes, raw material substitutions, and recycling.

Pollution prevention in the chemical industry in process specific. As such it is difficult to generalize about the relative merits of different pollution prevention strategies. The age and size of the facility, and the type and number of its processes will determine the most effective pollution prevention strategy. Brief descriptions of some of the more widespread, general pollution prevention techniques found to be effective at inorganic chemicals facilities are provided below. Many of these pollution prevention opportunities can be applied to the petrochemical industry as a whole due to the many similar processes found throughout the industry. It should be noted that many of the ideas identified below as pollution prevention opportunities, aimed at reducing wastes and reducing materials use, have been carried out by the chemicals manufacturing industry for many years as the primary means of improving process efficiencies and increasing profits.

In chlor-alkali production, pollution prevention options have been demonstrated for both the mercury cell and diaphragm cell processes; however, the best opportunity to reduce pollutant outputs, conserve energy, and reduce costs in the chlor-alkali industry are in the conversion to the membrane cell process. In terms of energy consumption, the membrane cell process uses only about 77 percent of that of the mercury cell process and about 90 percent of that of the diaphragm cell process. The membrane cell process also generates significantly less airborne and waterborne pollutants and solid wastes (see Section III.B. - Raw Material Inputs and Pollution Outputs).

Substitute raw materials. The substitution or elimination of some of the raw materials used in the manufacturing of inorganic chemicals can result in substantial waste reductions and cost savings. Because impurities in the feed stream can be a major contributor to waste generation, one of the most common substitutions is to use a higher purity feedstock. This can be accomplished either by working with suppliers to get a higher quality feed or by installing purification equipment. Raw materials can also be substituted with less toxic and less water soluble materials to reduce water contamination, and with less volatile materials to reduce fugitive emissions. Sometimes certain raw materials can be eliminated all together. The need for raw materials that end up as wastes should be reexamined to determine if raw materials can be eliminated by modifying the process and improving control.

Improve reactor efficiencies. Since the chemical products are primarily created inside the process reactor, it can be the primary source for waste (off-spec) materials. One of the most important parameters dictating the reactor efficiency is the quality of mixing. A number of techniques can be used to improve mixing, such as installing baffles in the reactor, a higher rpm motor for the agitator, a different mixing blade design, multiple impellers, and pump recirculation. The method used to introduce feed to the reactor can also have an effect on the quality of mixing. A feed distributor can be added to equalize residence time through the reactor, and feed streams can be added at a point in time closer to the ideal reactant concentration. This will avoid secondary reactions which form unwanted by-products.

Improve catalyst. The catalyst plays a critical role in the effectiveness of chemical conversion in the reactor. Alternative chemical makeups and physical characteristics can lead to substantial improvements in the effectiveness and life of a catalyst. Different catalysts can also eliminate by-product formation. Noble metal catalysts can replace heavy metal catalysts to eliminate wastewater contaminated with heavy metals. The consumption of catalysts can be reduced by using a more active form and emissions and effluents generated during catalyst activation can be eliminated by obtaining the catalyst in the active form.

Optimize processes. Process changes that optimize reactions and raw materials use can reduce waste generation and releases. Many larger facilities are using computer controlled systems which analyze the process continuously and respond more quickly and accurately than manual control systems. These systems are often capable of automatic startups, shutdowns. and product changeover which can bring the process to stable conditions quickly, minimizing the generation of off-spec wastes. Other process optimization techniques include: equalizing the reactor and storage tank vent lines during batch filling to minimize vent gas losses; sequencing the addition of reactants and reagents to optimize yields and lower emissions; and optimizing sequences to minimize washing operations and cross-contamination of subsequent batches.

Reduce heat exchanger wastes and inefficiencies. Heat exchangers are often the source of significant off-spec product wastes generated by overheating the product closest to the tube walls. The best way to reduce off-spec product from overheating is by reducing the heat exchanger tube wall temperature. This can be accomplished through a number of techniques which do not reduce the overall heat transferred such as: reducing the tube wall temperature and increasing the effective surface area of the heat exchanger; using staged heating by first heating with waste heat, then low pressure steam, followed by superheated high pressure steam; monitor and prevent fouling of the heat exchanger tubes so that lower temperature heat sources can be used; using noncorroding tubes which will foul less quickly than tubes that corrode.

Improve wastewater treatment and recycling. A large portion of the inorganic chemical industry's pollutants leave the facilities as wastewater or wastewater treatment system sludge. Improved treatment and minimization of wastewater are effective pollution prevention opportunities that often do not require significant changes to the industrial processes. Modern wastewater treatment technologies such as ion exchange, electrolytic cells.

reverse osmosis, and improved distillation, evaporation, and dewatering can often be added to existing treatment systems. Wastewater streams containing acids or metals can be concentrated enough to be sold commercially as a product by slightly altering the manufacturing process, adding processing steps, and segregating wastewater streams. Furthermore, many wastewater streams can be reused within the same or different processes, significantly reducing discharges to the wastewater treatment system. An ion exchange system installed in a mercury cell chlor-alkali plant reduced mercury by 99 percent in the facility's effluent. An inorganic chemicals plant making photochemistry solution generated a wastewater containing silver. Electrolytic cells were installed that recovered 98 percent of the silver and an evaporator was added that concentrated the remaining liquid for disposal resulting in a 90 percent reduction in waste volume.

Prevent leaks and spills. The elimination of sources of leaks and spills can be a very cost effective pollution prevention opportunity. Leaks and spills can be prevented by installing seamless pumps and other "leakless" components, maintaining a preventative maintenance program, and maintaining a leak detection program.

Improve inventory management and storage. Good inventory management can reduce the generation of wastes by preventing materials from exceeding their shelf life, preventing materials from being left over or not needed, and reducing the likelihood of accidental releases of stored material. Designating a materials storage area, limiting traffic through the area, and giving one person the responsibility to maintain and distribute materials can reduce materials use, and the contamination and dispersal of materials.

Exhibit 18 summarizes the above pollution prevention opportunities and provides additional examples provided by the Chemical Manufacturers Association.

Exhibit 18: Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
Byproducts Coproducts		
Quantity and Quality	▪ Process inefficiencies result in the generation of undesired by-products and co-products. Inefficiencies will require larger volumes of raw materials and result in additional secondary products. Inefficiencies can also increase fugitive emissions and wastes generated through material handling.	▪ Increase product yield to reduce by-product and co-product generation and raw material requirements.
Uses and Outlets	▪ By-products and co-products are not fully utilized, generating material or waste that must be managed.	▪ Identify uses and develop a sales outlet. Collect information necessary to firm up a purchase commitment such as minimum quality criteria, maximum impurity levels that can be tolerated, and performance criteria.
Catalysts		
Composition	▪ The presence of heavy metals in catalysts can result in contaminated process wastewater from catalyst handling and separation. These wastes may require special treatment and disposal procedures or facilities. Heavy metals can be inhibitory or toxic to biological wastewater treatment units. Sludge from wastewater treatment units may be classified as hazardous due to heavy metals content. Heavy metals generally exhibit low toxicity thresholds in aquatic environments and may bioaccumulate.	▪ Catalysts comprised of noble metals, because of their cost, are generally recycled by both onsite and offsite reclaimers.
Preparation and Handling	▪ Emissions or effluents are generated with catalyst activation or regeneration.	▪ Obtain catalyst in the active form. ▪ Provide in situ activation with appropriate processing/activation facilities.
	▪ Catalyst attrition and carry over into product requires de-ashing facilities which are a likely source of wastewater and solid waste.	▪ Develop a more robust catalyst or support.

R0075462

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Catalysts (cont'd)		
Preparation and Handling (cont')	▪ Catalyst is spent and needs to be replaced.	▪ In situ regeneration eliminates unloading/loading emissions and effluents versus offsite regeneration or disposal.
	▪ Pyrophoric catalyst needs to be kept wet, resulting in liquid contaminated with metals.	▪ Use a nonpryrophoric catalyst. Minimize amount of water required to handle and store safely.
	▪ Short catalyst life.	▪ Study and identify catalyst deactivation mechanisms. Avoid conditions which promote thermal or chemical deactivation. By extending catalyst life, emissions and effluents associated with catalyst handling and regeneration can be reduced.
Effectiveness	▪ Catalyzed reaction has by-product formation, incomplete conversion and less-than-perfect yield.	▪ Reduce catalyst consumption with a more active form. A higher concentration of active ingredient or increased surface area can reduce catalyst loadings.
		▪ Use a more selective catalyst which will reduce the yield of undesired by-products.
	▪ Catalyzed reaction has by-product formation, incomplete conversion and less-than perfect yield.	▪ Improve reactor mixing/contacting to increase catalyst effectiveness.
		▪ Develop a thorough understanding of reaction to allow optimization of reactor design. Include in the optimization, catalyst consumption and by-product yield.
Intermediate Products		
Quantity and Quality	▪ Intermediate reaction products or chemical species, including trace levels of toxic constituents, may contribute to process waste under both normal and upset conditions.	▪ Modify reaction sequence to reduce amount or change composition of intermediates.
	▪ Intermediates may contain toxic constituents or have characteristics that are harmful to the environment.	▪ Modify reaction sequence to change intermediate properties. ▪ Use equipment design and process control to reduce releases.

R0075463

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration		
Temperature	▪ High heat exchange tube temperatures cause thermal cracking/decomposition of many chemicals. These lower molecular weight by-products are a source of "light ends" and fugitive emissions. High localized temperature gives rise to polymerization of reactive monomers, resulting in "heavies" or "tars." such materials can foul heat exchange equipment or plug fixed-bed reactors, thereby requiring costly equipment cleaning and production outage.	▪ Select operating temperatures at or near ambient temperature whenever possible. ▪ Use lower pressure steam to lower temperatures. ▪ Use intermediate exchangers to avoid contact with furnace tubes and walls. ▪ Use staged heating to minimize product degradation and unwanted side reactions. ▪ Use a super heat of high-pressure steam in place of furnace. ▪ Monitor exchanger fouling to correlate process conditions which increase fouling, avoid conditions which rapidly foul exchangers. ▪ Use online tube cleaning technologies to keep tube surfaces clean to increase heat transfer. ▪ Use scraped wall exchangers in viscous service. ▪ Use falling film reboiler, pumped recirculation reboiler or high-flux tubes.
	▪ Higher operating temperatures imply "heat input" usually via combustion which generates emissions.	▪ Explore heat integration opportunities (e.g., use waste heat to preheat materials and reduce the amount of combustion required.)
	▪ Heat sources such as furnaces and boilers are a source of combustion emissions.	▪ Use thermocompressor to upgrade low-pressure steam to avoid the need for additional boilers and furnaces.
	▪ Vapor pressure increases with increasing temperature. Loading/ unloading, tankage and fugitive emissions generally increase with increasing vapor pressure.	▪ If possible, cool materials before sending to storage. ▪ Use hot process streams to reheat feeds.

R0075464

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration (cont'd)		
Temperature (cont'd)		▪ Add vent condensers to recover vapors in storage tanks or process.
		▪ Add closed dome loading with vapor recovery condensers.
	▪ Water solubility of most chemicals increases with increasing temperature.	▪ Use lower temperature (vacuum processing).
Pressure	▪ Fugitive emissions from equipment.	▪ Equipment operating in vacuum service is not a source of fugitives; however, leaks into the process require control when system is degassed.
	▪ Seal leakage potential due to pressure differential.	▪ Minimize operating pressure.
	▪ Gas solubility increases with higher pressures.	▪ Determine whether gases can be recovered, compressed, and reused or require controls.
Corrosive Environment	▪ Material contamination occurs from corrosion products. Equipment failures result in spills, leaks, and increased maintenance costs.	▪ Improve metallurgy or provide coating or lining.
		▪ Neutralize corrosivity of materials contacting equipment.
		▪ Use corrosion inhibitors.
		▪ Improve metallurgy or provide coating or lining.
	▪ Increased waste generation due to addition of corrosion inhibitors or neutralization.	▪ Improve metallurgy or provide coating or lining or operate in a less corrosive environment.
Batch vs. Continuous Operations	▪ Vent gas lost during batch fill.	▪Equalize reactor and storage tank vent lines.
		▪Recover vapors through condenser, adsorber, etc.
	▪ Waste generated by cleaning/purging of process equipment between production batches.	▪ Use materials with low viscosity. Minimize equipment roughness.

R0075465

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration (cont'd)		
Batch vs. Continuous Operations (cont'd)		▪ Optimize product manufacturing sequence to minimize washing operations and cross-contamination of subsequent batches.
	▪ Process inefficiencies lower yield and increase emissions.	▪ Sequence addition of reactants and reagents to optimize yields and lower emissions.
	▪ Continuous process fugitive emissions and waste increase over time due to equipment failure through a lack of maintenance between turnarounds.	▪Design facility to readily allow maintenance so as to avoid unexpected equipment failure and resultant release.
Process Operation/Design	▪ Numerous processing steps create wastes and opportunities for errors.	▪ Keep it simple. Make sure all operations are necessary. More operations and complexity only tend to increase potential emission and waste sources.
	▪ Nonreactant materials (solvents, absorbents, etc.) create wastes. Each chemical (including water) employed within the process introduces additional potential waste sources; the composition generated wastes also tends to become more complex.	▪ Evaluate unit operation or technologies (e.g., separation) that do not require the addition of solvents or other nonreactant chemicals.
	▪ High conversion with low yield results in wastes.	▪ Recycle operations generally improve overall use of raw materials and chemicals, thereby increasing the yield of desired products while at the same time reducing the generation of wastes. A case-in-point is to operate at a lower conversion per reaction cycle by reducing catalyst consumption, temperature, or residence time. Many times, this can result in a higher selectivity to desired products. The net effect upon recycle of unreacted reagents is an increase in product yield, while at the same time reducing the quantities of spent catalyst and less desirable by-products.

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration (cont'd)		
Process Operation/Design	▪ Non-regenerative treatment systems result in increased waste versus regenerative systems.	▪ Regenerative fixed bed treating or desiccant operation (e.g.. aluminum oxide, silica, activated carbon, molecular sieves, etc.) will generate less quantities of solid or liquid waste than nonregenerative units (e.g., calcium chloride or activated clay). With regenerative units though, emissions during bed activation and regeneration can be significant. Further, side reactions during activation/regeneration can give rise to problematic pollutants.
Product		
Process Chemistry	▪ Insufficient R&D into alternative reaction pathways may miss pollution opportunities such as reducing waste or eliminating a hazardous constituent.	▪ R&D during process conception and laboratory studies should thoroughly investigate alternatives in process chemistry that affect pollution prevention.
Product Formulation	▪ Product based on end-use performance may have undesirable environmental impacts or use raw materials or components that generate excessive or hazardous wastes.	▪ Reformulate products by substituting different material or using a mixture of individual chemicals that meet end-use performance specifications.
Raw Materials		
Purity	▪ Impurities may produce unwanted by-products and waste. Toxic impurities, even in trace amounts, can make a waste hazardous and therefore subject to strict and costly regulation.	▪ Use higher purity materials. ▪ Purify materials before use and reuse if practical. ▪ Use inhibitors to prevent side reactions.
	▪ Excessive impurities may require more processing and equipment to meet product specifications, increasing costs and potential for fugitive emissions, leaks, and spills.	▪ Achieve balance between feed purity, processing steps, product quality, and waste generation.

R0075467

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Raw Materials (cont'd)		
Purity (cont'd)	▪ Specifying a purity greater than needed by the process increases costs and can generate more waste generation by the supplier.	▪ Specify a purity no greater than what the process needs.
	▪ Impurities in clean air can increase inert purges.	▪Use pure oxygen.
	▪ Impurities may poison catalyst prematurely resulting in increased wastes due to yield loss and more frequent catalyst replacement.	▪Install guard beds to protect catalysts.
Vapor Pressure	▪ Higher vapor pressures increase fugitive emissions in material handling and storage.	▪ Use material with lower vapor pressure.
	▪ High vapor pressure with low odor threshold materials can cause nuisance odors.	▪ Use materials with lower vapor pressure and higher odor threshold.
Water Solubility	▪ Toxic or nonbiodegradable materials that are water soluble may affect wastewater treatment operation, efficiency, and cost.	▪ Use less toxic or more biodegradable materials.
	▪ Higher solubility may increase potential for surface and groundwater contamination and may require more careful spill prevention, containment, and cleanup (SPCC) plans.	▪ Use less soluble materials.
	▪ Higher solubility may increase potential for storm water contamination in open areas.	▪ Use less soluble materials. ▪ Prevent direct contact with storm water by diking or covering areas.
	▪ Process wastewater associated with water washing or hydrocarbon/water phase separation will be impacted by containment solubility in water. Appropriate wastewater treatment will be impacted.	▪ Minimize water usage. ▪ Reuse wash water. ▪ Determine optimum process conditions for phase separation. ▪ Evaluate alternative separation technologies (coalescers, membranes, distillation, etc.)

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Raw Materials (cont'd)		
Toxicity	▪ Community and worker safety and health concerns result from routine and nonroutine emissions. Emissions sources include vents, equipment leaks, wastewater emissions, emergency pressure relief, etc.	▪ Use less toxic materials. ▪ Reduce exposure through equipment design and process control. Use systems which are passive for emergency containment of toxic releases.
	▪ Surges or higher than normal continuous levels of toxic materials can shock or miss wastewater biological treatment systems resulting in possible fines and possible toxicity in the receiving water.	▪ Use less toxic material. ▪ Reduce spills, leaks, and upset conditions through equipment and process control. ▪ Consider effect of chemicals on biological treatment; provide unit pretreatment or diversion capacity to remove toxicity. ▪ Install surge capacity for flow and concentration equalization.
Regulatory	▪ Hazardous or toxic materials are stringently regulated. They may require enhanced control and monitoring; increased compliance issues and paperwork for permits and record keeping; stricter control for handling, shipping, and disposal; higher sampling and analytical costs; and increased health and safety costs.	▪ Use materials which are less toxic or hazardous. ▪ Use better equipment and process design to minimize or control releases; in some cases, meeting certain regulatory criteria will exempt a system from permitting or other regulatory requirements.
Form of Supply	▪ Small containers increase shipping frequency which increases chances of material releases and waste residues from shipping containers (including wash waters).	▪ Use bulk supply, ship by pipeline, or use "jumbo" drums or sacks. ▪ In some cases, product may be shipped out in the same containers the material supply was shipped in without washing.
	▪ Nonreturnable containers may increase waste.	▪ Use returnable shipping containers or drums.
Handling and Storage	▪ Physical state (solid, liquid, gaseous) may raise unique environmental, safety, and health issues with unloading operations and transfer to process equipment.	▪ Use equipment and controls appropriate to the type of materials to control releases.

R0075469

Exhibit 18 (cont.): Process/Product Modifications Create Pollution Prevention Ops.

Area	Potential Problem	Possible Approach
Raw Materials (cont'd)		
Handling and Storage (cont'd)	▪ Large inventories can lead to spills, inherent safety issues and material expiration.	▪ Minimize inventory by utilizing just-in-time delivery.
Waste Streams		
Quantity and Quality	▪ Characteristics and sources of waste streams are unknown.	▪ Document sources and quantities of waste streams prior to pollution prevention assessment.
	▪ Wastes are generated as part of the process.	▪ Determine what changes in process conditions would lower waste generation of toxicity.
		▪ Determine if wastes can be recycled back into the process.
Composition	▪ Hazardous or toxic constituents are found in waste streams. Examples are: sulfides, heavy metals, halogenated hydrocarbons, and polynuclear aromatics.	▪ Evaluate whether different process conditions, routes, or reagent chemicals (e.g., solvent catalysts) can be substituted or changed to reduce or eliminate hazardous or toxic compounds.
Properties	▪ Environmental fate and waste properties are not known or understood.	▪ Evaluate waste characteristics using the following type properties: corrosivity, ignitability, reactivity, BTU content (energy recovery), biodegradability, aquatic toxicity, and bioaccumulation potential of the waste and of its degradable products, and whether it is a solid, liquid, or gas.
Disposal	▪ Ability to treat and manage hazardous and toxic waste unknown or limited.	▪ Consider and evaluate all onsite and offsite recycle, reuse, treatment, and disposal options available. Determine availability of facilities to treat or manage wastes generated.

Source: Chemical Manufacturers Association. *Designing Pollution Prevention into the Process. Research. Development and Engineering.*

R0075470

Exhibit 19: Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Compressors, blowers, fans	▪ Shaft seal leaks Piston rod seal leaks Vent streams	▪ Seal-less designs (diaphragmatic, hermetic or magnetics) ▪ Design for low emissions (internal balancing, double inlet, gland eductors) ▪ Shaft seal designs (carbon rings, double mechanical seals, buffered seals) ▪ Double seal with barrier fluid vented to control device	▪ Preventive maintenance program
Concrete pads, floors, sumps	▪ Leaks to groundwater	▪ Water stops ▪ Embedded metal plates ▪ Epoxy sealing ▪ Other impervious sealing	▪ Reduce unnecessary purges, transfers, and sampling ▪ Use drip pans where necessary
Controls	▪ Shutdowns and Start-ups generate waste and releases	▪ Improve on-line controls ▪ On-line instrumentation ▪ Automatic start-up and shutdown ▪ On-line vibration analysis ▪ Use "consensus" systems (e.g., shutdown trip requires two out of three affirmative responses)	▪ Continuous versus batch ▪ Optimize on-line run time ▪ Optimize shutdown interlock inspection frequency ▪ Identify safety and environment critical instruments and equipment
Distillation	▪ Impurities remain in process streams	▪ Increase reflux ratio ▪ Add section to column ▪ Column intervals ▪ Change feed tray	▪ Change column operating conditions - reflux ratio - feed tray - temperature - pressure - etc.

Exhibit 19 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Distillation (cont'd)	▪ Impurities remain in process streams (cont'd)	▪ Insulate to prevent heat loss ▪ Preheat column feed ▪ Increase vapor line size to lower pressure drop	▪ Clean column to reduce fouling
	▪ Large amounts of contaminated water condensage from stream stripping	▪ Use reboilers or inert gas stripping agents	▪ Use higher temperature steam
General manufacturing equipment areas	▪ Contaminated rainwater	▪ Provide roof over process facilities ▪ Segregate process sewer from storm sewer (diking) ▪ Hard-pipe process streams to process sewer	▪ Return samples to process ▪ Monitor stormwater discharge
	▪ Contaminated sprinkler and fire water	▪ Seal floors ▪ Drain to sump ▪ Route to waste treatment	
	▪ Leaks and emissions during cleaning	▪ Design for cleaning ▪ Design for minimum rinsing ▪ Design for minimum sludge ▪ Provide vapor enclosure ▪ Drain to process	▪ Use drip pans for maintenance activities ▪ Rinse to sump ▪ Reuse cleaning solutions

R0075472

Exhibit 19 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Heat exchangers	▪ Increased waste due to high localized temperatures	▪ Use intermediate exchangers to avoid contact with furnace tubes and walls ▪ Use staged heating to minimize product degradation and unwanted side reactions. (waste heat >>low pressure steam >>high pressure steam) ▪ Use scraped wall exchangers in viscous service ▪ Using falling film reboiler, piped recirculation reboiler or high-flux tubes ▪ Use lowest pressure steam possible	▪ Select operating temperatures at or near ambient temperature whenever possible. These are generally most desirable from a pollution prevention standpoint ▪ Use lower pressure steam to lower temperatures ▪ Monitor exchanger fouling to correlate process conditions which increase fouling, avoid conditions which rapidly foul exchangers ▪ Use on-line tube cleaning techniques to keep tube surfaces clean
	▪ Contaminated materials due to tubes leaking at tube sheets	▪ Use welded tubes or double tube sheets with inert purge. Mount vertically	▪ Monitor for leaks
	▪ Furnace emissions	▪ Use super heat of high-pressure steam in place of a furnace	
Piping	▪ Leaks to groundwater Fugitive emissions	▪ Design equipment layout so as to minimize pipe run length ▪ Eliminate underground piping or design for cathodic protection if necessary to install piping underground ▪ Use welded fittings ▪ Reduce number of flanges and valves	▪ Monitor for corrosion and erosion ▪ Paint to prevent external corrosion

Exhibit 19 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Piping (cont'd)	▪ Leaks to groundwater Fugitive emissions (cont'd)	▪ Use all welded pipe ▪ Use secondary containment ▪ Use spiral-wound gaskets ▪ Use plugs and double valves for open end lines ▪ Change metallurgy ▪ Use lined pipe	
	▪ Releases when cleaning or purging lines	▪ Use "pigs" for cleaning ▪ Slope to low point drain ▪ Use heat tracing and insulation to prevent freezing ▪ Install equalizer lines	▪ Flush to product storage tank
Pumps	▪ Fugitive emissions from shaft seal leaks	▪ Mechanical seal in lieu of packing ▪ Double mechanical seal with inert barrier fluid ▪ Double machined seal with barrier fluid vented to control device ▪ Seal-less pump (canned motor magnetic drive) ▪ Vertical pump	▪ Seal installation practices ▪ Monitor for leaks
	▪ Fugitive emissions from shaft seal leaks	▪ Use pressure transfer to eliminate pump	
	▪ Residual "heel" of liquid during pump maintenance	▪ Low point drain on pump casing	▪ Flush casing to process sewer for treatment

R0075474

Exhibit 19 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Pumps (cont'd)	▪ Injection of seal flush fluid into process stream	▪ Use double mechanical seal with inert barrier fluid where practical	▪ Increase the mean time between pump failures by: - selecting proper seal material; - aligning well; - reducing pipe-induced stress; - maintaining seal lubrication
Reactors	▪ Poor conversion or performance due to inadequate mixing	▪ Static mixing ▪ Add baffles ▪ Change impellers	▪ Add ingredients with optimum sequence
		▪ Add horsepower ▪ Add distributor	▪ Allow proper head space in reactor to enhance vortex effect
	▪ Waste by-product formation	▪ Provide separate reactor for converting recycle streams to usable products	▪ Optimize reaction conditions (temperature, pressure, etc.)
Relief Valve	▪ Leaks	▪ Provide upstream rupture disc	
	▪ Fugitive emissions	▪ Vent to control or recovery device	▪ Monitor for leaks and for control efficiency
	▪ Discharge to environment from over pressure	▪ Pump discharges to suction of pump ▪ Thermal relief to tanks ▪ Avoid discharge to roof areas to prevent contamination of rainwater	▪ Monitor for leaks
	▪ Frequent relief	▪ Use pilot operated relief valve ▪ Increase margin between design and operating pressure	▪ Reduce operating pressure ▪ Review system performance

R0075475

Exhibit 19 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Sampling	▪ Waste generation due to sampling (disposal, containers, leaks, fugitives, etc.)	▪ On line in situ analyzers ▪ System for return to process ▪ Closed loop ▪ Drain to sump	▪ Reduce number and size of samples required ▪ Sample at the lowest possible temperature ▪ Cool before sampling
Tanks	▪ Tank breathing and working losses	▪ Cool materials before storage ▪ Insulate tanks ▪ Vent to control device (flare, condenser, etc.) ▪ Vapor balancing ▪ Floating roof ▪ Floating roof ▪ Higher design pressure	▪ Optimize storage conditions to reduce losses
	▪ Leak to groundwater	▪ All aboveground (situated so bottom can routinely be checked for leads) ▪ Secondary containment ▪ Improve corrosion resistance	▪ Monitor for leaks and corrosion
	▪ Large waste heel	▪ Design for 100 percent de-inventory	▪ Recycle to process if practical
Vacuum Systems	▪ Waste discharge from jets	▪ Substitute mechanical vacuum pump ▪ Evaluate using process fluid for powering jet	▪ Monitor for air leaks ▪ Recycle condensate to process

Exhibit 19 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Valves	▪ Fugitive emissions from leaks	▪ Bellow seals ▪ Reduce number where practical ▪ Special packing sets	▪ Stringent adherence to packing procedures
Vents	▪ Release to environment	▪ Route to control or recovery device	▪ Monitor performance

Source: Chemical Manufacturers Association. *Designing Pollution Prevention into the Process. Research. Development and Engineering.*

It is critical to emphasize that pollution prevention in the chemical industry is process specific and oftentimes constrained by site-specific considerations. As such, it is difficult to generalize about the relative merits of different pollution prevention strategies. The age, size, and purpose of the plant will influence the most effective pollution prevention strategy. Commodity chemical manufacturers redesign their processes infrequently so that redesign of the reaction process or equipment is unlikely in the short term. Here, operational changes are the most feasible response. Specialty chemical manufacturers are making a greater variety of chemicals and have more process and design flexibility. Incorporating changes at the earlier research and development phases may be possible for them.

R0075477

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil** storage and disposal regulations (40 CFR Part 279) do not define **Used Oil Management Standards** impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

R0075481

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized approximately forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control** (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to

R0075486

manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50 through 99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA

Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Requirements

The inorganic chemical industry is affected by nearly all federal environmental statutes. In addition, the industry is subject to numerous laws and regulations from state and local governments designed to protect and improve health, safety, and the environment. A summary of the major federal regulations affecting the chemical industry follows.

Federal Statutes

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA), passed in 1976, gives the Environmental Protection Agency comprehensive authority to regulate any chemical substance whose manufacture, processing, distribution in commerce, use, or disposal may present an unreasonable risk of injury to health or the environment. Three sections are of primary importance to the inorganic chemical industry. Section 5 mandates that chemical companies submit to EPA pre-manufacture notices that provide information on health and environmental effects for each new product and test existing products for these effects. To date, over 20,000 premanufacturing notices have been filed. Section 4 authorizes the EPA to require testing of certain substances. Section 6 gives the EPA authority to prohibit, limit, or ban the manufacture, process, and use of chemicals. Under Section 6 of TSCA, EPA has banned most uses of asbestos. In 1990, however, the chlor-alkali industry was able to show that it did not have difficulty meeting the required exposure limits for asbestos fibers, and the use of asbestos as a diaphragm material was exempted from the TSCA ban.

Clean Air Act

The Clean Air Act Amendments of 1990 set National Emission Standards for Hazardous Air Pollutants (NESHAP) from industrial sources for 41 pollutants to be met by 1995 and for 148 other pollutants to be reached by 2003. Several provisions affect the inorganic chemical industry. The EPA will promulgate maximum achievable control technology (MACT) standards and Lowest Achievable Emission Rates will be required in NAAQS non-attainment areas (Iliam Rosario, U.S. EPA, OAQPS, WAM for Chlorine Production NESHAP (919)-541-5308). An information collection request survey was sent out to the chlor-alkali industry in 1992. The data obtained from the survey will be analyzed and. based on the results. EPA will propose MACT standards (or EPA may propose that no new standards are necessary) for the chlor-alkali industry by 1997. For any subject facility, a six year extension of MACT requirements is available if they can demonstrate early emission reductions.

The Clean Air Act Amendments of 1990 contain provisions to phase out the use of ozone depleting chemicals such as chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform. as required by the Montreal Protocol on Substances that Deplete the Ozone Layer. The chlor-alkali industry has been and will continue to be significantly affected by these provisions due to decreases in the demand for chlorine as a feedstock in manufacturing these chemicals. In addition, many of these chemicals are used extensively by the industry to process chlorine.

Clean Water Act

The Clean Water Act, first passed in 1972 and amended in 1977 and 1987, gives EPA the authority to regulate effluents from sewage treatment works. chemical plants, and other industrial sources into waters. The act sets "best available technology" standards for treatment of wastes for both direct and indirect (to a Publicly Owned Treatment Works) discharges. Effluent guidelines for the chlor-alkali industry were last updated in 1984 (40 CFR Section 415). EPA is currently conducting a study to assess the need for new effluent guidelines. (Contact: George Zipf, U.S. EPA, Office of Water, 202-260-2275)

Restrictions on dioxin emissions in the wastewater from pulp mills are having significant effects on the chlor-alkali industry. Dioxins are formed during the chlorine bleaching process and are subsequently released to rivers and streams. Many mills are switching from chlorine to alternative bleaching agents in response to the effluent restrictions. Pulp mills accounted for about 15 percent of the chlorine demand in the U.S. in 1982 and 11 percent in 1992. The demand for chlorine for pulp bleaching is expected to continue to decrease through the 1990s.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) of 1976 gives the EPA authority to establish a list of solid and hazardous wastes, and to establish standards and regulations for handling and disposing of these wastes. New wastes specific to the inorganic chemical industry have not been added to the RCRA list since the original waste listings in 1980. EPA is currently under a consent order, however, to propose new hazardous waste listings for the industry by March 1997, and to finalize by March 1998.

(Contact: Rick Brandes, U.S. EPA, Office of Solid Waste, 202-260-4770) The Act also requires companies to establish programs to reduce the volume and toxicity of hazardous wastes. It was last amended in 1984 when Congress mandated some 70 new programs for the hazardous waste (Subtitle C) program. Included were tighter standards for handling and disposing of hazardous wastes, land disposal prohibitions, corrective action (or remediation) regulations, and regulations for underground storage tanks. The inorganic chemical industry is strongly affected by the RCRA regulations because of the disposal costs for hazardous waste and the record keeping requirements.

Occupational Safety and Health Act

The Occupational Safety and Health Act gave the Department of Labor the authority to set comprehensive workplace safety and health standards including permissible exposures to chemical in the workplace and authority to conduct inspections and issue citations for violations of safety and health regulations. The chemical industry is subject to hazard identification standards established by OSHA, which require extensive documentation of chemicals in trade and in the workplace and mandate warning labels on containers. The industry is also subject to OSHA's Hazard Communication Standard and various state and local laws, which give workers the right to know about hazardous chemicals in the workplace.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act (HMTA) gives the Department of Transportation authority to regulate the movement of hazardous materials. Chemical manufacturers must comply with regulations governing shipment preparation, including packaging, labeling and shipping papers; handling, loading and unloading; routing emergency and security planning; incident notifications; and liability insurance. The chemical manufacturers must also comply with operating requirements for vehicle, vessel, and carrier transportation of hazardous materials by road, rail, air, and sea. The chemicals covered by the HMTA span a broad list of substances, including hazardous wastes normally regulated by RCRA and hazardous materials that DOT designates as hazardous for the purposes of transportation that may not be considered hazardous under RCRA. These regulations especially apply to chlorine gas which can cause significant risk during transport.

Pollution Prevention Act

The Pollution Prevention Act makes it a national policy of the United States to reduce or eliminate the generation of waste at the source whenever feasible. The EPA is directed to undertake a multi-media program of information collection, technology transfer, and financial assistance to enable the states to implement this policy and to promote the use of source reduction techniques. The reorganization of the Office of Compliance by industry sector is part of EPA's response to this act.

State Statutes

Toxics Use Reduction Act, Massachusetts

The Massachusetts Toxics Use Reduction Act affects those facilities that use, manufacture, or process more than a specified amount of substances that are on the Massachusetts toxic or hazardous substances list. Facilities must submit annual reports on the amounts of substances used, manufactured, or processed and must pay annual fees based on these amounts. In addition, facilities must prepare toxics use reduction plans which show in-plant changes in production processes or raw materials that would reduce, avoid, or eliminate the use or generation of toxic or hazardous substances. The Massachusetts toxic or hazardous substance list initially consists of those substances listed under §313 of EPCRA and will eventually include those substances listed under CERCLA. New Jersey has recently passed a similar act.

VI.C. Pending and Proposed Regulatory Requirements

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) listed waste streams specific to the inorganic chemical industry have not been updated since the original RCRA hazardous wastes list developed in 1980. EPA is under a court-ordered deadline to propose and finalize additional waste listings for the industry by March 1997 and March 1988, respectively. The Office of Solid Waste will begin assessing the need for new listings by early 1996. (Contact: Rick Brandes, U.S. EPA, Office of Solid Waste, 202-260-4770)

Clean Air Act

The new NESHAP standards for the inorganic chemical industry are scheduled to be promulgated by EPA by 1997. (Contact: Iliam Rosario, U.S. EPA, OAQPS, WAM for Chlorine Production NESHAP, 919-541-5308) The standards required will, in most cases, be in the form of MACT standards. Lowest Achievable Emission Rates will be required in NAAQS non-attainment areas. An information collection request survey was sent out to the chlor-alkali industry in 1992. The data obtained will be analyzed and used to assess the need for NESHAP standards in the chlor-alkali industry.

The chlor-alkali industry will continue to be affected by the provisions to phase out the use of ozone depleting chemicals as required by the Montreal Protocol on Substances that Deplete the Ozone Layer. The demand for chlorine as a feedstock in manufacturing these chemicals, which accounted for about 15 percent of total domestic demand in 1990, will continue to decline through the 1990s. In addition, costs of purifying and liquefying chlorine gas may increase as the cost of carbon tetrachloride and refrigerants increases, and as alternative processes are introduced.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections or enforcement actions, and solely reflect EPA, state, and local compliance assurance activity that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[e] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information

[e] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with three enforcement actions counts as one). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with three enforcement actions counts as three).

R0075496

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. Reported inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance. Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame. but do not distinguish between the severity of the noncompliance. Percentages within this column may exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Inorganic Chemical Industry Compliance History

Exhibit 20 provides an overview of the reported compliance and enforcement data for the inorganic chemical industry over the past five years (August 1990 to August 1995). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Slightly more than half of the TRI reporting inorganic chemical facilities in the EPA databases were inspected over the five year period resulting in an average of 11 months between inspections of these facilities.

- On average, the states carried out three times the number of inspections as the Regions; however, the percentage of state led actions varied across the Regions from 44 percent to 96 percent.

- The enforcement to inspection rate varied significantly from Region to Region. Region IX had the highest enforcement to inspection rate as well as the highest percentage of state led actions.

Exhibit 20: Five-Year Enforcement and Compliance Summary for Inorganic Chemicals Manufacturing									
A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	10	5	16	38	0	0	--	--	--
II	46	29	354	8	12	29	72%	28%	0.08
III	60	41	544	7	12	38	89%	11%	0.07
IV	105	54	916	7	21	113	89%	11%	0.12
V	108	62	469	14	11	42	45%	55%	0.09
VI	93	40	401	14	24	106	61%	39%	0.26
VII	19	12	62	18	2	9	44%	56%	0.15
VIII	17	9	38	27	4	5	80%	20%	0.13
IX	70	35	171	25	9	53	96%	4%	0.31
X	20	11	63	19	4	7	86%	14%	0.11
TOTAL	548	298	3,034	11	99	402	76%	24%	0.13

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 21 and 22 allow the compliance history of the inorganic chemical manufacturing sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Exhibits 21 and 22 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past year. Some points evident from the data are listed below.

- The inorganic chemicals industry has a relatively low frequency of inspections compared to most of the other sectors shown. On average, the number of months between inspections at inorganic chemicals facilities has been only about twice that of organic chemicals facilities.

- Over the past five years the inorganic chemical industry has had a ratio of enforcement actions to inspections lower than most of the other sectors listed including the organic chemicals sector. This difference has continued over the past year.

- Enforcement actions are brought against only about 10 percent of the facilities with violations; lower than most other sectors listed.

Exhibits 23 and 24 provide a more in-depth comparison between the inorganic chemicals industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Exhibits (21 and 22), the data cover the last five years (Exhibit 23) and the last one year (Exhibit 24) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- Inspections of inorganic chemical facilities are split relatively evenly between Clean Air Act, Clean Water Act, and RCRA, although RCRA accounts for a significantly larger portion of the total actions brought against the inorganic chemicals industry over the past five years.

- Significantly more Clean Water Act inspections are carried out at inorganic chemicals facilities in comparison to the organic chemicals industry, although the Clean Water Act accounts for a smaller portion of the total actions brought against inorganic chemicals facilities.

- Over the past year RCRA inspections have accounted for a significantly smaller portion of the enforcement actions brought against the industry and the Clean Air Act has taken a far greater share.

Exhibit 21: Five-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	**548**	**298**	**3,034**	**11**	**99**	**402**	**76%**	**24%**	**0.13**
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-Metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Nonferrous Metal	844	474	3,097	16	145	470	76%	24%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11

Exhibit 22: One-Year Inspection and Enforcement Summary for Selected Industries

A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	**548**	**158**	**427**	**167**	**106%**	**19**	**12%**	**49**	**0.12**
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.16
Furniture	293	160	113	66	41%	3	2%	5	0.03
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	104%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10

* Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 23: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act: % of Total Inspections	Clean Air Act: % of Total Actions	Clean Water Act: % of Total Inspections	Clean Water Act: % of Total Actions	Resource Conservation and Recovery Act: % of Total Inspections	Resource Conservation and Recovery Act: % of Total Actions	FIFRA/TSCA/ EPCRA/Other: % of Total Inspections	FIFRA/TSCA/ EPCRA/Other: % of Total Actions
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	**298**	**3,034**	**402**	**29%**	**26%**	**29%**	**17%**	**39%**	**53%**	**3%**	**4%**
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	0%	1%
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	0%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay, and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%

Exhibit 24: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	0%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	0%	4%
Inorganic Chemicals	**158**	**427**	**49**	**26%**	**38%**	**29%**	**21%**	**45%**	**36%**	**0%**	**6%**
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	437	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	0%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	0%	7%
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	0%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	0%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	0%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	0%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	0%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	0%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	0%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%

VII.C. Review of Major Legal Actions

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

VII.C.1. Review of Major Cases

Historically, OECA's Enforcement Capacity and Outreach Office does not regularly compile information related to major cases and pending litigation within an industry sector. The staff are willing to pass along such information to Agency staff as requests are made. In addition, summaries of completed enforcement actions are published each fiscal year in the Enforcement Accomplishments Report. To date, these summaries are not organized by industry sector. (Contact: Office of Enforcement Capacity and Outreach 202-260-4140)

VII.C.2. Supplementary Environmental Projects

Supplemental environmental projects (SEPs) are an enforcement option that requires the non-compliant facility to complete specific projects. Regional summaries of SEPs undertaken in the 1993 and 1994 federal fiscal years were reviewed. Five SEPs were undertaken that involved inorganic chemical manufacturing facilities, as shown in Exhibit 25.

CERCLA violations engendered three out of the five SEPs identified; the fourth and fifth were due to a CAA violation and a TSCA violation. Due to regional reporting methods, the specifics of the original violations are not known and, for one SEP, details of the actual project were not available.

One of the five projects was conducted at a facility that manufactures both inorganic and organic chemicals. This project has been included in both industry sector project summaries. The FY 1993 and 1994 SEPs for inorganic chemical manufacturers fall into four categories: process related projects; control and recovery technology inprovement or installation; leak prevention; and donations to the community.

•Process related projects

A Region IV project carried out in 1993 entailed specific process changes intended to reduce chlorinated wastes at the facility. In conjunction with other non-process components of the project, the implementation cost was $93,000.

•Control and recovery technology improvement/installation

A Louisiana facility, the combined organic and inorganic chemical manufacturer, implemented a SEP to reduce emissions from returned gas canisters. The SEP involved the installation of recovery technologies to reduce emissions of residual CFC and HCFC from the used canisters. The cost to the company was $158,400.

•Leak prevention

A Region IV facility constructed retaining walls around underground storage tanks to prevent hazardous leachate from reaching groundwater. The cost to the company was $46,200.

•Donations to Community

Following a CERCLA violation, a facility in Texas donated emergency and computer equipment to the Local Emergency Planning Commission (LEPC) which could be used in the planning and responding to potential chemical emergencies. The facility also agreed to participate in LEPC activities and to provide technical assistance.

Exhibit 25: FY-1993-1994 Supplemental Environmental Projects Overview: Inorganic Chemical Manufacture

General Information				Violation Information					Pollutant Reduction		
FY	Docket #	Company Name	State/ Region	Type	Initial Penalty	Final Penalty	SEP Credit	SEP Cost to Company	Pollutant of Concern	Pollutant Reduction	Supplemental Environmental Projects Description
93	--	LaRoche Chemicals, Inc.	LA	*CAA	$88,360	$25,000	---	$158,400	CFC/HCFC	---	Company purchased, installed, and operated equipment for recovery of residual CFCs and HCFCs in used gas cylinders returned by customers
93	---	Coastal Chemicals	Reg. 4	CERCLA 103/EPCRA 304	$90,000	$2,000	---	$93,000	chlorinated waste	---	Altered process to reduce chlorinated wastes, provided computer and Cameo training for county EMA, donated funds to LEPC for hazards analysis, and held response exercises at plant
93	---	Scholle Corp.	Reg. 4	CERCLA, EPCRA	$40,000	$10,000	---	$46,200	---	---	Constructed retaining walls around underground storage tanks to prevent hazardous material leachate from reaching groundwater
93	6-93-16	ALCOA	TX	CERCLA 103(a)	$25,000	$3,000	---	$10,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies, agreed to participate in LEPC activities and to provide technical assistance
94	---	Anzon, Inc.	Reg.III	TSCA	N/A	N/A	N/A	$198,000	---	---	N/A

*Facilities identified as combined inorganic and organic chemical manufacturers

Violation Information Terms
Initial penalty: Initial proposed cash penalty for violation
Final penalty: Total penalty after SEP negotiation
SEP credit: Cash credit given for SEP so that, Final penalty - SEP credit = Final cash penalty
SEP cost to company: Actual cost to company of SEP implementation

NOTE: Due to differences in terminology and level of detail between regional SEP information, in some cases the figure listed as Final penalty may be the Final cash penalty after deduction for SEP credit

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

None identified.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of seventeen chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given out to participants meeting their 1992 goals. The list of chemicals includes seventeen high-use chemicals reported in the Toxics Release Inventory. Exhibit 26 lists those companies participating in the 33/50 program that reported the SIC code 281 to TRI. Many of the companies shown listed multiple SIC codes and, therefore, are likely to carry out operations in addition to inorganic chemicals manufacturing. The SIC codes reported by each company are listed in no particular order. In addition, the number of facilities within each company that are participating in the 33/50 program and that report SIC 281 to TRI is shown. Finally, each company's total 1993 releases and transfers of 33/50 chemicals and the percent reduction in these chemicals since 1988 are presented.

The inorganic chemicals industry as a whole used, generated or processed almost all of the seventeen target TRI chemicals. Of the target chemicals, chromium and chromium compounds, lead and lead compounds, and nickel and nickel compounds are released and transferred most frequently and in similar quantities. These three toxic chemicals account for about nine percent of TRI releases and transfers from inorganic chemical facilities. Seventy-five companies, representing 168 facilities, listed under SIC 281 (inorganic chemicals) are currently participating in the 33/50 program. This accounts for 30 percent of the facilities reporting to SIC code 281 to TRI which is significantly higher than the average for all industries of 14 percent participation. (Contact: Mike Burns, 202-260-6394 or the 33/50 Program, 202-260-6907)

Exhibit 26: 33/50 Program Participants Reporting SIC 281 (Inorganic Chemicals)

Parent Company	City, State	SIC Codes Reported	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
3M MINNESOTA MINING & MFG CO.	ST. PAUL, MN	2821, 2816, 2899	1	16,481,098	70
AIR PRODUCTS AND CHEMICALS	ALLENTOWN, PA	2819, 2869	5	144,876	50
AKZO NOBEL INC.	CHICAGO, IL	2819, 2869	1	930,189	13
ALBEMARLE CORP.	RICHMOND, VA	2869, 2819	1	1,005,108	51
ALLIED-SIGNAL INC.	MORRISTOWN, NJ	2819, 2869	4	2,080,501	50
ASHLAND OIL INC.	RUSSELL, KY	2819	1	723,562	50
B F GOODRICH COMPANY	AKRON, OH	2812, 2821, 2869	1	621,207	50
BASF CORP.	PARSIPPANY, NJ	2869, 2865, 2819	1	1,157,548	50
BENJAMIN MOORE & CO	MONTVALE, NJ	2851, 2812,	7	20,635	*
BORDEN CHEM & PLAS LTD PARTNR	COLUMBUS, OH	2813, 2821, 2869	1	12,662	***
CABOT CORP	BOSTON, MA	3339, 2819	2	2,407,581	50
CALGON CARBON CORP.	PITTSBURGH, PA	2819	1	14,845	50
CIBA-GEIGY CORP.	ARDSLEY, NY	2819, 2865, 2869	2	1,875,028	50
CITGO PETROLEUM CORP.	TULSA, OK	2911, 2819, 2869	1	1,164,354	20
CONKLIN COMPANY INC.	SHAKOPEE, MN	2819, 2952, 2992	1	2,977	*
CORNING INC.	CORNING, NY	3339, 2819	1	1,521,528	14
CRITERION CATALYST LTD PARTNR	HOUSTON, TX	28190	3	3,716	*
CYTEC INDUSTRIES	WEST PATERSON, NJ	2819, 2869	2	1,074,646	50
DEGUSSA CORP.	RIDGEFIELD PARK, NJ	2819, 2869, 2879	1	676,418	***
DOW CHEMICAL COMPANY	MIDLAND, MI	2800, 2819, 2821	4	2,769,363	50
E. I. DU PONT DE NEMOURS & CO.	WILMINGTON, DE	2816	9	11,740,853	50
EAGLE CHEMICALS INC.	HAMILTON, OH	2899, 2819, 2841	1	500	33
EAGLE-PICHER INDUSTRIES INC.	CINCINNATI, OH	2816	1	227,242	50
ELF AQUITAINE INC.	NEW YORK, NY	2812	7	273,274	43
ENGELHARD CORP.	ISELIN, NJ	3714, 2819	6	236,302	50
ETHYL CORP.	RICHMOND, VA	2869, 2819,	1	251,519	46
FERRO CORP.	CLEVELAND, OH	2819, 2869	5	165,529	50
FMC CORP.	CHICAGO, IL	2812, 2819	4	502,318	50
GENERAL ELECTRIC COMPANY	FAIRFIELD, CT	2821, 2812, 2869	2	5,010,856	50
GEORGIA GULF CORP.	ATLANTA, GA	2865, 2812, 2819	1	39,480	80
GEORGIA-PACIFIC CORP.	ATLANTA, GA	2611, 2621, 2812	1	2,722,182	50
HANLIN GROUP INC.	EDISON, NJ	2812, 2819	3	6,174	75
HM ANGLO-AMERICAN LTD.	NEW YORK, NY	2816	4	1,265,741	2
HOECHST CELANESE CORP.	SOMERVILLE, NJ	2819, 2869, 2873	1	2,603,661	50
INTERNATIONAL PAPER COMPANY	PURCHASE, NY	28190	1	2,784,831	50
ISK AMERICAS INC.	SAN FRANCISCO, CA	2879, 2819	2	300,088	50
KEMIRA HOLDINGS INC.	SAVANNAH, GA	2816, 2819	1	394,070	*
KERR-MCGEE CORP.	OKLAHOMA CITY, OK	2819	3	374,098	35
LAIDLAW ENVIRONMENTAL SERVICES	COLUMBIA, SC	2819, 2869	1	8,167	***
LAROCHE HOLDINGS INC.	ATLANTA, GA	2812, 2869	1	81,470	*

R0075509

Parent Company	City, State	SIC Codes Reported	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
MALLINCKRODT GROUP INC.	SAINT LOUIS, MO	2869, 2833, 2819	3	775,206	50
MAYO CHEMICAL CO. INC	SMYRNA, GA	2819	2	15	67
MILES INC.	PITTSBURGH, PA	2819	3	1,095,504	40
MOBIL CORP.	FAIRFAX, VA	2869, 2819, 2821	1	4,263,284	50
MONSANTO COMPANY	SAINT LOUIS, MO	2865, 2869, 2819	3	1,683,580	23
MORTON INTERNATIONAL INC.	CHICAGO, IL	2819, 2869	1	721,216	20
NALCO CHEMICAL COMPANY	NAPERVILLE, IL	2899, 2819, 2843	2	107,651	50
OCCIDENTAL PETROLEUM CORP.	LOS ANGELES, CA	2812, 2819	8	8,896,126	19
OLIN CORP.	STAMFORD, CT	2819	4	574,673	70
PHILLIPS PETROLEUM COMPANY	BARTLESVILLE, OK	2911, 2819	2	2,367,877	50
PPG INDUSTRIES INC.	PITTSBURGH, PA	2812, 2816, 2869	3	2,772,331	50
PQ CORP	VALLEY FORGE, PA	2819	3	19	50
PROCTER & GAMBLE COMPANY	CINCINNATI, OH	28190	1	612,520	*
RHONE-POULENC INC.	MONMOUTH JUNCTION, NJ	2821, 2819, 2841	6	1,437,778	50
ROHM AND HAAS COMPANY	PHILADELPHIA, PA	2819, 2869	1	1,210,244	50
SHELL PETROLEUM INC.	HOUSTON, TX	2869, 2819	1	3,240,716	55
SHEPHERD CHEMICAL CO.	CINCINNATI, OH	2819, 2869	1	828	72
SHERWIN-WILLIAMS COMPANY	CLEVELAND, OH	2816, 2851	1	1,352,412	50
STANDARD CHLORINE CHEM. CO.	KEARNY, NJ	2865, 2819	1	48,246	***
STAR ENTERPRISE	HOUSTON, TX	2911, 2819, 4463	1	601,640	50
STERLING CHEMICALS INC.	HOUSTON, TX	2869, 2865, 2819	1	182,216	65
SUD-CHEMIE NORTH AMERICA DE	LOUISVILLE, KY	2819	2	196,438	16
TEXACO INC.	WHITE PLAINS, NY	2869, 2865, 2819	1	514,803	50
TEXAS INSTRUMENTS INC.	DALLAS, TX	3674, 3812, 2819	2	344,225	25
UNILEVER UNITED STATES INC.	NEW YORK, NY	2819	1	164,034	50
UNIROYAL CHEMICAL CORP.	MIDDLEBURY, CT	2821, 2879, 2813	1	1,970,357	20
UNOCAL CORP.	LOS ANGELES, CA	2819	1	238,520	50
UOP	DES PLAINES, IL	2819, 2869	2	14,169	50
US DEPARTMENT OF ENERGY	WASHINGTON, DC	2819	4	148,198	50
VELSICOL CHEMICAL CORP.	ROSEMONT, IL	2865, 2819, 2869	1	224,664	50
VISTA CHEMICAL COMPANY	HOUSTON, TX	2869, 2865, 2819	2	106,497	50
VULCAN MATERIALS COMPANY	BIRMINGHAM, AL	2869, 2812	2	679,566	85
W R GRACE & CO INC.	BOCA RATON, FL	2819	2	615,509	50
WEYERHAEUSER COMPANY	TACOMA, WA	2621, 2611, 2812	1	1,006,356	*
WITCO CORP.	NEW YORK, NY	2819, 2869	1	327,611	50

* = not quantifiable against 1988 data.
** = use reduction goal only.
*** = no numerical goal.

Source: U.S. EPA, Toxic Release Inventory, 1993.

R0075510

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and state agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct violations discovered during these experimental projects. Forty proposals were received from companies, trade associations, and federal facilities representing many manufacturing and service sectors. Two chemical companies (Ciba Geigy of St. Gabriel, LA and Akzo Chemicals of Edison, NJ), one pharmaceutical manufacturer (Schering Plough of Kenilworth, NJ), and one manufacturer of agricultural chemicals (Gowan Milling of Yuma, AZ) submitted proposals. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Jon Kessler, Office of Policy Analysis, 202-260-4034)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; federal, state and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Maria Tikoff 202-233-9178 or the Green Light/Energy Star Hotline, 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA, in turn, provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn 202-260-0700 or the WasteWi$e Hotline, 800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman 202-260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, 303-275-4729)

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Environmental Programs

Global Environmental Management Initiative

The Global Environmental Management Initiative (GEMI) is made up of a group of leading companies dedicated to fostering environmental excellence by business. GEMI promotes a worldwide business ethic for environmental management and sustainable development to improve the environmental performance of business through example and leadership. In 1994, GEMI's membership consisted of about 30 major corporations including Amoco Corporation.

National Pollution Prevention Roundtable

The National Pollution Prevention Roundtable published *The Pollution Prevention Yellow Pages* in September 1994. It is a compilation of information collected from mail and telephone surveys of state and local government pollution prevention programs. (Contact: Natalie Roy 202-543-7272) The following state programs listed themselves as having expertise in pollution prevention related to inorganic chemical manufacture and use. The contacts listed below (Exhibit 27) are also likely to be aware of various state- and local-level initiatives affecting the inorganic chemical industry.

Exhibit 27: Contacts for State and Local Pollution Prevention Programs			
State	Program	Contact	Telephone
Alabama	AL Dept. of Env. Protection, Ombudsman and Small Business Assistance Program	Blake Roper, Michael Sherman	(800) 533-2336 (205) 271-7861
	AL WRATT Foundation	Roy Nicholson	(205) 386-3633
California	CA State Dept. of Toxic Substances Control	David Harley, Kim Wilhelm, Kathy Barwick	(916) 322-3670
	County Sanitation Districts of LA	Michelle Mische	(310) 699-7411
Colorado	Region VIII HW Minimization Program	Marie Zanowich	(303) 294-1065
Illinois	IL HW Research and Information Center	David Thomas	(217) 333-8940
Indiana	IN Dept. of Env. Mgmt.	Tom Neltner	(317) 232-8172
Iowa	IA Dept. of Natural Resources	Larry Gibson	(515) 281-8941
Kentucky	KY Partners. State Waste Reduction Center	Joyce St. Clair	(502) 852-7260
Massachusetts	Toxics Use Reduction Institute	Janet Clark	(508) 934-3346
Michigan	University of Detroit Mercy	Daniel Klempner	(313) 993-3385
New Mexico	Waste Management Education and Research Consortium	Ron Bhada	(505) 646-1510
North Dakota	Energy and Env. Research Center	Gerald Groenewold	(701) 777-5000
Ohio	Institute of Advanced Manufacturing Sciences	Harry Stone, Sally Clement	(513) 948-2050
Pennsylvania	Center for Hazardous Materials Research	Roger Price, Steven Ostheim	(412) 826-5320
Rhode Island	RI Center for P2, URI	Stanley Barnett	(401) 792-2443
South Carolina	Clemson University	Eric Snider	(803) 656-0985
Texas	TX Natural Resource Conservation Commission	Andrew Neblett	(512) 239-3100
Vermont	Retired Engineers and Professionals Program	Muriel Durgin	(802) 879-4703
Washington	WA State Dept. of Ecology	Peggy Morgan	(206) 407-6705
Wisconsin	WI Dept. of Natural Resources, Small Business Assistance Program	Robert Baggot	(608) 267-3136
Wyoming	WY Dept. of Env. Quality	Charles Raffelson	(307) 777-7391

Center for Waste Reduction Technologies

Center for Waste Reduction Technologies, under the aegis of the American Institute of Chemical Engineers, sponsors research on innovative technologies to reduce waste in the chemical processing industries. The primary mechanism is through funding of academic research.

National Science Foundation and the Office of Pollution Prevention and Toxics

The National Science Foundation and EPA's Office of Pollution Prevention and Toxics signed an agreement in January of 1994 to coordinate the two agencies' programs of **basic research related to pollution prevention**. The collaboration will stress research in the use of less toxic chemical and synthetic feedstocks, use of photochemical processes instead of traditional ones that employ toxic reagents, use of recyclable catalysts to reduce metal contamination, and use of natural feedstocks when synthesizing chemicals in large quantities.

Chemical Manufacturers Association

The **Chemical Manufacturers Association** funds research on issues of interest to their members particularly in support of their positions on proposed or possible legislation. They recently funded a study to characterize the environmental fate of organochlorine compounds.

Responsible Care Program

The **Responsible Care Program** of the Chemical Manufacturers Association requires members to pledge commitment to six codes that identify 106 management practices that companies must carry out in the areas of community awareness and emergency response, pollution prevention, process safety, distribution, employee health and safety, and product stewardship.

ISO 9000

ISO 9000 is a series of international total quality management guidelines. After a successful independent audit of their management plans, firms are qualified to be ISO 9000 registered. In June of 1993, the International Standards Organization created a technical committee to begin work on new standards for environmental management systems. The new standards are called ISO 14000 and are expected to be issued in 1996.

VII.C.2. Summary of Trade Associations

Chemical Industry

American Chemical Society
1155 16th Street, NW
Washington, D.C. 20036
Phone: (202) 872-8724
Fax: (202) 872-6206

Members: 145,000
Staff: 1700
Budget: $192,000,000

The American Chemical Society (ACS) has an educational and research focus. The ACS produces approximately thirty different industry periodicals and research journals, including *Environmental Science and Technology* and *Chemical Research in Toxicology*. In addition to publishing, the ACS presently conducts studies and surveys; legislation monitoring, analysis, and reporting; and operates a variety of educational programs. The ACS library and on-line information services are extensive. Some available on-line services are *Chemical Journals Online*, containing the full text of 18 ACS journals, 10 Royal Society of Chemistry journals, and five polymer journals. and the Chemical Abstracts Service (CAS), which provides a variety of information on chemical compounds. Founded in 1876, the ACS is presently comprised of 184 local groups and 843 student groups nationwide.

Chemical Manufacturers Association
2501 M St., NW
Washington, D.C. 20037
Phone: (202) 887-1164
Fax: (202) 887-1237

Members: 185
Staff: 246
Budget: $36,000,000
Contact: Joseph Mayhew

Presently, the principle focus of the Chemical Manufacturers Association (CMA) is on regulatory issues facing chemical manufacturers at the local, state, and federal level. At its inception in 1872, the focus of the CMA was on serving chemical manufacturers through research. Research is still ongoing at the CMA, however, as the CHEMSTAR program illustrates. CHEMSTAR consists of a variety of self-funded panels working on single-chemical research agendas. This research fits in with the overall regulatory focus of the CMA; CHEMSTAR study results are provided to both CMA membership and regulatory agencies. Other initiatives include the "responsible care" program. Membership in the CMA is contingent upon enrollment in the "responsible care" program, which includes six codes of management practice (including pollution prevention) that attempt to "go beyond simple regulatory compliance." The CMA also conducts workshops and technical symposia, promotes in-plant safety, operates a chemical emergency center (CHEMTREC) which offers guidance in chemical emergency situations, and operates the Chemical Referral Center which provides chemical health and safety information to the public. Publications include: *ChemEcology*, a 10-issue-per-year newsletter covering environmental, pollution-control, worker-safety, and federal and state regulatory actions, and the *CMA Directory*, a listing of the CMA membership. The CMA holds an annual meeting in White Sulphur Springs, WV.

Chlor-alkali Industry

The Chlorine Institute, Inc.
2001 L Street, N.W.
Suite 506
Washington, D.C. 20036
Phone: (202) 223-2790
Fax: (202) 223-7225

Members: 200
Budget: $1.500,000
Contact: Gary Trojak

The Chlorine Institute, Inc. was established in 1924 and represents companies in the U.S., Canada, and other countries that produce, distribute, and use chlorine, sodium and potassium hydroxides, and sodium hypochlorite; and that distribute and use hydrogen chloride. The Institute is a non-profit scientific and technical organization which serves as a safety, health, and environmental protection center for the industry.

Chlorine Chemistry Council
2501 M Street, N.W.
Washington, D.C. 20037
Phone: (202) 887-1100
Fax: (202) 887-6925

Members: 30
Staff: 24
Budget: $14.000.000
Contact: Kip Howlett Jr.

The Chlorine Chemistry Council (CCC), established in 1993, is a business council of the Chemical Manufacturers Association (CMA) and is made up of producers and users of chlorine and chlorine-related products. With involvement from all stakeholders, the CCC works to promote science-based public policy regarding chlorine chemistry and is committed to develop and produce only those chemicals that can be manufactured, transported, used, and disposed of safely. CCC facilitates risk-benefit analyses and product stewardship through the collection, development, and use of scientific data on health, safety, and environmental issues. CCC hopes to heighten public awareness of chlorine chemistry and its many societal benefits by collaborating with the public health and scientific community in assessing and communicating chlorine-related human health and environmental issues.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the inorganic chemicals industry a list of contacts and publications are provided below:

Contacts[f]

Name	Organization	Telephone	Subject
Walter DeRieux	EPA/OECA	(202) 564-7067	Regulatory requirements and compliance assistance
Sergio Siao	EPA/NEIC	(303) 236-3636	Industrial processes and regulatory requirements
Iliam Rosario	EPA/OAQPS	(919) 541-5308	Regulatory requirements (Air), Chlorine NESHAPs
George Zipf	EPA/OW	(202) 260-2275	Regulatory requirements (Water)
Rick Brandes	EPA/OSWER	(202) 260-4770	Regulatory requirements (Solid waste)
Ed Burks	EPA/Region IV	(404) 347-5205	Inspections, regulatory requirements (RCRA)
Jim Gold	EPA/Region VI	(713) 983-2153	Inspections and regulatory requirements (Water, AIR and TSCA)

OECA: Office of Enforcement and Compliance Assistance
NEIC: National Enforcement Investigations Center
OAQPS: Office of Air Quality Planning and Standards
OW: Office of Water
OSWER: Office of Solid Waste and Emergency Response

General Profile

U.S. Industrial Outlook 1994, Department of Commerce

1987 Census of Manufacturers, Industry Series, Industrial Inorganic Chemicals. Bureau of the Census [Published every five years the next version will be available in September of 1994]

1992 Census of Manufacturers, Preliminary Report Industry Series, Industrial Inorganic Chemicals. Bureau of the Census [Data will be superseded by a more comprehensive report in September of 1994]

[f] Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements make within this notebook.

Chlorine and Its Derivatives: A World Survey of Supply, Demand, and Trade to 1992, Tecnon Consulting Group, London, 1988.

North American Chlor-Alkali Industry Plants and Production Data Book, Pamphlet 10, The Chlorine Institute, Washington, D.C., January, 1989.

Process Descriptions and Chemical Use Profiles

Riegel's Handbook of Industrial Chemistry, 9th ed., Kent, James A., Ph.D., editor, Van Nostrand Reinhold, New York, 1993.

Kirk-Othmer Encyclopedia of Chemical Technology, Fourth edition, volume 1, John Wiley and Sons, New York, 1994.

Buchner, Schliebs, Winter, Buchel. *Industrial Inorganic Chemistry*. VCH Publishers, New York, 1989.

Multi-media Assessment of the Inorganic Chemicals Industry, Chapter 12-Salt Derivatives, Prepared for U.S. EPA Industrial Environmental Research Laboratory by Verser, Inc., Springfield, Virginia, 1980.

Recommendations To Chlor-alkali Manufacturing Facilities for the Prevention of Chlorine Releases, The Chlorine Institute, First Edition, October, 1990.

Assessment of Solid Waste Management Problems and Practices in the Inorganic Chemicals Industry, Final Report, Versar, Inc. for U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio, April 1979.

Chlorine, Its Manufacture, Properties, and Uses, J.S. Sconce, Reinhold Publishing Corp., New York, 1962.

Electrolytic Manufacture of Chemicals from Salt, D.W.F. Hardie and W.W. Smith, The Chlorine Institute, New York, 1975.

Modern Chlor-Alkali Technology, Vol. 4, N.M. Prout and J.S. Moorhouse, eds., Elsevier Applied Science, 1990.

Regulatory Profile

Sustainable Environmental Law, Environmental Law Institute, West Publishing Co., St. Paul, Minn., 1993.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Major Inorganic Products Segment of the Inorganic Chemicals Point Source Category, U.S. Environmental Protection Agency, Washington, D.C., March 1974. Report No. EPA-440/1-74-007a.

ENDNOTES

1. U.S. Department of Commerce. U.S. Industrial Outlook 1994. January 1994.

2. U.S. Department of Commerce, Bureau of the Census. 1994 Census of Manufacturers, Industrial Inorganic Chemicals. April 1995.

3. U.S. Department of Commerce. U.S. Industrial Outlook 1994. January 1994.

4. U.S. Department of Commerce, Bureau of the Census. 1994 Census of Manufacturers, Industrial Inorganic Chemicals. April 1995.

5. Büchner. Schliebs. Winter, Büchel. Industrial Inorganic Chemistry. New York: VCH Publishers, 1989.

6. Ibid.

7. U.S. Department of Commerce, Bureau of the Census. 1994 Census of Manufacturers, Industrial Inorganic Chemicals. April 1995.

8. Charles River Associates. Chlorine Chemistry Plays a Vital Role in the U.S. Economy. Washington, D.C.: The Chlorine Institute, 1993.

9. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Ed. New York: John Wiley and Sons, 1994.

10. U.S. Department of Commerce. U.S. Industrial Outlook 1994. January 1994.

11. Ibid.

12. Ibid.

13. Ibid.

14. Ibid.

15. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Ed. New York: John Wiley and Sons, 1994.

16. Büchner, Schliebs. Winter, Büchel. Industrial Inorganic Chemistry. New York: VCH Publishers, 1989.

17. Ibid.

18. Ibid.

19. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Ed. New York: John Wiley and Sons, 1994.

20. Büchner, Schliebs, Winter, Büchel. Industrial Inorganic Chemistry. New York: VCH Publishers, 1989.

21. Ibid.

22. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Ed. New York: John Wiley and Sons, 1994.

23. Ibid.

24. Ibid.

25. Ibid.

26. Büchner, Schliebs, Winter, Büchel. Industrial Inorganic Chemistry. New York: VCH Publishers, 1989.

27. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Ed. New York: John Wiley and Sons, 1994.

28. Ibid.

29. Ibid.

30. Büchner, Schliebs, Winter, Büchel. Industrial Inorganic Chemistry. New York: VCH Publishers, 1989.

31. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Ed. New York: John Wiley and Sons, 1994.

32. Ibid.

33. Ibid.

34. Ibid.

35. Ibid.

36. Ibid.

37. Ibid.

38. Ibid.

39. Versar, Inc. Multi-Media Assessment of the Inorganic Chemicals Industry. Ch. 12. Cincinnati, Ohio: U.S. EPA Industrial Environmental Research Laboratory, August, 1980.

40. Versar, Inc. Multi-Media Assessment of the Inorganic Chemicals Industry. Ch. 12. Cincinnati, Ohio: U.S. EPA Industrial Environmental Research Laboratory, August, 1980.

41. Ibid.

42. Ibid.

43. Ibid.

44. Ibid.

45. Ibid.

46. Ibid.

47. Ibid.

48. Ibid.

49. Ibid.

50. Ibid.

51. Ibid.

52. Ibid.

53. Ibid.

54. Ibid.

55. U.S. EPA Office of Pollution Prevention and Toxics. 1993 Toxics Release Inventory Public Data Release. May 1994.

56. Ibid.

57. Kent, James A. Ph.D., editor. Riegel's Handbook of Industrial Chemistry, 9th ed. New York: Van Nostrand Reinhold, 1993.

58. Ibid.

59. Ibid.

APPENDIX A

INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy! VISA MasterCard DISCOVER NOVUS

Order Processing Code:
* 3212

Fax your orders (202) 512–2250
Phone your orders (202) 512–1800

Qty.	Stock Number	Published in 1995 Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	Published in 1997 Title	Price Each	Total Price
	055–000–00570–2	Air Transportation Industry, 90 pages	$ 7.50	
	055–000–00571–1	Ground Transportation Industry, 130 pages	10.00	
	055–000–00572–9	Water Transportation Industry, 90 pages	7.50	
	055–000–00573–7	Metal Casting Industry, 150 pages	13.00	
	055–000–00574–5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055–000–00575–3	Plastic Resin & Man–made Fiber Industry, 180 pages	15.00	
	055–000–00576–1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055–000–00577–0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055–000–00578–8	Textile Industry, 130 pages	10.00	
	055–000–00579–6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents
❑ GPO Deposit Account
❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0075524

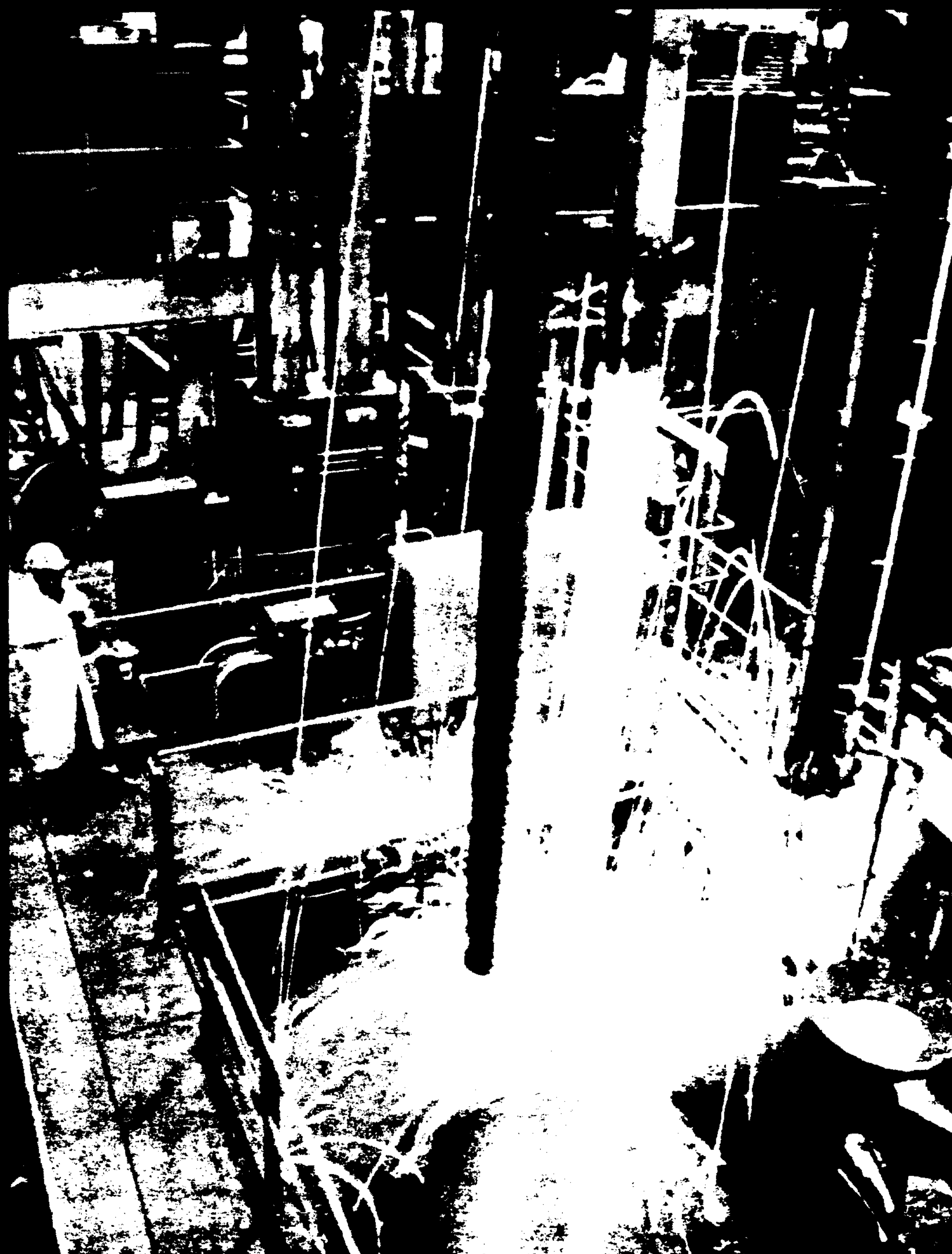
EPA

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

United States Environmental Protection Agency
Enforcement And Compliance Assurance (2221A)
EPA 310-R-95-005
September 1995

EPA

Profile Of The Iron And Steel Industry



SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

R0075526

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-005

EPA Office of Compliance Sector Notebook Project

Profile of the Iron and Steel Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048272-0

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers are included on the following page.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., ET, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via the Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph courtesy of American Iron and Steel Institute.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

Industry Sector Notebook Contents: Iron and Steel Industry

Exhibits Index

List of Acronyms

AFS - AIRS Facility Subsystem (CAA database)
AIRS - Aerometric Information Retrieval System (CAA database)
BIFs - Boilers and Industrial Furnaces (RCRA)
BOD - Biochemical Oxygen Demand
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CO - Carbon Monoxide
COD - Chemical Oxygen Demand
CSI - Common Sense Initiative
CWA - Clean Water Act
D&B - Dun and Bradstreet Marketing Index
ELP - Environmental Leadership Program
EPA - United States Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
HAPs - Hazardous Air Pollutants (CAA)
HSDB - Hazardous Substances Data Bank
IDEA - Integrated Data for Enforcement Analysis
LDR - Land Disposal Restrictions (RCRA)
LEPCs - Local Emergency Planning Committees
MACT - Maximum Achievable Control Technology (CAA)
MCLGs - Maximum Contaminant Level Goals
MCLs - Maximum Contaminant Levels
MEK - Methyl Ethyl Ketone
MSDSs - Material Safety Data Sheets
NAAQS - National Ambient Air Quality Standards (CAA)
NAFTA - North American Free Trade Agreement
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NEIC - National Enforcement Investigation Center
NESHAP - National Emission Standards for Hazardous Air Pollutants
NO_2 - Nitrogen Dioxide
NOV - Notice of Violation
NO_X - Nitrogen Oxide
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center

NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SO_X -	Sulfur Oxides
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the

information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project. 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Environ$ense World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE IRON AND STEEL INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the iron and steel industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The iron and steel industry is categorized by the Bureau of the Census under the Standard Industrial Classification (SIC) code 33, primary metal industries. The industry is further classified by the three-digit codes 331. Steel Works, Blast Furnaces, and Rolling and Finishing Mills, and 332 Iron and Steel Foundries. Since steel works, blast furnaces, and rolling and finishing mills account for the majority of environmental releases. employees, and value of shipments, this profile concentrates on the three-digit SIC 331. The environmental releases associated with foundries are similar to the steel casting and finishing processes included under SIC 331. therefore SIC 332 will not be addressed in this notebook. Some sections of the profile focus specifically on industries in the four-digit SIC 3312, since virtually all establishments producing primary products (iron and steel) under SIC 3312, also produce secondary products that fall under some of the other iron and steel SIC codes under SIC 331.

II.B. Characterization of the Iron and Steel Industry

II.B.1. Industry Size and Geographic Distribution

There are approximately 1,118 manufacturing facilities under SIC 331 according to *1992 Census of Manufactures* data.[1] The payroll totaled $9.3 billion for a workforce of 241,000 employees, and value of shipments totaled $58 billion. Net shipments of steel mill products for all grades including carbon, alloy, and stainless totaled 92.7 million net tons in 1993[2] and 95.1 million net tons in 1994.[3] In terms of environmental issues, value of shipments, and number of employees, SIC 3312 (Blast Furnaces and Steel Mills), is the most significant four-digit code under SIC 331. The 1992 Census data reported 247 establishments under SIC 3312, with an estimated 172,000 employees, a payroll of $7 billion, and a value of shipments totaling $42 billion. For the same year, the American Iron and Steel Institute estimated 114 companies operated 217 iron and steel facilities: this estimate included any facility with one or more iron or steelmaking operation.[4]

The *1987 Census of Manufactures*[5] further categorizes SIC 3312 by the type of steel mill: integrated or non-integrated. A fully integrated facility produces steel from raw materials of coal, iron ore, and scrap. Non-integrated plants do not have all of the equipment to produce steel from coal, iron ore, and scrap on-site, instead they purchase some of their raw materials in a processed form.

SIC Diversity

The Bureau of the Census categorizes the three- and four-digit SIC codes related to iron and steel as follows:

SIC 331 - Steel works, blast furnaces, coke ovens, rolling and finishing mills
- 3312 - Steel works, blast furnaces, and rolling mills
- 3313 - Electrometallurgical products, except steel
- 3315 - Steel wiredrawing and steel nails and spikes
- 3316 - Cold-rolled steel sheet, strip, and bars
- 3317 - Steel pipe and tubes

The remainder of the industries classified under SIC code 33 cover the ferrous and non-ferrous foundries, and smelting, refining, and shaping of nonferrous metals which are not covered in this profile.

Two Steel Industries

In the past fifteen years, the U.S. steel industry has lost over 61 percent of its employees and 58 percent of its facilities. Slow growth in demand for steel, markets lost to other materials, increased imports, and older, less efficient production facilities are largely to blame for the industry's decline. While the integrated steel industry was contracting, a group of companies, called minimills, more than doubled their capacity in the same period and they continue to expand into new markets. Minimills use electric arc furnaces (EAFs) to melt scrap and other materials to make steel products, instead of using coke, iron ore, and scrap as the integrated producers do. In addition to fundamentally different production technologies, other differences between the integrated steel mills and minimill are also significant: minimills have narrow product lines, they often have small, non-unionized work forces that may receive higher pay per hour than a comparable unionized work force, but without union benefits. Additionally, minimills typically produce much less product per facility (less than 1 million tons of steel per year). Lower scrap prices in the 1960s and 1970s created opportunities for the minimill segment of the market to grow rapidly. Initially, the EAF technology could only be used in the production of low quality long products, such as concrete reinforcing bar, but over the years minimill products have improved in quality and have overcome technological limitations to diversify their product lines. Recently, minimills have entered new markets, such as flat-rolled products, however, more than half of the market for quality steel products still remains beyond minimill capability. The EAF producers do face the problems of fluctuating scrap prices which are more volatile than the prices of raw materials used by integrated producers.

Geographic Distribution

The highest geographic concentration of mills is in the Great Lakes region, where most integrated plants are based (Exhibit 1). According to the *1987 Census of Manufactures*, 46 percent of steel mills are located in six Great Lakes states: New York, Pennsylvania, Ohio, Indiana, Illinois, and Michigan, with a heavy concentration of steel manufacturing in the Chicago area. Approximately 80 percent of the U.S. steelmaking capacity is in these states. The South is the next largest steel-producing region, although there are only two integrated steel plants. Steel production in the western U.S. is limited to one integrated plant and several minimills. Historically, the mill sites were selected for their proximity to water (tremendous amounts are used for cooling and processing, and for transportation) and the sources of their raw materials, iron ore and coal. Traditional steelmaking regions included the Monongahela River valley near Pittsburgh and along the Mahoning River near Youngstown, Ohio. The geographic concentration of the industry continues to change as minimills are built anywhere electricity and scrap are available at a reasonable cost and there is a local market for a single product.

Size Distribution

Large, fully-integrated steel mills have suffered considerably in the last 15 years, largely due to loss of market share to other materials, competition, and the high cost of pension liabilities. In comparing the *1992 Census of Manufacture* data with the data from 1977, these changes are clear. While the number of establishments under SIC 3312 fell by 58 percent from 504 facilities in 1977 to 247 in 1992, the absolute number of integrated mills has always been small, and the reduction is largely due to a drop in the number of small establishments. A more relevant statistic is the reduction in employees during the same time period. The work force for these facilities was dramatically reduced as plants closed or were reorganized by bankruptcy courts. Those that remained open automated and streamlined operations resulting in a 61 percent reduction in the number of production employees over the same 15 year period. Approximately 172,000 were still employed in SIC 3312 establishments in 1992.

The *1987 Census of Manufactures* breaks the SIC code 3312 down into four sub-industries: Fully-integrated (consists of coke ovens, blast furnaces, steel furnaces, and rolling and finishing mills), partially integrated with blast furnace (consists of blast furnaces, steel furnaces, and rolling and finishing mills), partially integrated without blast furnaces (consists of steel furnaces and either rolling and finishing mills or a forging department; includes mini mills), and non-integrated (all others, including stand-alone rolling and finishing mills, and stand-alone coke plants). This division highlights some important characteristics about the size of facilities in this industry. Only 8 percent (20 plants) of the establishments under SIC 3312 in 1987 were fully integrated mills. However, 46 percent of the industry's employees worked in these 20 plants.

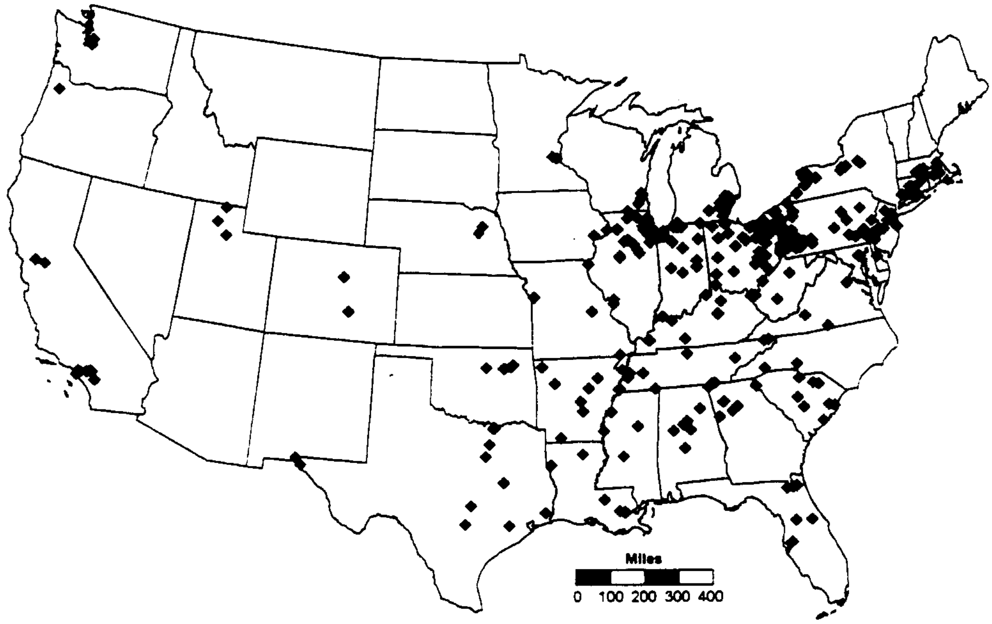


Exhibit 1: Geographic Distribution of SIC 331 Establishments: Steel Works, Blast Furnaces, and Rolling and Finishing Mills

Top Steel Producers

Market Share Reporter, published by Gale Research Inc., annually compiles reported market share data on companies, products, and services. The 1995 edition ranks top U.S. steel producers by 1993 sales in millions of dollars, as shown in Exhibit 2.

Exhibit 2: Top U.S. Iron and Steel Producers

Rank	Company	1993 Sales (millions of dollars)
1	US Steel Group - Pittsburgh, PA	5,422
2	Bethlehem Steel Corp. - Bethlehem, PA	4,219
3	LTV Corp. - Dallas, TX	3,868
4	National Steel Corp. - Pittsburgh, PA	2,418
5	Inland Steel Industries, Inc. - Chicago, IL	2,175
6	Armco Inc. - Parsippany, NJ	1,595
7	Weirton Steel Corp. - Weirton, WV	1,201
8	Wheeling-Pittsburgh Steel - Pittsburgh, PA	1,047

Source: Market Share Reporter, 1995.

II.B.2. Product Characterization

The iron and steel industry produces iron and steel mill products, such as bars, strips, and sheets, as well as formed products such as steel nails, spikes, wire, rods, pipes, and non-steel electrometallurgical products such as ferroalloys. Under SIC 3312, Blast Furnaces and Steel Mills, products also include coke, and products derived from chemical recovery in the coking process such as coal tar and distillates.

Historically, the automotive and construction sectors have been the two largest steel consuming industries. Consequently, fluctuations in sales and choice of materials in these industries have a significant impact on the iron and steel industry. Over the last two decades, the structure of the steelmaking industry has changed dramatically due to new technologies, foreign competition, and loss of market share to other materials. Many of the large, fully-integrated facilities have closed, and those that are still operating, have reduced their workforce, increased automation, and invested in new technologies to remain competitive.

R0075543

II.B.3. Economic Trends

Domestic Market

After years of collapsing markets, bankruptcies, mill closings and layoffs, the steel industry experienced a turnaround in 1993. Shipments were at their highest level since 1981.[6] For the first time since 1989, steelmakers were able to boost their prices. This increase in demand is due in part to the weak dollar, which makes importing foreign steel more expensive than it used to be. The relatively high level of shipments was also attributable to a strong demand from the steel industry's two largest customers - the automotive and construction sectors.[7] Recently, prices for steel sold to the automotive industry have been set in long-term contracts. The prices set in the automotive contracts tend to influence the steel prices of other contract negotiations, such as those with appliance manufacturers. Overall, more than half of all steel sold in the U.S. is covered by long-term contracts; the rest is sold on the spot market.

International Trade

Problems in international steel trade intensified in the last 5 years due in large part to a worldwide weakening in demand. With the exception of China, where rapid economic growth has led to a steady increase in steel demand, the export market has been weak. The "voluntary restraint arrangements" that limited imports in the 1980s expired in 1992. Since then, the U.S. steel industry has discouraged imports by filing complaints that products are being dumped - sold at less than the cost of production. Similar cases have also been filed against U.S. exporters. To address the problems of unfairly traded steel, most major steel-producing countries have participated in multilateral steel agreement (MSA) negotiations under the General Agreement on Tariffs and Trade (GATT).[8]

Steel imports for 1992 totaled 15.2 million metric tons. From 1989 to 1993, the quantity of steel imported was fairly consistent, from 15.7 million metric tons in 1989 to 15.3 million metric tons estimated for 1993. The exception is a slight dip to 14.3 million metric tons in 1991. The forecast for 1994, at 16.3 million metric tons, is a more significant increase than has been seen in the last five years. The export market has seen slightly more variability over the same time period, with a high of 5.7 million metric tons exported in 1991, and 3.8 million metric tons in exports forecast for 1994.[9]

Labor

According to *1992 Census of Manufactures*, there were an estimated 172,000 people employed in SIC 3312 industries, with a payroll of $7 billion. This was a 61 percent decrease from 1977 levels of 442,000 employees, and a 42% reduction from 1982 levels of 295,000 employees. This dramatic reduction in workforce was primarily due to reductions at the large integrated facilities. For example, the U.S. Steel plant in Gary, Indiana, employed 30,000 people during the plant's peak employment in 1953. In 1992, there were about 8,000 employees working at the 4,000-acre facility.

This reduction in workforce, coupled with investments in new equipment, automation, and management restructuring has resulted in the increased productivity that was essential for integrated mills to remain competitive in the face of the severe competitive pressures both from EAF producers in the U.S. and from abroad. With these changes, the U.S. industry has become one of the lowest-cost producers in the developed world. Productivity in steelmaking is often measured in man-hours per ton of finished steel. For every ton produced, American steelmakers spend 5.3 man-hours, compared with 5.6 for the Japanese and Canadian industries, and 5.7 for the British, French, and Germans. The increase in productivity is also reflected in changes in the value added by manufacture, as reported by the Census. During the ten year period where employment in the industry dropped by 42% (1982 - 1992), the value added by manufacture increased by 39% from $11.8 million in 1982 to $16.5 million in 1992.

Problems from such a sizable workforce reduction persist. The industry says one big cost is "legacy costs" - obligations to pay pensions and health benefits to the tens of thousands of retirees and their spouses. Some integrated companies have five retired workers for every active employee. For many of the large, integrated facilities, these pensions are underfinanced. Of the 50 most underfinanced pension plans, five are in the steel industry. This puts the newer minimills, who do not have such legacy costs, at a clear competitive advantage.

In addition to pension payments, major U.S. steel producers are now paying out an average $5.30 per hour worked, 17 percent of total hourly employment costs, for health care. The industry argues that these high costs place it at a disadvantage with its major foreign competitors, some of whom pay no direct health care expenses.

Long-term Prospects

Production of steel products in 1993 totaled 89.0 million net tons which represents an 89.1 percent capacity utilization. Shipments for 1994 rose to 95.1 million net tons and it is forecasted that demand will stay high, with industry capacity utilization increasing through 1995.[10] After years of losing market share to other materials, steel appears to be regaining a competitive position. In the automotive market, some parts that were recently made of plastic. such as fenders, roofs, and hoods, are being returned to steel. The decades-long downtrend in steel content in automobiles appears to have slowed and recently has actually reversed. According to Ford Motor Company, the average vehicle built in 1993 contained 1,726 pounds of steel, up from 1,710 pounds in 1992, marking the second consecutive yearly increase. A further increase is anticipated in 1994 due to new and expanding applications of steel. In addition to increased orders from the automotive sector. the residential construction sector is a potentially rich market for steel producers. Steel framing for houses is being promoted as a light-weight. high strength alternative to wood framing. A galvanized steel frame for a 2,000 square foot house would weigh approximately one-fourth the weight of a lumber structure.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the iron and steel industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Iron and Steel Industry

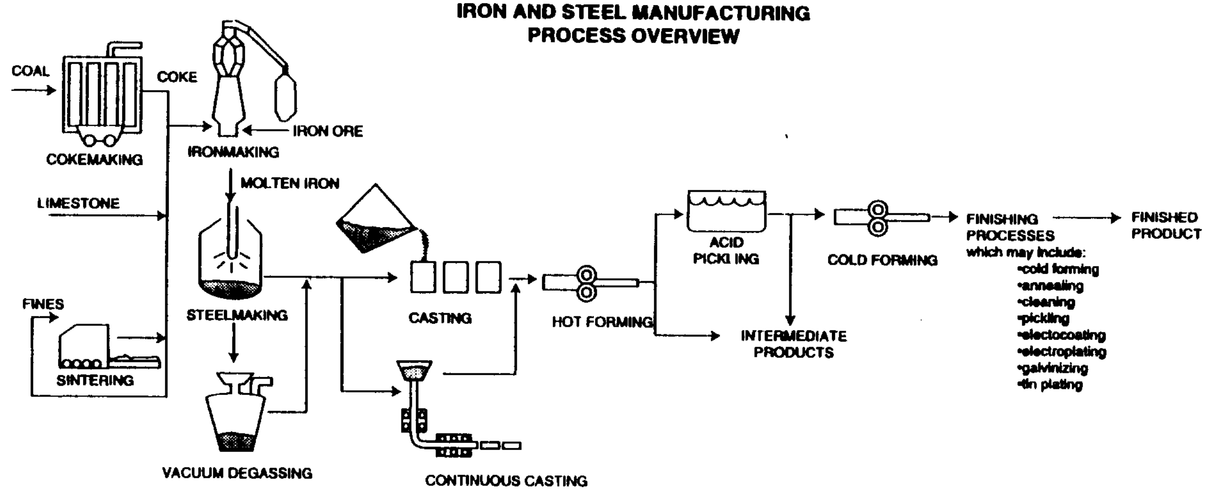
In view of the high cost of most new equipment and the relatively long lead time necessary to bring new equipment on line in the steel industry, changes in production methods and products in the steel industry are typically made gradually. Installation of major pieces of new steelmaking equipment may cost millions of dollars and require additional retrofitting of other equipment. Even new process technologies that fundamentally improve productivity, such as the continuous casting process (described below), are adopted only over long periods of time. Given the recent financial performance of the steel industry, the ability to raise the capital needed to purchase such equipment is limited.

Environmental legislation is challenging the industry to develop cleaner and more efficient steelmaking processes at the same time competition from substitute materials are forcing steelmakers to invest in cost-saving and quality enhancing technologies. In the long term, the steel industry will likely continue to move towards more simplified and continuous manufacturing technologies that reduce the capital costs for new mill construction and allow smaller mills to operate efficiently. The companies that excel will be those that have the resources and foresight to invest in such technologies.

Steel is an alloy of iron usually containing less than one percent carbon. The process of steel production occurs in several sequential steps (Exhibit 3). The two types of steelmaking technology in use today are the basic oxygen furnace (BOF) and the electric arc furnace (EAF). Although these two technologies use different input materials, the output for both furnace types is molten steel which is subsequently formed into steel mill products. The BOF input materials are molten iron, scrap, and oxygen. In the EAF, electricity and scrap are the input materials used. BOFs are typically used for high tonnage production of carbon steels, while EAFs are used to produce carbon steels and low tonnage alloy and specialty steels. The processes leading up to steelmaking in a BOF are very different than the steps preceeding steelmaking in an EAF; the steps after each of these processes producing molten steel are the same.

When making steel using a BOF, cokemaking and ironmaking precede steelmaking; these steps are not needed for steelmaking with an EAF. Coke, which is the fuel and carbon source, is produced by heating coal in the absence of oxygen at high temperatures in coke ovens. Pig iron is then produced by heating the coke, iron ore, and limestone in a blast furnace. In the BOF, molten iron from the blast furnace is combined with flux and scrap steel where high-purity oxygen is injected. This process, with cokemaking, ironmaking, steelmaking, and subsequent forming and finishing operations is referred to as fully integrated production. Alternatively, in an EAF, the input material is primarily scrap steel, which is melted and refined by passing an electric current from the electrodes through the scrap. The molten steel from either process is formed into ingots or slabs that are rolled into finished products. Rolling operations may require reheating, rolling, cleaning, and coating the steel. A description of both steelmaking processes follows:

EXHIBIT 3
IRON AND STEEL MANUFACTURING
PROCESS OVERVIEW



III.A.1. Steelmaking Using the Basic Oxygen Furnace

The process of making steel in a Basic Oxygen Furnace (BOF) is preceded by cokemaking and ironmaking operations. In cokemaking, coke is produced from coal. In ironmaking, molten iron is produced from iron ore and coke. Each of these processes and the subsequent steelmaking process in the BOF are described below.

Cokemaking
Coal processing in the iron and steel industry typically involves producing coke, coke gas and by-product chemicals from compounds released from the coal during the cokemaking process (Exhibit 4). Coke is carbon-rich and is used as a carbon source and fuel to heat and melt iron ore in ironmaking. The cokemaking process starts with bituminous pulverized coal charge which is fed into the coke oven through ports in the top of the oven. After charging, the oven ports are sealed and the coal is heated at high temperatures (1600 to 2300°F) in the absence of oxygen. Coke manufacturing is done in a batch mode where each cycle lasts for 14 to 36 hours. A coke oven battery comprises a series of 10 to 100 individual ovens, side-by-side, with a heating flue between each oven pair. Volatile compounds are driven from the coal, collected from each oven, and processed for recovery of combustible gases and other coal byproducts.[11] The solid carbon remaining in the oven is the coke. The necessary heat for distillation is supplied by external combustion of fuels (e.g., recovered coke oven gas, blast furnace gas) through flues located between ovens.[12] At the end of the heating cycle, the coke is pushed from the oven into a rail quench car. The quench car takes it to the quench tower, where the hot coke is cooled with a water spray. The coke is then screened and sent to the blast furnace or to storage.

In the by-products recovery process, volatile components of the coke oven gas stream are recovered including the coke oven gas itself (which is used as a fuel for the coke oven), naphthalene, ammonium compounds, crude light oils, sulfur compounds, and coke breeze (coke fines). During the coke quenching, handling, and screening operation, coke breeze is produced. Typically, the coke breeze is reused in other manufacturing processes on-site (e.g., sintering) or sold off-site as a by-product.[13]

The cokemaking process is seen by industry experts as one of the steel industry's areas of greatest environmental concern, with air emissions and quench water as major problems. In efforts to reduce the emissions associated with cokemaking, U.S. steelmakers are turning to technologies such as pulverized coal injection, which substitutes coal for coke in the blast furnace. Use of pulverized coal injection can replace about 25 to 40 percent of coke in the blast furnace, reducing the amount of coke required and the associated emissions. Steel producers also inject other fuels, such as natural gas, oil, and tar/pitch to replace a portion of the coke.

Quench water from cokemaking is also an area of significant environmental concern. In Europe, some plants have implemented technology to shift from water quenching to dry quenching which eliminates suspected carcinogenic particulates and VOCs. However, major construction changes are required for such a solution and considering the high capital costs of coke batteries, combined with the depressed state of the steel industry and increased regulations for cokemaking, it is unlikely that new facilities will be constructed. Instead, industry experts expect to see an increase in the amount of coke imported.

Ironmaking

In the blast furnace, molten iron is produced (Exhibit 4). Iron ore, coke, and limestone are fed into the top of the blast furnace. Heated air is forced into the bottom of the furnace through a bustle pipe and tuyeres (orifices) located around the circumference of the furnace. The carbon monoxide from the burning of the coke reduces iron ore to iron. The acid part of the ores reacts with the limestone to create a slag which is drawn periodically from the furnace. This slag contains unwanted impurities in the ore, such as sulfur from the fuels. When the furnace is tapped, iron is removed through one set of runners and molten slag via another. The molten iron is tapped into refractory-lined cars for transport to the steelmaking furnaces. Residuals from the process are mainly sulfur dioxide or hydrogen sulfide, which are driven off from the hot slag. The slag is the largest by-product generated from the ironmaking process and is reused extensively in the construction industry.[14] Blast furnace flue gas is cleaned and used to generate steam to preheat the air coming into the furnace, or it may be used to supply heat to other plant processes. The cleaning of the gas may generate air pollution control dust in removing coarse particulates (which may be reused in the sintering plant or landfilled), and water treatment plant sludge in removing fine particulates by venturi scrubbers.

Sintering is the process that agglomerates fines (including iron ore fines, pollution control dusts, coke breeze, water treatment plant sludge, coke breeze, and flux) into a porous mass for charging to the blast furnace.[15] Through sintering operations, a mill can recycle iron-rich material, such as mill scale and processed slag. Not all mills have sintering capabilities. The input materials are mixed together, placed on a slow-moving grate and ignited. Windboxes under the grate draw air through the materials to deepen the combustion throughout the traveling length of the grate. The coke breeze provides the carbon source for sustaining the controlled combustion. In the process, the fine materials are fused into the sinter agglomerates, which can be reintroduced into the blast furnace along with ore. Air pollution control equipment removes the particulate matter generated during the thermal fusing process. For wet scrubbers, water treatment plant sludge are generally land disposed waste. If electrostatic precipitators or baghouses are used as the air pollution control equipment, the dry particulates captured are typically recycled as sinter feedstock, or are landfilled as solid waste.

Steelmaking Using the Basic Oxygen Furnace

Molten iron from the blast furnace, flux, alloy materials, and scrap are placed in the basic oxygen furnace, melted and refined by injecting high-purity oxygen. A chemical reaction occurs, where the oxygen reacts with carbon and silicon generating the heat necessary to melt the scrap and oxidize impurities. This is a batch process with a cycle time of about 45 minutes. Slag is produced from impurities removed by the combination of the fluxes with the injected oxygen. Various alloys are added to produce different grades of steel. The molten steel is typically cast into slabs, beams or billets.

The waste products from the basic oxygen steelmaking process include slag, carbon monoxide, and oxides of iron emitted as dust. Also, when the hot iron is poured into ladles or the furnace, iron oxide fumes are released and some of the carbon in the iron is precipitated as graphite (kish). The BOF slag can be processed to recover the high metallic portions for use in sintering or blast furnaces, but its applications as a saleable construction materials are more limited than the blast furnace slag.

Basic oxygen furnaces are equipped with air pollution control systems for containing, cooling, and cleaning the volumes of hot gases and sub-micron fumes that are released during the process. Water is used to quench or cool the gases and fumes to temperatures at which they can be effectively treated by the gas cleaning equipment. The resulting waste streams from the pollution control processes include air pollution control dust and water treatment plant sludge. About 1,000 gallons of water per ton of steel (gpt) are used for a wet scrubber. The principal pollutants removed from the off-gas are total suspended solids and metals (primarily zinc, and some lead).[16]

EXHIBIT 4
IRON AND STEEL MANUFACTURING
COKEMAKING AND IRONMAKING

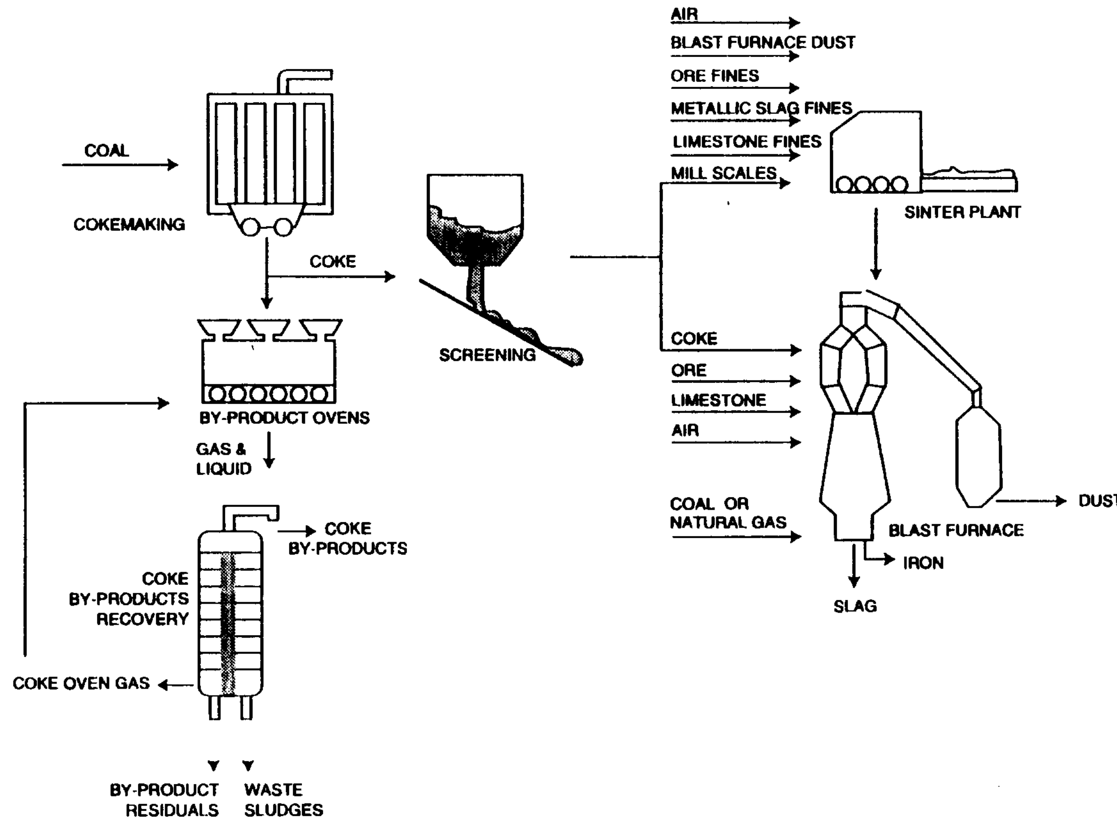
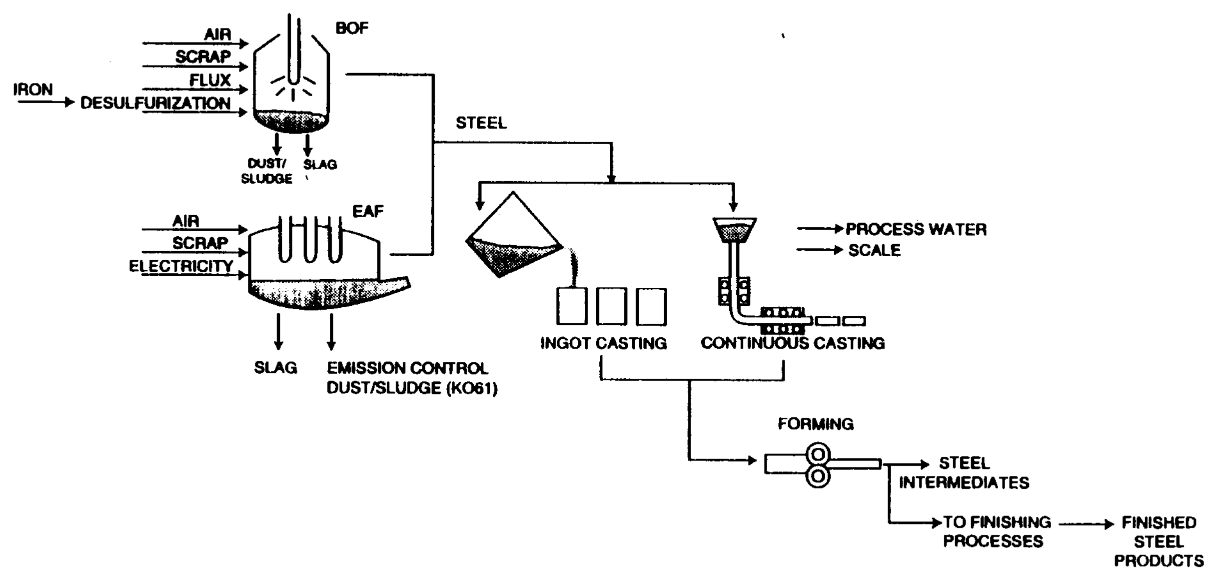


EXHIBIT 5
IRON AND STEEL MANUFACTURING
STEELMAKING



III.A.2. Steelmaking Using the Electric Arc Furnace (EAF)

In the steelmaking process that uses an electric arc furnace (EAF), the primary raw material is scrap metal, which is melted and refined using electric energy. During melting, oxidation of phosphorus, silicon, manganese, carbon and other materials occurs and a slag containing some of these oxidation products forms on top of the molten metal.[17] Oxygen is used to decarburize the molten steel and to provide thermal energy. This is a batch process with a cycle time of about two to three hours. Since scrap metal is used instead of molten iron, there are no cokemaking or ironmaking operations associated with steel production that uses an EAF.

The process produces metal dusts, slag, and gaseous products. Particulate matter and gases evolve together during the steelmaking process and are conveyed into a gas cleaning system. These emissions are cleaned using a wet or dry system. The particulate matter that is removed as emissions in the dry system is referred to as EAF dust, or EAF sludge if it is from a wet system and it is a listed hazardous waste (RCRA K061). The composition of EAF dust can vary greatly depending on the scrap composition and furnace additives. The primary component is iron or iron oxides, and it may also contain flux (lime and/or fluorspar), zinc, chromium and nickel oxides (when stainless steel is being produced) and other metals associated with the scrap. The two primary hazardous constituents of EAF emission control dust are lead and cadmium.[18] Generally, 20 pounds of dust per ton of steel is expected, but as much as 40 pounds of dust per ton of steel may be generated, depending on production practices.[19] Oils are burned off "charges" of oil-bearing scrap in the furnace. Minor amounts of nitrogen oxides and ozone are generated during the melting process. The furnace is extensively cooled by water; however, this water is recycled through cooling towers.

III.A.3. Forming and Finishing Operations

Whether the molten steel is produced using a BOF or an EAF, to convert it into a product, it must be solidified into a shape suitable and finished.

Forming

The traditional forming method, called ingot teeming, has been to pour the metal into ingot molds, allowing the steel to cool and solidify. The alternative method of forming steel, called continuous casting accounted for more 86% of raw steel produced in the U.S. in 1992[20], compared with approximately 30 percent in 1982. The continuous casting process bypasses several steps of the conventional ingot teeming process by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir from which it is released into the molds of the casting machine. The metal is cooled as it descends through the molds, and before emerging, a hardened outer shell is formed. As the semifinished shapes proceed on the runout table, the center also solidifies, allowing the cast shape to be cut into lengths.

Process contact water cools the continuously cast steel and is collected in settling basins along with oil, grease, and mill scale generated in the casting process. The scale settles out and is removed and recycled for sintering operations, if the mill has a Sinter Plant. Waste treatment plant sludge is also generated.[21]

The steel is further processed to produce slabs, strips, bars, or plates through various forming operations. The most common hot forming operation is hot rolling, where heated steel is passed between two rolls revolving in opposite directions. Modern hot rolling units may have as many as 13 stands, each producing an incremental reduction in thickness. The final shape and characteristics of a hot formed piece depend on the rolling temperature, the roll profile, and the cooling process after rolling. Wastes generated from hot rolling include waste treatment plant sludge and scale.

In subsequent cold forming, the cross-sectional area of unheated steel is progressively reduced in thickness as the steel passes through a series of rolling stands. Generally, wires, tubes, sheet and strip steel products are produced by cold rolling operations. Cold forming is used to obtain improved mechanical properties, better machinability, special size accuracy, and the production of thinner gages than hot rolling can accomplish economically.[22] During cold rolling, the steel becomes hard and brittle. To make the steel more ductile, it is heated in an annealing furnace.

Process contact water is used as a coolant for rolling mills to keep the surface of the steel clean between roller passes. Cold rolling operations also produce a waste treatment plant sludge, primarily due to the lubricants applied during rolling. Grindings from resurfacing of the worn rolls and disposal of used rolls can be a significant contributor to the plant's wastestream.

Finishing

One of the most important aspects of a finished product is the surface quality. To prevent corrosion, a protective coating may be applied to the steel product. Prior to coating, the surface of the steel must be cleaned so the coating will adhere to the steel. Mill scale, rust, oxides, oil, grease, and soil are chemically removed from the surface of steel using solvent cleaners, pressurized water or air blasting, cleaning with abrasives, alkaline agents or acid pickling. In the pickling process, the steel surface is chemically cleaned of scale, rust, and other materials. Inorganic acids such as hydrochloric or sulfuric acid are most commonly used for pickling. Stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids. Spent pickle liquor may be a listed hazardous waste (RCRA K062), if it contains considerable residual acidity and high concentrations of dissolved iron salts. Pickling prior to coating may use a mildly acidic bath which is not considered K062.

Steel generally passes from the pickling bath through a series of rinses. Alkaline cleaners may also be used to remove mineral oils and animal fats and oils from the steel surface prior to cold rolling. Common alkaline cleaning agents include: caustic soda, soda ash, alkaline silicates, phosphates.

Steel products are often given a coating to inhibit oxidation and extend the life of the product. Coated products can also be painted to further inhibit corrosion. Common coating processes include: galvanizing (zinc coating), tin coating, chromium coating, aluminizing, and terne coating (lead and tin). Metallic coating application processes include hot dipping, metal spraying, metal cladding (to produce bi-metal products), and electroplating. Galvanizing is a common coating process where a thin layer of zinc is deposited on the steel surface.

III.B. Raw Material Inputs and Pollution Outputs

Numerous outputs are produced as a result of the manufacturing of coke, iron, and steel, the forming of metals into basic shapes, and the cleaning and scaling of metal surfaces. These outputs, categorized by process (RCRA waste code provided where applicable), include:

Cokemaking

Inputs:

- Coal, heat, quench water

Outputs:

- Process residues from coke by-product recovery (RCRA K143, K148)
- Coke oven gas by-products such as coal tar, light oil, ammonia liquor, and the remainder of the gas stream is used as fuel. Coal tar is typically refined to produce commercial and industrial products including pitch, creosote oil, refined tar, naphthalene, and bitumen.
- Charging emissions (fine particles of coke generated during oven pushing, conveyor transport, loading and unloading of coke that are captured by pollution control equipment. Approximately one pound per ton of coke produced are captured and generally land disposed).
- Ammonia, phenol, cyanide and hydrogen sulfide
- Oil (K143 and K144)
- Lime sludge, generated from the ammonia still (K060)
- Decanter tank tar sludge (K087)
- Benzene releases in coke by-product recovery operations
- Naphthalene residues, generated in the final cooling tower
- Tar residues (K035, K141, K142, and K147)
- Sulfur compounds, emitted from the stacks of the coke ovens
- Wastewater from cleaning and cooling (contains zinc, ammonia still lime (K060), or decanter tank tar (K087), tar distillation residues (K035))
- Coke oven gas condensate from piping and distribution system; may be a RCRA characteristic waste for benzene.

Ironmaking

Inputs:

- Iron ore (primarily in the form of taconite pellets), coke, sinter, coal. limestone, heated air

Outputs:

- Slag, which is either sold as a by-product, primarily for use in the construction industry, or landfilled
- Residual sulfur dioxide or hydrogen sulfide
- Particulates captured in the gas, including the air pollution control (APC) dust or waste treatment plant (WTP) sludge
- Iron is the predominant metal found in the process wastewater
- Blast furnace gas (CO)

Steelmaking

Inputs:

- In the steelmaking process that uses a basic oxygen furnace (BOF), inputs include molten iron, metal scrap, and high-purity oxygen
- In the steelmaking process that uses an electric arc furnace (EAF), the primary inputs are scrap metal, electric energy and graphite electrodes.
- For both processes, fluxes and alloys are added, and may include: fluorspar. dolomite, and alloying agents such as aluminum, manganese, and others.

Outputs:

- Basic Oxygen Furnace emission control dust and sludge, a metals-bearing waste.
- Electric Arc Furnace emission control dust and sludge (K061); generally, 20 pounds of dust per ton of steel is expected, but as much as 40 pounds of dust per ton of steel may be generated depending on the scrap that is used.
- Metal dusts (consisting of iron particulate, zinc, and other metals associated with the scrap and flux (lime and/or fluorspar)) not associated with the EAF.
- Slag.
- Carbon monoxide.
- Nitrogen oxides and ozone, which are generated during the melting process.

Forming, Cleaning, and Descaling

Inputs:

- Carbon steel is pickled with hydrochloric or sulfuric acid: stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids.
- Various organic chemicals are used in the pickling process.
- Alkaline cleaners may also be used to remove mineral oils and animal fats and oils from the steel surface. Common alkaline cleaning agents include: caustic soda, soda ash, alkaline silicates, phosphates.

Outputs:

- Wastewater sludge from rolling, cooling, descaling, and rinsing operations which may contain cadmium (D006), chromium (D007), lead (D008)
- Oils and greases from hot and cold rolling
- Spent pickle liquor (K062)
- Spent pickle liquor rinse water sludge from cleaning operations
- Wastewater from the rinse baths. Rinse water from coating processes may contain zinc, lead, cadmium, or chromium.
- Grindings from roll refinishing may be RCRA characteristic waste from chromium (D007)
- Zinc dross

III.C. Management of Chemicals in the Production Process

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has increased and the portions treated or managed through energy recovery on-site have decreased between 1992 and 1995 (projected). While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The PPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 6 shows that the iron and steel industry managed about 1.3 billion pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, over half (52%) was either transferred off-site or released to the environment, and most of this quantity was recycled off-site (typically in a metals recovery process). Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 48% of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns E, F and G, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns H, I and J, respectively. The remaining portion of the production related wastes (15% for 1993), shown in column D, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

Exhibit 6: Source Reduction and Recycling Activity for Iron and Steel Industry (SIC 331) as Reported within TRI

A	B	C	D	On-Site			Off-Site		
				E	F	G	H	I	J
Year	Quantity of Production-Related Waste (10⁶ lbs.)[a]	% Released and Transferred[b]	% Released and Disposed[c] Off-site	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated
1992	1,301	40%	10%	32%	2%	16%	34%	1%	5%
1993	1,340	52%	15%	24%	1%	17%	35%	1%	6%
1994	1,341	---	15%	23%	1%	18%	37%	1%	6%
1995	1,357	---	15%	22%	1%	18%	38%	1%	6%

[a] Does not include any accidental, non-production related wastes.
[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes; this value may not equal the sum of the percentages released and transferred due to reporting errors in Section 8.
[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

R0075560

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases, please note that in general, toxic chemical releases reported in TRI have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emission occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Iron and Steel Industry

This section summarizes TRI data of facilities involved in the production of iron and steel products who report their operations under SIC 331. These include blast furnaces and steel mills, steel wire manufacture, and cold rolled steel products but also include a small number of nonferrous operations (such as facilities manufacturing nonferrous electrometalurgical products under SIC 3313). The *Census of Manufactures* reports 1,118 iron and steel establishments under SIC 331. Although 381 iron and steel facilities filed

TRI reports in 1993 (under SIC 3312, 3313, 3315, 3316. 3317), the 155 facilities (41 percent) classified under SIC 3312 (blast furnaces and steel mills) are responsible for over 75 percent of reported releases and transfers. TRI information is likely to provide a fairly different profile for the facilities not reporting under 3312 (non-steel producing facilities).

According to TRI data, the iron and steel industry released and transferred a total of approximately 695 million pounds of pollutants during calendar year 1993. These releases and transfers are dominated by large volumes of metal-bearing wastes. The majority of these wastes (70 percent or 488 million pounds) are transferred off-site for recycling, typically for recovery of the metal content. *Transfers* of TRI chemicals account for 86 percent of the iron and steel industry's total TRI-reportable chemicals (609 million pounds) while *releases* make up 14 percent (85 million pounds). Metal-bearing wastes account for approximately 80 percent of the industry's transfers and over fifty percent of the releases.

Releases from the industry continue to decrease, while transfers increased from 1992 to 1993. The increase in transfers is likely due to increased off-site shipments for recovery of metals from wastes. This shift may also have contributed to the decrease in releases. Another factor influencing an overall downward trend since 1988 in releases and transfers is the steel mill production decrease during the 1988 to 1993 period. In addition, pollution control equipment and a shift to new technologies, such as continuous casting, are responsible for significant changes in the amount and type of pollutants released during steelmaking. Finally, the industry's efforts in pollution preventing also play a role in driving pollutant release reductions.

Evidence of the diversity of processes at facilities reporting to TRI is found in the fact that the most frequently reported chemical (sulfuric acid) is reported by only 41 percent of the facilities; the sixth most frequently reported chemical was used by just one-fourth of TRI facilities. The variability in facilities' pollutant profile may be attributable to a number of factors. Fewer than 30 of the facilities in the TRI database for SIC 331 are fully integrated plants making coke, iron, and steel products. The non-integrated facilities do not perform one or more of the production steps and, therefore, may have considerably different emissions profiles. Furthermore, steel making operations with electric arc furnaces have significantly different pollutant profiles than those making steel with basic oxygen furnaces.

Releases

The iron and steel industry releases just 14 percent of its TRI total poundage. Of these releases, over half go to on-site land disposal, and one quarter of releases are fugitive or point source air emissions (Exhibit 7). Manganese, zinc, chromium, and lead account for over 90 percent of the on-site land disposal. The industry's air releases are associated with volatilization, fume or aerosol formation in the high temperature furnaces and byproduct processing. Ammonia, lighter weight organics, such as methanol, acids and metal contaminants found in the iron ore are the principal types of chemicals released to the air. In addition to air releases of chemicals reported in TRI, the iron and steel industry is a significant source of particulates, carbon monoxide, nitrogen oxides and sulfur compounds due to combustion. Ammonia releases account for the largest part of the fugitive releases (approximately 42 percent) and 1,1,1-trichloroethane, hydrochloric acid, zinc compounds, and trichloroethylene each contribute another 4 - 5 percent. Underground injection (principally of hydrochloric acid) makes up about 14 percent of the releases reported by the industry.

Transfers

Eighty percent of transfers reported by SIC 331 industries are sent off-site for recycling. Zinc, manganese, chromium, copper, nickel, and lead are the six metals transferred by the greatest number of facilities (Exhibit 8).

Acids used during steel finishing, such as hydrochloric, sulfuric, nitric, and phosphoric acids, account for another 17 percent of transfers. These acids are most often sent off-site for recycling or for treatment. Hydrochloric acids are also managed by on-site underground injection. The next class of chemicals of significant volume in TRI are solvents and lightweight carbon byproducts, including: 1,1,1-trichloroethane, trichloroethylene, phenol, xylene, methanol, and toluene. These solvents are primarily released as fugitive air emissions, but also from point sources. A small percentage of these solvents are transferred off-site for recycling.

Chemicals sent off-site for disposal (primarily zinc, sulfuric acid, manganese, and ammonium sulfate) account for another 10 percent of transfers. Only approximately 7 percent of chemicals transferred off-site go to treatment. These chemicals are primarily hydrochloric acid, sulfuric acid, and nitric acid. Only about one percent of transfers by weight are POTW discharges (mainly sulfuric acid). Another one percent of transfers are sent for energy recovery (with hydrochloric acid as the most significant contributor).

Exhibit 7: Releases for Iron and Steel Facilities (SIC 331) in TRI, by Number of Facilities Reporting (1993 Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASE PER FACILITY
SULFURIC ACID	157	385,882	321,639	27,700	0	4,705	739,926	4,713
MANGANESE COMPOUNDS	110	472,855	808,182	145,595	4,800	21,252,405	22,683,837	206,217
CHROMIUM COMPOUNDS	108	19,821	87,971	53,107	4,800	1,953,629	2,119,328	19,623
ZINC COMPOUNDS	108	596,037	874,585	121,804	250	13,497,412	15,090,088	139,723
HYDROCHLORIC ACID	102	612,814	1,469,636	25	11,726,300	744	13,809,519	135,387
CHROMIUM	95	10,858	24,926	4,432	0	415,839	456,055	4,801
MANGANESE	94	38,655	42,782	79,069	0	791,189	951,695	10,124
NICKEL COMPOUNDS	86	9,030	12,107	11,007	1,100	654,514	687,758	7,997
NICKEL	83	10,505	19,817	9,490	3,200	126,359	169,371	2,041
NITRIC ACID	66	96,647	487,887	39	0	44,730	629,303	9,535
LEAD	61	34,634	107,468	17,088	0	126,479	285,669	4,683
LEAD COMPOUNDS	61	55,593	76,024	11,559	0	1,087,501	1,230,677	20,175
AMMONIA	59	5,162,886	1,012,664	4,836,185	860,000	6,479	11,878,214	201,326
PHOSPHORIC ACID	56	78,666	7,672	260	0	142,814	229,412	4,097
COPPER COMPOUNDS	51	10,474	81,731	8,918	1,100	1,518,033	1,620,256	31,770
COPPER	36	17,281	4,902	3,237	0	16,320	41,740	1,159
ZINC (FUME OR DUST)	36	328,089	322,975	58,831	0	3,571,000	4,280,895	118,914
XYLENE (MIXED ISOMERS)	32	172,712	76,091	510	0	274	249,587	7,800
HYDROGEN FLUORIDE	30	96,276	133,328	19	0	20,789	250,412	8,347
TOLUENE	30	222,938	408,507	513	0	328	632,286	21,076
NAPHTHALENE	26	98,890	35,809	1,830	15,000	300	151,829	5,840
BENZENE	24	482,755	347,643	911	7,000	600	838,909	34,955
CYANIDE COMPOUNDS	24	14,928	91,928	72,033	41,000	909	220,798	9,200
CHLORINE	23	16,510	6,409	48,910	0	0	71,829	3,123
ETHYLENE GLYCOL	21	52,505	255	99,306	0	6,950	159,016	7,572
ETHYLENE	20	196,170	771,732	0	0	0	967,902	48,395
BARIUM COMPOUNDS	19	847	1,260	12,523	0	140,857	155,487	8,184
1,1,1-TRICHLOROETHANE	19	1,184,793	160,942	0	0	0	1,345,735	70,828
ANTHRACENE	17	3,830	11,636	9	0	0	15,475	910
PHENOL	16	101,903	77,677	30,445	76,000	23,817	309,842	19,365
ALUMINUM (FUME OR DUST)	15	5,536	56,575	22,522	0	210,064	294,697	19,646
PROPYLENE	15	28,149	81,649	0	0	0	109,798	7,320
METHANOL	14	487,709	18	0	0	35	487,762	34,840
DIBENZOFURAN	13	2,571	29	0	0	0	2,600	200
MOLYBDENUM TRIOXIDE	13	923	852	1,860	0	6,450	10,085	776
ETHYLBENZENE	12	13,504	3,803	250	0	0	17,557	1,463
TRICHLOROETHYLENE	12	572,277	484,600	5	0	0	1,056,882	88,074
AMMONIUM SULFATE(SOLUTION)	10	5	0	5,693	0	0	5,698	570
CADMIUM COMPOUNDS	10	904	1,391	5	0	0	2,300	230
STYRENE	10	4,724	636	5	0	7	5,372	537
COBALT	9	419	684	3,709	0	760	5,572	619
GLYCOL ETHERS	8	76,065	268,798	0	0	0	344,863	43,108
DICHLOROMETHANE	7	133,725	264,215	0	0	0	397,940	56,849
COBALT COMPOUNDS	6	18	781	535	0	3,100	4,434	739
CRESOL (MIXED ISOMERS)	6	6,341	1,801	259	0	0	8,401	1,400
QUINOLINE	6	379	1,801	5	0	0	2,185	364

Exhibit 7 (cont.): Releases for Iron and Steel Facilities (SIC 331) in TRI, by Number of Facilities Reporting (1993 Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG RELEASE PER FACILITY
QUINOLINE	6	2,185	379	1,801	5	0	2,185	364
1,2,4-TRIMETHYLBENZENE	6	9,730	434	0	0	0	10,164	1,694
ANTIMONY COMPOUNDS	5	1,715	110	635	0	1,052	3,512	702
BIPHENYL	5	202	1	0	0	0	203	41
ANTIMONY	4	803	650	5,515	0	1,300	8,260	2,067
TETRACHLOROETHYLENE	4	34,498	10,800	0	0	0	45,290	11,325
ACETONE	3	340,285	0	0	0	0	340,285	113,428
BARIUM	3	373	996	4,416	0	117,264	123,049	41,016
CADMIUM	3	24	388	0	0	0	412	137
SEC-BUTYL ALCOHOL	3	56,794	10,650	250	0	0	67,694	22,565
VANADIUM (FUME OR DUST)	3	4,180	700	3,200	0	22,000	30,080	10,027
CALCIUM CYANAMIDE	2	0	0	0	0	0	0	0
CARBON DISULFIDE	2	1,638	250	0	0	0	1,888	944
DIETHANOLAMINE	2	1,900	0	25,000	0	0	26,900	13,450
HYDROGEN CYANIDE	2	5	10	0	0	0	15	8
METHYL ETHYLKETONE	2	3,700	51,400	0	0	0	55,100	27,550
N-BUTYL ALCOHOL	2	250	27,807	0	0	0	28,057	14,029
SILVER	2	5	0	0	0	0	5	3
THIOUREA	2	250	0	767	0	0	1,017	509
ALUMINUM OXIDE(FIBROUS	1	250	0	0	0	0	250	250
ARSENIC	1	15	15	0	0	0	30	30
BROMOTRIFLUOROMETHANE	1	250	0	0	0	0	250	250
BUTYL BENZYL PHTHALATE	1	0	0	0	0	0	0	0
CARBONYL SULFIDE	1	250	0	0	0	0	250	250
METHYL ISOBUTYL KETONE	1	170	0	0	0	0	170	170
POLYCHLORINATED BIPHENYLS	1	0	0	0	0	0	0	0
PYRIDINE	1	750	16,000	0	8,200	0	24,950	24,950
SELENIUM COMPOUNDS	1	0	0	0	0	0	0	0
1,3-BUTADIENE	1	250	0	0	0	0	250	250
2,4-DIMETHYLPHENOL	1	250	0	0	0	0	250	250
TOTAL	381	12,377,570	9,174,029	5,729,986	12,748,750	45,767,008	85,797,343	85,797,343

Exhibit 8: Transfers for Iron and Steel Facilities in TRI, by Number of Facilities Reporting (1993 Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
SULFURIC ACID	157	7,192,127	11,060,393	15,416,092	6,533,083	0	40,295,552	256,660
MANGANESE COMPOUNDS	110	1,498	2,500,170	25,091,810	514,579	0	28,108,057	255,528
CHROMIUM COMPOUNDS	108	1,353	1,394,134	25,225,915	312,628	1,059	26,935,089	249,399
ZINC COMPOUNDS	108	8,611	34,813,453	157,386,808	5,021,396	3,100	197,233,368	1,826,235
HYDROCHLORIC ACID	102	217,138	395,161	32,888,151	23,981,197	8,497,000	65,978,647	646,849
CHROMIUM	95	2,289	1,010,326	32,865,366	36,816	750	33,915,547	357,006
MANGANESE	94	2,461	4,442,385	39,076,967	40,744	0	43,562,557	463,431
NICKEL COMPOUNDS	86	4,678	381,519	8,831,918	121,984	0	9,340,099	108,606
NICKEL	83	2,091	455,271	13,271,504	57,207	0	13,786,073	166,097
NITRIC ACID	66	51,087	1,616,149	54,046	3,073,168	0	4,794,450	72,643
LEAD	61	2,242	515,410	7,382,111	151,145	27	8,050,935	131,983
LEAD COMPOUNDS	61	957	682,835	13,703,747	152,866	0	14,540,405	238,367
AMMONIA	59	488,144	53,077	0	5,650	2,700	549,821	9,319
PHOSPHORIC ACID	56	9	90,626	18,000	19,549	0	128,184	2,289
COPPER COMPOUNDS	51	1,930	99,140	998,167	35,473	0	1,134,710	22,249
COPPER	36	746	63,934	5,598,545	7,123	0	5,670,348	157,510
ZINC (FUME OR DUST)	36	958	669,220	60,234,732	199,821	0	61,104,731	1,697,354
XYLENE(MIXED ISOMERS)	32	308	600	7,360	828	23,816	32,912	1,029
HYDROGEN FLUORIDE	30	28,300	387,574	15,046	827,889	0	1,258,809	41,960
TOLUENE	30	360	650	1,760	7,747	7,897	18,414	614
NAPHTHALENE	26	1,578	24,300	0	3,561	900	30,339	1,167
BENZENE	24	1,574	1,800	469	4,477	1,800	10,120	422
CYANIDE COMPOUNDS	24	29,753	3,184	0	13,238	0	46,175	1,924
CHLORINE	23	1,310	250	92,563	0	0	94,123	4,092
ETHYLENE GLYCOL	21	250	16,984	279,247	25,000	57,550	379,031	18,049
ETHYLENE	20	0	0	0	0	0	0	0
BARIUM COMPOUNDS	19	0	132,219	68,028	0	0	200,247	10,539
1,1,1-TRICHLOROETHANE	19	0	2,000	165,861	33,988	79,528	281,377	14,809
ANTHRACENE	17	0	4,200	0	2	0	4,202	247
PHENOL	16	359,945	1,176	0	108,247	6,464	475,832	29,740
ALUMINUM(FUME OR DUST)	15	5	125,775	47,675,040	0	0	47,800,820	3,186,721
PROPYLENE	15	0	0	0	0	0	0	0
METHANOL	14	720	0	0	0	0	720	51
DIBENZOFURAN	13	0	2,690	0	0	0	2,690	207
MOLYBDENUM TRIOXIDE	13	0	750	139,341	0	0	140,091	10,776
ETHYLBENZENE	12	0	325	760	250	1,502	2,837	236
TRICHLOROETHYLENE	12	0	38,556	76,036	53,726	24,191	192,509	16,042
AMMONIUM	10	0	2,000,000	0	0	0	2,000,000	200,000
CADMIUM COMPOUNDS	10	0	0	194,474	1,369	0	195,843	19,584
STYRENE	10	5	322	0	0	0	327	33
COBALT	9	0	40,026	830,040	7	0	870,073	96,675
GLYCOL ETHERS	8	0	0	0	1,273	26,000	27,273	3,409
DICHLOROMETHANE	7	0	0	8,229	8,200	750	17,179	2,454
COBALT COMPOUNDS	6	255	444	75,378	1,355	0	77,432	12,905
CRESOL(MIXED ISOMERS)	6	5	5	0	501	2,107	2,618	436
QUINOLINE	6	5	510	0	0	0	515	86

Exhibit 8 (cont.): Transfers for Iron and Steel Facilities in TRI, by Number of Facilities Reporting (1993 Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG TRANSFER PER FACILITY
QUINOLINE	6	5	510	0	0	0	515	86
1,2,4-TRIMETHYLBENZENE	6	0	380	0	250	750	1,380	230
ANTIMONY COMPOUNDS	5	0	410	0	0	0	410	82
BIPHENYL	5	0	550	0	0	0	550	110
ANTIMONY	4	0	34,855	0	0	0	34,855	8,714
TETRACHLOROETHYLENE	4	0	4,000	13,853	0	3,517	21,370	5,343
ACETONE	3	0	1	0	4,308	0	4,309	1,436
BARIUM	3	0	5	3,105	0	0	3,110	1,037
CADMIUM	3	0	17,400	82,944	0	0	100,344	33,448
SEC-BUTYL ALCOHOL	3	0	0	0	990	0	990	330
VANADIUM (FUME OR DUST)	3	0	0	0	0	0	0	0
CALCIUM CYANAMIDE	0	0	0	0	0	0	0	0
CARBON DISULFIDE	0	0	0	0	0	0	0	0
DIETHANOLAMINE	0	0	0	0	0	0	0	0
HYDROGEN CYANIDE	0	0	0	0	0	0	0	0
METHYL ETHYL KETONE	2	0	0	0	0	339	0	170
N-BUTYL ALCOHOL	2	0	0	0	0	500	2	250
SILVER	2	5	0	2,666	0	0	2	1,336
THIOUREA	0	0	0	0	0	0	2	0
ALUMINUM OXIDE(FIBROUS	1	0	0	0	52,117	0	1	52,117
ARSENIC	0	0	0	0	0	0	1	0
BROMOTRIFLUOROMETHANE	0	0	0	0	0	0	1	0
BUTYL BENZYL PHTHALATE	0	0	0	0	0	0	1	0
CARBONYL SULFIDE	0	0	0	0	0	0	1	0
METHYL ISOBUTYL KETONE	0	0	0	0	0	0	1	0
POLYCHLORINATED BIPHENYLS	1	0	18,691	0	6,428	0	1	25,119
PYRIDINE	0	0	0	0	0	0	1	0
SELENIUM COMPOUNDS	1	0	736	0	0	0	1	736
1,3-BUTADIENE	0	0	0	0	0	0	1	0
2,4-DIMETHYLPHENOL	0	0	0	0	0	0	1	0
TOTAL	381	8,402,697	63,104,571	487,776,079	41,420,180	8,742,247	609,539,881	1,599,842

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector based on pounds released are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations - some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 9: Top 10 TRI Releasing Iron and Steel Facilities[a]

Rank	Facility	Total TRI Releases in Pounds
1	Elkem Metals Co* - Marietta, OH	18,604,572
2	Northwestern Steel & Wire Co. - Sterling, IL	14,274,570
3	Granite City Steel - Granite City, IL	5,156,148
4	Midwest Steel Div. Midwest Steel Div. - Portage, IN	4,735,000
5	AK Steel Corp. Middletown Works - Middletown, OH	4,189,050
6	Bethlehem Steel Corp. Burns Harbor Div. - Burns Harbor, IN	3,899,470
7	Wheeling-Pittsburgh Steel Corp Mingo Junction Plant - Mingo Junction, OH	3,089,795
8	USS Gary Works - Gary, IN	2,403,348
9	LTV Steel Co. Inc. Cleveland Works - Cleveland, OH	1,985,131
10	Gulf States Steel Inc. - Gadsden, AL	1,959,707

Source: U.S. EPA *Toxic Release Inventory Database*, 1993.
* This is an Electrometallurgical Products facility (SIC 3313), not a steel mill.

[a] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075570

Exhibit 10: Top 10 TRI Releasing Facilities Reporting SIC 331 Operations[b]

Rank	SIC Codes Reported in TRI	Facility	Total TRI Releases in Pounds
1	3313	Elkem Metals Co* - Marietta, OH	18,604,572
2	3312, 3315	Northwestern Steel & Wire Co. - Sterling, IL	14,274,570
3	3312, 3274	Inland Steel Co. - East Chicago, IN	10,618,719
4	3313, 2819	Kerr-McGee Chemical Corp. Electrolytic Plant - Hamilton, MS*	5,446,555
5	3312	Granite City Steel - Granite City, IL	5,156,148
6	3316	Midwest Steel Div. Midwest Steel Div. - Portage, IN	4,735,000
7	3312	AK Steel Corp. Middletown Works - Middletown, OH	4,189,050
8	3312	Bethlehem Steel Corp. Burns Harbor Div. - Burns Harbor, IN	3,899,470
9	3312	Wheeling-Pittsburgh Steel Corp Mingo Junction Plant - Mingo Junction, OH	3,089,795
10	3312	USS Gary Works - Gary, IN	2,403,348

Source: U.S. EPA *Toxic Release Inventory Database*, 1993.
* This is an Electrometallurgical Products facility (SIC 3313), not a steel mill.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reduction over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

[b] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075571

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), and the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, the National Cancer Institute, and the National Institute for Occupational Safety and Health.[c] HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766.

Ammonia (CAS: 7664-41-7)

Sources. In cokemaking, ammonia is produced by the decomposition of the nitrogen-containing compounds which takes place during the secondary thermal reaction (at temperatures greater than 700°C (1296°F)). The ammonia formed during coking exists in both the water and gas that form part of the volatile products. The recovery of this ammonia can be accomplished by several different processes where the by-product ammonium sulfate is formed by the reaction between the ammonia and sulfuric acid.[23]

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

[c] Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory).

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Hydrochloric Acid (CAS: 7647-01-1)

Sources. During hot rolling, a hard black iron oxide is formed on the surface of the steel. This "scale" is removed chemically in the pickling process which commonly uses hydrochloric acid.[24]

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e.. increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Manganese and Manganese Compounds (CAS: 7439-96-5; 20-12-2)

Sources. Manganese is found in the iron charge and is used as an addition agent added to alloy steel to obtain desired properties in the final product. In carbon steel, manganese is used to combine with sulfur to improve the ductility of the steel. An alloy steel with manganese is used for applications involving relatively small sections which are subject to severe service conditions, or in larger sections where the weight saving derived from the higher strength of the alloy steels is needed.[25]

Toxicity. There is currently no evidence that human exposure to manganese at levels commonly observed in ambient atmosphere results in adverse health effects. However, recent EPA review of the fuel additive MMT

R0075573

(methylcyclopentadienyl manganese tricarbonyl) concluded that use of MMT in gasoline could lead to ambient exposures to manganese at a level sufficient to cause adverse neurological effects in humans.

Chronic manganese poisoning bears some similarity to chronic lead poisoning. Occurring via inhalation of manganese dust or fumes, it primarily involves the central nervous system. Early symptoms include languor, speech disturbances, sleepiness, and cramping and weakness in legs. A stolid mask-like appearance of face, emotional disturbances such as absolute detachment broken by uncontrollable laughter, euphoria, and a spastic gait with a tendency to fall while walking are seen in more advanced cases. Chronic manganese poisoning is reversible if treated early and exposure stopped. Populations at greatest risk of manganese toxicity are the very young and those with iron deficiencies.

Ecologically, although manganese is an essential nutrient for both plants and animals, in excessive concentrations manganese inhibits plant growth.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Manganese is an essential nutrient for plants and animals. As such, manganese accumulates in the top layers of soil or surface water sediments and cycles between the soil and living organisms. It occurs mainly as a solid under environmental conditions, though may also be transported in the atmosphere as a vapor or dust.

1,1,1-Trichloroethane (CAS: 71-55-6)

Sources. Used for surface cleaning of steel prior to coating.

Toxicity. Repeated contact of 1,1,1-trichloroethane (TCE) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCE causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCE leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsions and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCE to surface water or land will almost entirely volatilize. Releases to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCE degrades very slowly by photooxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCE that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCE does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Zinc and Zinc Compounds (CAS: 7440-66-6; 20-19-9)

Sources. To protect steel from rusting, it is coated with a material that will protect it from moisture and air. In the galvanizing process, steel is coated with zinc.[26]

Toxicity. Zinc is a nutritional trace element; toxicity from ingestion is low. Severe exposure to zinc might give rise to gastritis with vomiting due to swallowing of zinc dusts. Short-term exposure to very high levels of zinc is linked to lethargy, dizziness, nausea, fever, diarrhea, and reversible pancreatic and neurological damage. Long-term zinc poisoning causes irritability, muscular stiffness and pain, loss of appetite, and nausea.

Zinc chloride fumes cause injury to mucous membranes and to the skin. Ingestion of soluble zinc salts may cause nausea, vomiting, and purging.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Significant zinc contamination of soil is only seen in the vicinity of industrial point sources. Zinc is a relatively stable soft metal, though burns in air. Zinc bioconcentrates in aquatic organisms.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures the vast majority of facilities in the iron and steel industry. It also allows for a comparison across years and industry sectors. Reported chemicals are limited however to the 316 reported chemicals. Most of the hydrocarbon emissions from iron and steel facilities are not captured by TRI.[27] The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many iron and steel manufacturing sources.[28]

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 11 summarizes annual releases (from the industries for which a

Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). With 1.5 million short tons/year of carbon monoxide, the iron and steel industry emissions are estimated as more than twice as much as the next largest releasing industry, pulp and paper. Of the eighteen industries listed, the iron and steel industry also ranks as one of the top five releasers for NO_2, PM10, PT, and SO_2. Carbon monoxide releases occur during ironmaking (in the burning of coke, CO produced reduces iron oxide ore), and during steelmaking (in either the basic oxygen furnace or the electric arc furnace). Nitrogen dioxide is generated during steelmaking. Particulate matter may be emitted from the cokemaking (particularly in quenching operations), ironmaking, basic oxygen furnace (as oxides of iron that are emitted as sub-micron dust), or from the electric arc furnace (as metal dust containing iron particulate, zinc, and other materials associated with the scrap). Sulfur dioxide can be released in ironmaking or sintering.

Exhibit 11: Pollutant Releases (short tons/year)

Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Production	123,756	42,658	14,135	63,761	9,419	41,423
Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	541,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	103,575	4,107	39,062	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,155	369,058
Rubber and Misc. Plastics	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	**1,518,642**	**138,985**	**42,368**	**83,017**	**238,268**	**82,292**
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

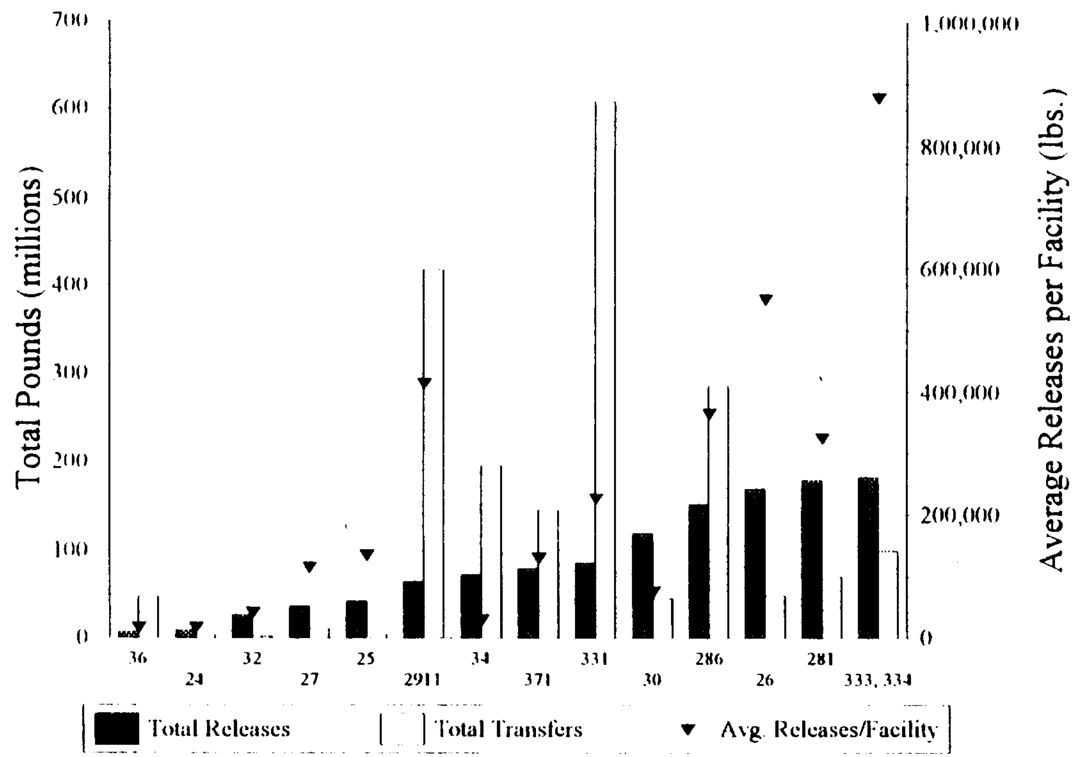
R0075577

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 12 is a graphical representation of a summary of the 1993 TRI data for the iron and steel industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangular points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 13 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the iron and steel industry, the 1993 TRI data presented here covers 381 facilities. These facilities listed SIC 331 (Steel Works, Blast Furnaces, and Rolling and Finishing Mills) as a primary SIC code.

Exhibit 12: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0075579

Exhibit 13: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	1993 TRI Releases: Total Releases (million lbs.)	1993 TRI Releases: Average Releases per Facility (pounds)	1993 TRI Transfers: Total Transfers (million lbs.)	1993 TRI Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (million lbs.)	Average Releases+ Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	42,000	2.2	4,000	28.8	46,000
Lumber and Wood Products	24	491	8.4	17,000	3.5	7,000	11.9	24,000
Furniture and Fixtures	25	313	42.2	135,000	4.2	13,000	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	32,000	46.7	147,000
Electronic Equip. and Components	36	406	6.7	17,000	47.1	116,000	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	75,000	45	29,000	163.4	104,000
Motor Vehicles, Bodies, Parts, and Accessories	371	609	79.3	130,000	145.5	239,000	224.8	369,000
Pulp and Paper	2611-2631	309	169.7	549,000	48.4	157,000	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72	30,000	195.7	83,000	267.7	123,000
Iron and Steel	**331**	**381**	**85.8**	**225,000**	**609.5**	**1,600,000**	**695.3**	**1,825,000**
Nonferrous Metals	333, 334	208	182.5	877,000	98.2	472,000	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting.						
Nonmetal Mining	14	Industry sector not subject to TRI reporting.						
Dry Cleaning	7216	Industry sector not subject to TRI reporting.						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the iron and steel industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Most of the pollution prevention activities in the iron and steel industry have concentrated on reducing cokemaking emissions, Electric Arc Furnace (EAF) dust, and spent acids used in finishing operations. Due to the complexity, size, and age of the equipment used in steel manufacturing, projects that have the highest pollution prevention potential often require significant capital investments. This section describes pollution prevention opportunities for each of the three focus areas (cokemaking, EAF dust, and finishing acids), and then lists some general pollution prevention opportunities that have been identified by the iron and steel industry.

Cokemaking

The cokemaking process is seen by industry experts as one of the steel industry's areas of greatest environmental concern, with coke oven air emissions and quenching waste water as the major problems. In response to expanding regulatory constraints, including the Clean Air Act National Emission Standards for coke ovens completed in 1993, U.S. steelmakers are turning to new technologies to decrease the sources of pollution from, and their reliance on, coke. Pollution prevention in cokemaking has focused on two areas: reducing coke oven emissions and developing cokeless ironmaking techniques. Although these processes have not yet been widely demonstrated on a commercial scale, they may provide significant benefits for the integrated segment of the industry in the form of substantially lower air emissions and wastewater discharges than current operations.

R0075581

Eliminating Coke with Cokeless Technologies

Cokeless technologies substitute coal for coke in the blast furnace, eliminating the need for cokemaking. Such technologies have enormous potential to reduce pollution generated during the steelmaking process. The capital investment required is also significant. Some of the cokeless technologies in use or under development include:

• *The Japanese Direct Iron Ore Smelting (DIOS) process.* This process produces molten iron directly with coal and sinter feed ore. A 500 ton per day pilot plant was started up in October, 1993 and the designed production rates were attained as a short term average. During 1995, the data generated will be used to determine economic feasibility on a commercial scale.

• *HIsmelt process.* A plant using the HIsmelt process for molten iron production, developed by HIsmelt Corporation of Australia, was started up in late 1993. The process, using ore fines and coal, has achieved a production rate of 8 tons per hour using ore directly in the smelter. Developers anticipate reaching the production goal of 14 tons per hour. During 1995, the data generated will be used to determine economic feasibility on commercial scale. If commercial feasibility is realized, Midrex is expected to become the U.S. engineering licensee of the HIsmelt process.

• *Corex process.* The Corex or Cipcor process has integral coal desulfurizing, is amenable to a variety of coal types, and generates electrical power in excess of that required by an iron and steel mill which can be sold to local power grids. A Corex plant is in operation in South Africa, and other plants are expected to be operational in the next two years in South Korea and India.

Reducing Coke Oven Emissions

Several technologies are available or are under development to reduce the emissions from coke ovens. Typically, these technologies reduce the quantity of coke needed by changing the method by which coke is added to the blast furnace or by substituting a portion of the coke with other fuels. The reduction in the amount of coke produced proportionally reduces the coking emissions. Some of the most prevalent or promising coke reduction technologies include:

• *Pulverized coal injection.* This technology substitutes pulverized coal for a portion of the coke in the blast furnace. Use of pulverized coal injection can replace about 25 to 40 percent of coke in the blast furnace, substantially reducing emissions associated with cokemaking operations. This reduction ultimately depends on the fuel injection rate applied to the blast furnaces which will, in turn be dictated by the aging of existing coking facilities, fuel costs, oxygen availability, capital requirements for fuel injection, and available hot blast temperature.

• *Non-recovery coke battery.* As opposed to the by-product recovery coke plant, the non-recovery coke battery is designed to allow combustion of the gasses from the coking process, thus consuming the by-products that are typically recovered. The process results in lower air emissions and substantial reductions in coking process wastewater discharges.

• *The Davy Still Autoprocess.* In this pre-combustion cleaning process for coke ovens, coke oven battery process water is utilized to strip ammonia and hydrogen sulfide from coke oven emissions.

• *Alternative fuels.* Steel producers can also inject other fuels, such as natural gas, oil, and tar/pitch, instead of coke into the blast furnace, but these fuels can only replace coke in limited amounts.

Recycling of Coke By-products

Improvements in the in-process recycling of tar decanter sludge, a RCRA listed hazardous waste (K087) are common practice. Sludge can either be injected into the ovens to contribute to coke yield, or converted into a fuel that is suitable for the blast furnace.

Reducing Wastewater Volume

In addition to air emissions, quench water from cokemaking is also an area of significant environmental concern. In Europe, some plants have implemented technology to shift from water quenching to dry quenching in order to reduce energy costs. However, major construction changes are required for such a solution and considering the high capital costs of coke batteries, the depressed state of the steel industry, and increased regulations for cokemaking, it is unlikely that this pollution prevention opportunity will be widely adopted in the U.S.

Electric Arc Furnace Dust

Dust generation in the EAF, and its disposal, have also been recognized as a serious problem, but one with potential for pollution prevention through material recovery. EAF dust is a RCRA listed waste (K061) because of its high concentrations of lead and cadmium. With 550,000 tons of EAF dust generated annually in the U.S., there is great potential to reduce the volume of this hazardous waste.[27] Steel companies typically pay a disposal fee of $150 to $200 per ton of dust. With an average zinc concentration of 19 percent, much of the EAF dust is shipped off-site for zinc reclamation. Most of the EAF dust recovery options are only economically viable for dust with a zinc content of at least 15 - 20 percent. Facilities producing specialty steels such as stainless steel with a lower zinc content, still have opportunities to recover chromium and nickel from the EAF dust.

In-process recycling of EAF dust involves pelletizing and then reusing the pellets in the furnace, however, recycling of EAF dust on-site has not proven to be technically or economically competitive for all mills. Improvements in technologies have made off-site recovery a cost effective alternative to thermal treatment or secure landfill disposal.

Pickling Acids

In finishing, pickling acids are recognized as an area where pollution prevention efforts can have a significant impact in reducing the environmental impact of the steel mill. The pickling process removes scale and cleans the surface of raw steel by dipping it into a tank of hydrochloric or sulfuric acid. If not recovered, the spent acid may be transported to deep injection wells for disposal, but as those wells continue to close, alternative disposal costs are rising.

Large-scale steel manufacturers commonly recover hydrochloric acid in their finishing operations, however the techniques used are not suitable for small- to medium-sized steel plants.[28] Currently, a recovery technique for smaller steel manufacturers and galvanizing plants is in pilot scale testing. The system under development removes iron chloride (a saleable product) from the hydrochloric acid, reconcentrates the acid for reuse, and recondenses the water to be reused as a rinse water in the pickling process. Because the only by-product of the hydrochloric acid recovery process is a non-hazardous. marketable metal chloride, this technology generates no hazardous wastes. The manufacturer projects industry-wide hydrochloric acid waste reduction of 42,000 tons/year by 2010. This technology is less expensive than transporting and disposing waste acid, plus it eliminates the associated long-term liability. The total savings for a small- to medium-sized galvanizer is projected to be $260,000 each year.

The pilot scale testing project is funded in part by a grant from the U.S. Department of Energy under the NICE[3] program (see section VIII.B. for program information) and the EPA. (Contact: Bill Ives, DOE, 303-275-4755)

To reduce spent pickling liquor (K062) and simultaneously reduce fluoride in the plant effluent, one facility modified their existing treatment process to recover the fluoride ion from rinse water and spent pickling acid raw water waste streams. The fluoride is recovered as calcium fluoride (fluorspar), an input product for steelmaking. The melt shop in the same plant had been purchasing 930 tons of fluorspar annually for use as a furnace flux material in the EAF at a cost of $100 per ton. Although the process is still under development, the recovered calcium fluoride is expected to be a better grade than the purchased fluorspar, which would reduce the amount of flux used by approximately 10 percent. Not only would the generation rate of sludge from spent pickling liquor treatment be reduced (resulting in a savings in off-site sludge disposal costs), but a savings in chemical purchases would be realized.

Other areas with pollution prevention opportunities

Other areas in iron and steel manufacturing where opportunities may exist for pollution prevention are listed below, in three categories: process modifications, materials substitution, and recycling.

Process Modification

Redesigning or modifying process equipment can reduce pollution output, maintenance costs, and energy consumption, for example:

• Replacing single-pass wastewater systems with closed-loop systems to minimize chemical use in wastewater treatment and to reduce water use.
• Continuous casting, now used for about 90% of crude steel cast in the U.S., offers great improvements in process efficiency when compared to the traditional ingot teeming method. This increased efficiency also results in a considerable savings in energy and some reduction in the volume of mill wastewater.

Materials Substitution

• Use scrap steel with low lead and cadmium content as a raw material, if possible.
• Eliminate the generation of reactive desulfurization slag generated in foundry work by replacing calcium carbide with a less hazardous material.

Recycling

Scrap and other materials are recycled extensively in the iron and steel industry to reduce the raw materials required and the associated pollutants. Some of these recycling activities include:
• Recycle or reuse oils and greases.
• Recover acids by removing dissolved iron salts from spent acids.
• Use thermal decomposition for acid recovery from spent pickle liquor.
• Use a bipolar membrane/electrodialytic process to separate acid from metal by-products in spent NO_3-HF pickle liquor.
• Recover sulfuric acid using low temperature separation of acid and metal crystals.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites: however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline. at (800) 424-9346. answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET. excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized approximately forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use

R0075590

classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw material storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities posing a substantial threat of harm to the environment prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). As iron and steel manufacturing is an energy intensive industry, an important requirement affecting iron and steel facilities is oil response plans for above ground storage. There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR Part 112) and for PCB transformers and PCB-containing items are being revised and finalized in 1995.[29]

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

R0075593

The SDWA **Underground Injection Control** (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control

Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET. excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT)." The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide nitrous oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.
Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2,000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Regulatory Requirements

The steel industry has invested substantial resources in compliance with environmental regulations. Expenditures for environmental air control totaled $279 million in 1991, while water and solid waste control combined totaled $66 million. This translates to 15 percent of total capital expenditures for the industry in 1991. The high percentage of total environmental capital expenditures for air control (81 percent) is primarily due to keeping coke ovens operating in compliance with the Clean Air Act. Although coke ovens are considered by many industry experts to be the biggest environmental problem of the iron and steel industry, environmental regulations affect the industry throughout all stages of the manufacturing and forming processes. An overview of how federal environmental regulations affect this industry follows.

Clean Air Act (CAA)

The CAA, with its 1990 amendments (CAAA), regulates the pollutants that steel mills can add to the air. Title I of the Act addresses requirements for the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS) (40 CFR, §50). EPA has set NAAQS for six criteria pollutants, which states must plan to meet through state implementation plans (SIPs). NAAQS for nitrogen dioxide, lead, and particulate matter frequently affect the iron and steel industry.

One of the most significant impacts of the CAAA on the iron and steel industry is tied to the standards developed for toxic air emissions or Hazardous Air Pollutants (HAPs). For the steel industry, these standards, National Emission Standards for Hazardous Air Pollutants (NESHAPs), have a significant effect on the industry's coke ovens. In late 1991, the coking industry entered into a formal regulatory negotiation with EPA and representatives of environmental groups, state and local air pollution control agencies, and the steelworkers union to develop a mutually acceptable rule to implement the terms of the Act's coke oven provisions. After a year of discussions, an agreement on a negotiated rule was signed. In exchange for a standard that is structured to give operators certainty and flexibility in the manner they demonstrate compliance, the industry agreed to daily monitoring, to install flare systems to control upset events, and to develop work practice plans to minimize emissions. National Emissions Standards currently in effect that pertain to the iron and steel industry include:

- Coke Oven Batteries (40 CFR §63 Subpart L). As of April 1, 1992, there were 30 plants with 87 by-product coke oven batteries that would be affected by this regulation.

- Benzene Emissions from Coke By-product Recovery Plants (40 CFR §61 Subpart L). Regulates benzene sources in coke by-product recovery operations by requiring that specified equipment be enclosed and the emissions be ducted to an enclosed point in the by-product recovery process where they are recovered or destroyed. Monitoring requirements are also stated.

- Halogenated Solvent Cleaning (40 CFR §63 Subpart T). Emission standards for the source categories listed in §112(d), including solvents used in the iron and steel industry such as 1,1,1-trichloroethane, trichloroethylene, and methylene chloride.

- Chromium - Industrial Process Cooling Towers (40 CFR §63 Subpart Q). This standard will eliminate chromium emissions from industrial process cooling towers. Industrial process cooling towers using chromate-based water treatment programs have been identified as potentially significant sources of chromium air emissions: chromium compounds being among the substances listed as HAPs in §112(e).

The CAA also impacts the minimill segment of the industry. The Electric Arc Furnace was identified as a possible source of hazardous air pollutants subject to a MACT determination, however. EPA data indicates that the impact is much less than originally anticipated and there are currently no plans for establishing a MACT standard.

The 1990 CAAA New Source Review (NSR) requirements apply to new facilities, expansions of existing facilities, or process modifications. New sources of the "criteria" pollutants regulated by the NAAQS in excess of levels defined by EPA as "major" are subject to NSR requirements (40 CFR Section 52.21(b)(1)(i)(a)-(b)). NSRs are typically conducted by the state agency under standards set by EPA and adopted by the state as part of its state implementation plan (SIP). There are two types of NSRs: Prevention of Significant Deterioration (PSD) reviews for facilities in areas that are meeting the NAAQS, and Nonattainment (NA) reviews for areas that are violating the NAAQS. Permits are required to construct or operate the new source for PSD and NA areas.

For NA areas, permits require the new source to meet the lowest achievable emission rate (LAER) standards and the operator of the new source must procure reductions in emissions of the same pollutants from other sources in the NA area in equal or greater amounts to the new source. These "emission offsets" may be banked and traded through state agencies.

For PSD areas, permits require the best available control technology (BACT), and the operator or owner of the new source must conduct continuous on-site air quality monitoring for one year prior to the new source addition to determine the effects that the new emissions may have on air quality. This one year waiting period before construction can be disruptive to some mills' expansion plans. In several cases, mills looking to construct or expand have attempted to be reclassified as a "synthetic minor," where they ask the state to put tighter restrictions on their quantity of emissions allowed on their air permit. With these reduced emissions, they become a minor instead of a major source, thereby becoming exempt from the lengthy and expensive PSD review.

EPA sets the minimum standards for LAER and BACT for iron and steel mill NSRs in its new source performance standards (NSPS), 40 CFR 60:

- Standards of Performance for Steel Plants: Electric Arc Furnaces (40 CFR §60, Subpart AA). Regulates the opacity and particulate matter in any gases discharged from EAFs constructed after October 21, 1974 and on or before August 17, 1983. Also requires a continuous monitoring system for the measurement of the opacity of emissions discharged from control equipment.

- Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels (AODs) (40 CFR §60.

Subpart AAa). Regulates the opacity and particulate matter in any gases discharged from EAFs and AODs (used to blow argon and oxygen or nitrogen into molten steel for further refining) constructed after August 7, 1983. Also requires a continuous monitoring system for the measurement of the opacity of emissions discharged from EAF and AOD air pollution control equipment.

- Standards of Performance for Primary Emissions from Basic Oxygen Process Furnaces (BOPF) (40 CFR §60, Subpart N). Regulates the discharge of gases for particulate matter and opacity. These standards apply to BOPFs for which construction is commenced after June 11, 1973. Primary emissions refer to particulate matter emissions from the BOPF generated during the steel production cycle and captured by the BOPF primary control system.

- Standards of Performance for Secondary Emissions from Basic Oxygen Process Steelmaking Facilities (40 CFR §60, Subpart Na). Regulates the discharge of gases for particulate matter and opacity for BOPFs for which construction is commenced after January 20, 1983. Secondary emissions means particulate matter emissions that are not captured by the BOPF primary control system.

Clean Water Act (CWA)

The steel industry is a major water user and 40 CFR 420 established Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. These are implemented through the NPDES permit program and through state and local pretreatment programs. Part 420 contains production-based effluent limitations guidelines and standards, therefore steel mills with higher levels of production will receive higher permit discharge allowances. The regulation contains 12 subparts for 12 distinct manufacturing processes:

A. Cokemaking	G. Hot Forming
B. Sintering	H. Salt Bath Descaling
C. Ironmaking	I. Acid Pickling
D. Steelmaking	J. Cold Forming
E. Vacuum Degassing	K. Alkaline Cleaning
F. Continuous Casting	L. Hot Coating

The pollutants regulated by 40 CFR 420 are divided into three categories:

1. *Conventional Pollutants:* Total Suspended Solids, Oil and Grease, pH
2. *Nonconvention Pollutants:* Ammonia-N, Phenols
3. *Priority or Toxic Pollutants:* Total cyanide, total chromium, hexavalent chromium, total lead, total nickel, total zinc, benzene, benzo(a)pyrene, naphthalene, tertrachloroethylene.

Wastewater is often recycled "in-plant" and at the "end-of-pipe" to reduce the volume of discharge. Process wastewater is usually filtered, and/or clarified on-site before being directly or indirectly discharged. Oil and greases are removed from the process wastewater by several methods which include oil skimming, filtration, and air flotation. These oils can then be used as lubricants and preservative coatings. The remaining sludge contains waste metals and organic chemicals. Iron in the sludges can be recovered and reclaimed through sintering and pelletizing operations. Many steel mills discharge industrial waste water through sewers to publicly owned treatment works.

The Storm Water Rule (40 CFR 122.26(b)(14) subparts (i, ii)) requires the capture and treatment of storm water at primary metal industry facilities including iron and steel manufacturing. Management of storm water will reduce discharges with respect to conventional pollutants (suspended solids and biological oxygen demand (BOD)), as well as other pollutants, such as certain metals and oil and grease.

Resource Conservation and Recovery Act (RCRA)

Several RCRA-listed wastes are produced during coke, iron, and steelmaking, forming, and cleaning/descaling operations. These wastes are identified below by process.

Coke Manufacturing

- Tar residues (K035, K087, K141, K142, and K147)
- Oil (K143 and K144)
- Naphthalene residues (K145)
- Lime sludge (K060)
- Wastewater sump residues containing benzene and polynuclear aromatic hydrocarbons (K144)
- Coke oven gas condensate from transfer and distribution lines

Iron and Steel Manufacturing

- EAF emission control dust and sludge (K061). Annually, 550,000 short tons of K061 are produced; 90 percent of this waste (500,000 short tons) is managed for metal recovery.[29]

Finishing

- Wastewater sludge from cooling, descaling, and rinsing (D006, D007, D008, D009, D010, and D011)
- Spent pickle liquor (K062). An exemption for this waste is detailed in 40 CFR 261.3(c)(2)(ii)(A). 904,945 short tons of K062 are generated annually in the U.S. and 52 percent of this waste is managed for recovery of iron, chromium, and nickel.[30]

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The metals and metal compounds used in steelmaking, as well as steelmaking process chemicals, are often found in steel mills' air emissions, water discharges, or waste shipments for off-site disposal include chromium, manganese, nickel copper, zinc, lead, sulfuric acid, and hydrochloric acid. Metals are frequently found at CERCLA's problem sites. When Congress ordered EPA and the Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR) to list the hazardous substances most commonly found at problem sites and that pose the greatest threat to human health, lead, nickel, and aluminum all made the list.[31] Several sites of former steel mills are on the National Priorities List. Compliance with the requirements of RCRA lessens the chances that CERCLA compliance will be an issue in the future.

VI.C. Pending and Proposed Regulatory Requirements

The iron and steel industry has been identified in the Source Reduction Review Project (SRRP) as an industry for which a more integrated (across environmental media) approach to rulemaking is warranted. Efforts such as the Office of Water's review of the need for revised effluent guidelines for the industry (described below) and the technology-based standards for coke oven emissions under the Clean Air Act Amendments will be coordinated among several media offices.

Clean Air Act

Even with the flexibility the industry gained through the formal negotiations to develop the rule to implement the coke oven provisions of the CAA, coke-producing steel companies face difficult decisions of how best to utilize scarce capital to meet the CAAA standards. Additionally, coke oven operators still face unknown technology-based standards in 2010 and risk-based standards in 2020.

The Act's air toxic provisions will also ultimately have other major impacts. Included on the list of chemicals under the air toxics program are compounds of chromium, nickel, manganese, cadmium and other heavy metals. Because many of these metals are routinely found in iron ore, scrap, and alloying materials that are processed in iron and steel plants, most steelmaking processes will be affected in some way. EPA's priority list of source categories calls for the development of regulations for most of these sources by 2000, but until EPA identifies the technology corresponding to MACT for these sources and promulgates regulations, it is difficult to determine the additional impacts and costs to the industry for this program.

Tightening the national ambient air quality standard for particulate matter (PM-10) may also affect the iron and steel industry. Under the CAAA, EPA will be reviewing the basis for the existing ambient air PM-10 standard. A lower standard may cause more areas of the country to be classified as non-attainment areas and would trigger requirements for states to impose much more stringent emission control standards for sources of particulate matter. including iron and steel sources.

Hydrochloric acid and chlorine are among the pollutants listed as hazardous air pollutants in §112 of the CAAA. Steel pickling processes that use hydrochloric acid have been identified by the EPA as potentially significant sources of hydrochloric acid and chlorine air emissions and, as such, a source category for which national emission standards are likely. EPA is expected to make a determination on the steel pickling process sometime in 1995, with the final rule promulgation scheduled for 11/96. Many facilities either are already in compliance, or they have the required control equipment, but need to upgrade it or perform maintenance procedure to come into compliance. (Contact: James Maysilles, EPA Office of Air Quality Planning and Standards, 919-541-3265).

Title III of the CAAA, requires EPA to develop national emission standards for hazardous air pollutants (NESHAP) from specific stationary sources including iron and steel mills (contact: Phil Murine, EPA Office of Air Quality Planning and Standards, 919-541-5289) and iron and steel foundries (contact: James Maysilles, EPA Office of Air Quality Planning and Standards, 919-541-3265). Both of these types of facilities have been identified by the EPA as potentially significant sources of air emissions of substances that are among the pollutants listed as hazardous air pollutants in §112 of the CAAA. As such, these industries may be source categories for which national emission standards may be warranted. In integrated iron and steel mills, air emission of HAPs may include compounds of chromium, lead, manganese, and polycyclic organic matter, in quantities sufficient to designate these facilities as major sources. Emission standards were to be developed for Electric Arc Furnaces also. However, EPA data does not show that EAFs emit sufficient hazardous pollutants to include them on the list of major sources of these pollutants. Therefore, a proposed regulatory action is scheduled to remove this category from the list of sources where new regulations will be promulgated.

Other, more general, proposed regulatory actions under the CAA have an effect on some facilities within the iron and steel industry. These include:

• Risk Management Program for Chemical Accidental Release Prevention (40 CFR 68). Requires facilities where a regulated substance is present (defined by the list, with threshold quantities, promulgated under §112(r)(3)) to prepare and implement a risk management plan and provide emergency response. The final rule will be promulgated by 3/29/96.

• New Source Review Reform (40 CFR 51, 52). This action will amend the new source review regulations to reduce the level of program complexity. The final rule will be promulgated 1/96.

R0075602

• Revised New Source Performance Standard for NOx (40 CFR 60, Subpart Db). Revisions apply to NOx emissions from fossil fuel-fired steam generating units, including industrial boilers and must reflect improvements in NOx reduction methods. The final rule will be promulgated by 12/31/96.

• Title V Federal Air Operating Permit Rules (40 CFR 70 and 71). Sets requirements for state permitting programs for major stationary air pollutants. Also establishes a federal permitting program for use where states fail to establish or implement an adequate program. The final rule will be promulgated by 11/95.

• Title V State Air Operating Permit Rules (40 CFR 70). Revisions of the state operating permit rules promulgated in 1992. This regulation is intended to restructure the process for issuing and revising permits, to give state agencies more flexibility. States will be allowed to issue a single permit covering both New Source Review and Title V permitting requirements.

Clean Water Act (CWA)

Since approximately 80 percent of the nation's integrated steelmaking capacity is located in the Great Lakes states, the current efforts to develop uniform water quality standards under the Great Lakes Water Quality Initiative may have a significant impact on the industry. According to the American Iron and Steel Institute (AISI), the industry is concerned with the establishment of uniform water quality guidance for all waters. AISI believes that states should be given the responsibility of designating uses and associated water quality standards for all water bodies within their jurisdictions. These designations, AISI believes, should take into account the feasibility of the attainment of swimmable and fishable waters where naturally occurring pollutants prevent its attainment, where pollution sources prevent attainment and correction of these sources would cause more environmental harm than good, or where attainment would result in unreasonable social and economic impacts. AISI concludes that requiring discharges of non-contact cooling water to be cleaner than when drawn from the stream or lake, while at the same time disregarding the water quality impacts of non-point sources such as urban or agricultural runoff, will impose huge costs, restrict growth, or force zero discharge on direct dischargers. By March 23, 1997, the Great lakes states (Illinois, Indiana, Michigan, Minnesota, New York, Pennsylvania, Ohio, and Wisconsin), as well as tribes in the area, must adopt rules and procedures consistent with the Water Quality Guidance for the Great Lakes System (40 CFR 132; also amends 122, 123, and 131). The Guidance places particular emphasis on decreasing bioaccumulative toxics and also provides a process for addressing both point and non-point source pollution.

The EPA is currently revisiting the CWA Effluent Guidelines and Standards for Iron and Steel Manufacturing Point Source Category. A two-year study is scheduled to be completed in late 1995 which reviews the existing regulations to determine what changes have been made in the industry since the 1982 regulations were promulgated. One focus of the project is to investigate the types of pollution prevention measures that have been implemented. The study was initiated as a result of a Natural Resources Defense Council (NRDC) consent decree. (Contact: George Jett, EPA Office of Water, 202-260-7151).

The Office of Water is also initiating a 3-year data collection and analysis effort (which began in 1994) to quantify the adverse impacts from cooling water intake structures and the efficacy of certain control mechanisms. Regulatory options will be developed and a regulation proposed based on the study results. This regulation may have a relatively significant impact on the iron and steel industry.

Resource Conservation and Recovery Act (RCRA)

Under RCRA, emission control dust and sludge from electric arc furnaces (EAF) are a listed hazardous waste (K061) and are subject to land disposal restrictions. This pollution control dust/sludge is composed of various metals: primarily iron with lesser concentrations of zinc, lead, cadmium, and sometimes nickel and chromium. The metals primarily recovered are iron or nickel alloys or zinc. Two or the primary hazardous constituents, lead and cadmium, are not initially recovered, although they are usually shipped off-site for further recovery. Annually, 550,000 short tons of K061 are produced; 90 percent of this waste (500,000 short tons) is managed for metal recovery.[32] EPA's treatment standards were originally based on high temperature metals recovery, but were recently revised to generic treatment levels. As a result, a generator may select one of a variety of options, including stabilization, as alternatives to recycling. Other recovery alternatives include: use as a fertilizer ingredient, use an ingredient in glass grit for abrasive blast, roofing shingles, glass ceramic or ceramic glaze, use as an ingredient in the production of cement, use as an ingredient in the production of special aggregates.[33]

Such recovery practices reduce the quantity of hazardous waste disposed of, however, the industry is concerned with the limitations that are placed on the disposal or uses of non-hazardous residuals from the high temperature metals recovery processes that might serve to discourage or inhibit metal recovery practices. According to several steel industry trade associations (SMA, SSINA, AISI), RCRA has discouraged metal recovery from hazardous wastes generated in steel production. For example, the derived-from rule has discouraged investment in on-site or regional recycling operations because of the additional cost of residual management. The trade associations also state that the lack of adequate metal recovery capacity in the U.S. requires their members to spend an average of $650,000 annually in transportation costs to ship K061 off-site, and a total of $1.4 million annually to recycle K061.[34] Other RCRA impediments stated by the trade associations include the 90-day storage limit for generators, and corrective action/financial assurance.

As part of a 1992 settlement agreement, EPA has agreed to propose (by June 30, 1995) and promulgate (by June 30, 1996) regulations for land disposal restrictions on mineral processing wastes. These regulations will set land disposal restrictions and standards for those mineral processing wastes that are found to be hazardous under RCRA Subtitle C. Currently, all extraction and beneficiation wastes, as well as 20 mineral processing wastes, are exempt from federal hazardous waste regulations.

Under a proposed regulation, "Hazardous Waste Management System: Amendment to Generic Exclusion for Encapsulated Uses (K061, K062, F006)," (40 CFR 261), the slags created from the treatment of pollution control dusts resulting from scrap metal recycling (i.e., electric arc furnace dust), will be reclassified as nonhazardous and be allowed for road-related uses if the toxic metals in the wastes have been reduced to safe levels by treatment. The final rule will be promulgated by 6/13/96.

Also under RCRA Subtitle C (40 CFR 261), the "Hazardous Waste Identification Rule" will be proposed in 1995 to allow listed wastes which are low risk to be removed from the hazardous waste regulatory scheme. This rule is intended to better align the burden of RCRA regulation with the risks being controlled.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Steel companies involved in Superfund sites would be affected by changes under impending CERCLA reauthorization. Questions of liability, funding mechanisms, selection of remedial actions, and application of risk concepts are all of concern to the steel industry.

Safe Drinking Water Act (SDWA)

The 1986 SDWA amendments required EPA to complete a study of Class V underground injection wells. These are all wells not included in Classes I through IV; they vary from simple septic systems and shallow cesspools to deep, technically sophisticated wells with a wide range of environmental impacts. As a follow up to the study, EPA developed a strategy to assess whether additional controls of these wells would be appropriate. A proposed regulation on Class V wells is being developed as part of this strategy and could potentially affect some iron and steel facilities. Final rule promulgation is scheduled for 11/96.

Global Climate Change

Legislative initiatives that address global climate change will also affect the iron and steel industry. Steel is a highly energy intensive industry, where 15 to 20 percent of the manufacturing cost of steel is for energy. Most of that energy is derived from coal, principally in the form of coke. Consequently, a carbon tax could have a major impact on the steel industry. While such a tax is designed to reduce carbon dioxide emissions and to curb energy consumption, industry analysts expect such a tax would also results in 177,000 to 362,000 job losses across the country, according to Wilbur Steger, president of CONSAD Research Corp., as reported in the March 1993 issue of *Iron Age*.

Increasing the corporate average fuel economy (CAFE) of automobiles has been identified as a means of encouraging energy conservation and reducing carbon dioxide emissions. An increase in fuel economy standards may lead to downsizing automobiles, which will affect steel markets by reducing demand for certain steel products.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[d] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System,

[d] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

R0075608

Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1).

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

R0075609

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Reported inspections and enforcement actions under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

R0075610

VII.A. Iron and Steel Industry Compliance History

Exhibit 14 provides an overview of the reported compliance and enforcement data for the iron and steel industry over the past five years (August 1990 to August 1995). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Eighty-five percent of iron and steel facility inspections occurred in Regions III, IV, and V, where the most facilities are located.

- Within the three regions where iron and steel mills are concentrated. the proportion of state-lead enforcement actions was significantly greater than federal action for Regions III and IV (87% state-lead and 91% state-lead, respectively). In Region V, the region with the greatest number of iron and steel facilities, enforcement actions were fairly evenly split between state-lead and federal-lead.

- Of the 275 facilities inspected over the five-year period examined. 115 had one or more enforcement actions (42%), however, the aggregate Enforcement to Inspection Rate across all Regions was 0.14 (499 enforcement actions/3,555 inspections).

R0075611

Exhibit 14: Five-Year Enforcement and Compliance Summary for Iron and Steel

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	17	11	37	28	6	9	78%	22%	0.24
II	23	19	184	8	8	21	76%	24%	0.11
III	79	68	962	5	26	135	87%	13%	0.14
IV	59	46	907	4	24	133	87%	13%	0.15
V	135	92	1,143	7	36	98	48%	52%	0.09
VI	32	21	185	10	7	59	39%	61%	0.32
VII	10	7	43	14	2	7	14%	86%	0.16
VIII	5	3	29	10	2	6	83%	17%	0.21
IX	11	6	23	29	3	21	100%	0%	0.91
X	3	2	42	4	1	10	50%	50%	0.24
TOTAL	374	275	3,555	6	115	499	72%	28%	0.14

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 15 and 16 allow the compliance history of the iron and steel sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Exhibits 15 and 16 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past year. Some points evident from the data are listed below.

- Of those sectors listed, facilities in iron and steel sector have been one of the most frequently inspected industries over the past five years with an average of 6 months between inspections. Only petroleum refining and pulp and paper facilities were inspected, on average, more frequently.

- Over the past year, the enforcement to inspection rate for the iron and steel industry has decreased from 0.14 for 1990 through 1995 to 0.09 for August 1994 through August 1995.

Exhibits 17 and 18 provide a more in-depth comparison between iron and steel industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Exhibits (Exhibits 15 and 16), the data cover the last five years (Exhibit 17) and the last one year (Exhibit 18) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- The percentage of inspections carried out under each environmental statute has changed little between the average of the past five years and that of the past year. Inspections are roughly divided equally among, CAA, CWA, and RCRA, although the past year has shown a slight increase in the percentage of CAA inspections and a slight decrease in the percentage of RCRA inspections.

- While approximately one-third of inspections are carried out under each statute (CAA, CWA, and RCRA), the majority of the enforcement actions are taken under RCRA.

R0075613

Exhibit 15: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	**374**	**275**	**3,555**	**6**	**115**	**499**	**72%**	**28%**	**0.14**
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-Metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Nonferrous Metal	844	474	3,097	16	145	470	76%	24%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11

Exhibit 16: One-Year Inspection and Enforcement Summary for Selected Industries

A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	**374**	**167**	**488**	**165**	**99%**	**20**	**12%**	**46**	**0.09**
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	104%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10

* Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 17: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspection	% of Total Actions
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	298	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	**275**	**3,555**	**499**	**32%**	**20%**	**30%**	**18%**	**37%**	**58%**	**2%**	**5%**
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	0%	1%
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	0%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay, and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%

Exhibit 18: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	0%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	0%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	0%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	437	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	**167**	**488**	**46**	**29%**	**18%**	**35%**	**26%**	**36%**	**50%**	**0%**	**6%**
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	0%	7%
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	0%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	0%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	0%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	0%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	0%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	0%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	0%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%

R0075617

VII.C. Review of Major Legal Action

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

VII.C.1. Review of Major Cases

The Office of Regulatory Enforcement does not regularly compile information related to major cases and pending litigation within an industry sector. The staff are willing to pass along such information to Agency staff as requests are made. (Contact: Pete Rosenberg 202-260-8869) In addition, summaries of completed enforcement actions are published each fiscal year in the *Enforcement Accomplishments Report*; the summaries are not organized by industry sector. (Contact: Robert Banks 202-260-8296).

VII.C.2. Supplementary Environmental Projects (SEPs)

Supplemental environmental projects (SEPs) are enforcement options that require the non-compliant facility to complete specific projects. Regional summaries of SEPs undertaken in the 1993 and 1994 federal fiscal years were reviewed. Three projects were undertaken that involved iron and steel facilities, as shown in Exhibit 19.

In the iron and steel sector, SEPs resulted from violations of EPCRA, CERCLA, and RCRA. Due to differences in regional descriptions, the specifics of the original violations are not known. The cost for the projects ranged from $53,000 to $900,000 corresponding to initial penalties ranging from $110,000 to $746,438.

R0075618

Exhibit 19: FY-1993-1994 Supplemental Environmental Projects Overview: Iron and Steel Manufacture

General Information				Violation Information					Pollution Reduction		
FY	Docket #	Company Name	State/ Region	Type	Initial Penalty	Final Penalty	SEP Credit	SEP Cost to Company	Pollutant Concern	Pollutant Reduction	Supplemental Environmental Project Description
93	---	Inland Steel Co.	IN	EPCRA 313	$260,000	$100,000	---	$165,000	Perchloro-ethylene	200,000 lbs/yr	Parts cleaning process modified by replacing perchloroethylene with a non-toxic
93	---	Follansbee Steel Division of the Louis Berkman Company	WV	CERCLA	$110,000	$72,250	$17,250	$53,000	Zinc compounds Sulfuric Acid	500 to 1,000 lb/yr air, 40,000 lb/yr zinc (100%)	Zinc preflux process eliminated and sulfuric acid spillage control installed
94	---	Indiana Steel and Wire/G.K. Technologies	IN	RCRA	$746,438	$425,000	---	$900,000	Ammonia	---	Will eliminate ammonia emissions through conversion of zinc plating line bath to eliminate the use of anhydrous ammonia

Violation Information Terms
Initial penalty: Initial proposed cash penalty for violation
Final penalty: Total penalty after SEP negotiation
SEP credit: Cash credit given for SEP so that, Final penalty - SEP credit = Final cash penalty
SEP cost to company: Actual cost to company of SEP implementation

NOTE: Due to differences in terminology and level of detail between regional SEP information, in some cases the figure listed as Final penalty may be the Final cash penalty after deduction for SEP credit

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

Common Sense Initiative

The EPA's Common Sense Initiative (CSI) was announced in November of 1993 to encourage pollution prevention in a few pilot industrial sectors including: iron and steel, electronics, metal plating and finishing, automobiles, printing, and oil refining. The program shifts regulatory focus from concentrating on individual toxic chemicals and media, to industry-wide approaches to environmental problems. A subcommittee will be formed for each industry and a strategic plan will be drawn up to identify opportunities to coordinate rulemaking, to streamline record-keeping and permitting requirements, and to identify innovative approaches in pollution prevention and environmental technology. For the iron and steel industry, a subcommittee has been formed and four workgroups have been established. The workgroups include representatives from industry, EPA (federal and regional), state environmental agencies, public interest groups, trade associations, and research institutions. The iron and steel CSI workgroups include: Innovative Technology, Permits Process, Compliance, and Brownfields. Projects proposed by each of the workgroups are subject to approval by the subcommittee. Project approval is expected in May, 1995. Common Sense Initiative contacts at EPA are:

Designated Federal Official (EPA Office of Water):
Mahesh Podar, 202-260-5387

Subcommittee Co-Chair (EPA Office of Water):
Bob Perciasepe, 202-260-5700

Subcommittee Co-Chair (EPA Region V):
Dave Ullrich, 312-886-3000

OECA contact (Compliance Workgroup):
Maria Malave, 202-564-7027

OECA contact (Permits Process Workgroup):
Mike Calhoun, 202-564-6031

R0075620

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of seventeen chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33% as of 1992 and by 50% as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given out to participants meeting their 1992 goals. The list of chemicals includes seventeen high-use chemicals reported in the Toxics Release Inventory. Exhibit 20 lists those companies participating in the 33/50 program that reported the SIC code 331 to TRI. Many of the companies shown listed multiple SIC codes and, therefore, are likely to carry out operations in addition to the iron and steel industry. The SIC codes reported by each company are listed in no particular order. In addition, the number of facilities within each company that are participating in the 33/50 program and that report SIC 331 to TRI is shown. Finally, each company's total 1993 releases and transfers of 33/50 chemicals and the percent reduction in these chemicals since 1988 are presented.

Thirteen of the seventeen target chemicals are used in the iron and steel industry. Of all TRI chemicals released by the iron and steel industry, chromium and chromium compounds, a 33/50 target chemical, were released most frequently (from 347 facilities), and were the third greatest volume. Other target chemicals that were in the top ten TRI releases by volume and by number of facilities reporting that chemical released were nickel and nickel compounds, lead and lead compounds, and 1,1,1-trichloroethane. Approximately twelve percent of eligible iron and steel companies are currently participating in the program. Exhibit 20 shows that 49 companies comprised of 115 facilities reporting SIC 331 are participating in the 33/50 program. (Contact: Mike Burns 202-260-6394 or 33/50 Program 202-260-6907).

Exhibit 20: SIC 331 Facilities Participating in the EPA's 33/50 Program

Parent Company	City, State	SIC Codes Reported	Number of Participating Facilities	1993 Releases and Transfers (lbs)	% Reduction 1988 to 1993
Acme Metals Inc.	Riverdale, IL	3312, 3499, 3479	3	157.232	38
Allegheny Ludlum Corporation	Pittsburgh, PA	3312	8	1.031.164	*
American Cast Iron Pipe Co.	Birmingham, AL	3322, 3317, 3325	1	315.184	25
Ameron Inc Delaware	Pasadena, CA	3272, 3317, 3443	1	184.882	**
Amsted Industries Incorporated	Chicago, IL	3315, 3496, 3471	1	1.834.493	66
Armco Inc.	Pittsburgh, PA	3312	11	1.849.709	4
Armco Steel Company L.P.	Middletown, OH	3312	2	159.944	*
Avesta Sheffield Holding Co.	New Castle, IN	3312	1	27.025	99
Bayou Steel Corporation	La Place, LA	3312	1	1.892	98
Bethlehem Steel Corporation	Bethlehem, PA	3312	9	792.550	50
Cargill Detroit Corporation	Clawson, MI	3312	8	717.558	31
Carpenter Technology Corp.	Reading, PA	3312	1	57.155	86
CF&L Steel Corp.	Pueblo, CO	3312	1	308.892	50
Commercial Metals Company	Dallas, TX	3312	3	36.457	47
Contran Corporation	Dallas, TX	3312, 3315	1	735.655	50
Cooper Industries Inc.	Houston, TX	3462, 3317	1	1.048.465	75
CSC Industries Inc.	Warren, OH	3312	1	8.808	50
Emerson Electric Co.	Saint Louis, MO	3469, 3315	1	2.140.497	50
First Mississippi Corporation	Jackson, MS	3312	1	200,977	***
Ford Motor Company	Dearborn, MI	3312	1	15.368.032	15
Geneva Steel	Orem, UT	3312, 3317, 3325	1	12.448	***
Inland Steel Industries Inc.	Chicago, IL	3312, 3274	1	733.786	48
J & L Specialty Steel Inc.	Pittsburgh, PA	3312	2	669.309	100
Kanthal Furnace Prods.	Bethel, CT	3315, 3316, 3357	1	21.581	41
Katy Industries Inc.	Englewood, CO	3316, 3351, 3353	1	82.256	52
Kerr-Mcgee Corporation	Oklahoma City, OK	2819, 3313	1	374.098	35
LTV Steel Co. Inc.	Cleveland, OH	3312	7	612.924	60
Lukens Inc.	Coatesville, PA	3312	4	312.442	14
Naco Inc.	Lisle, IL	3313	1	71.800	***
National Steel Corporation	Mishawaka, IN	3312	2	682.386	50
Olin Corporation	Stamford, CT	3351, 3316, 3356	1	574.673	70
Oregon Steel Mills Inc.	Portland, OR	3312, 3295	1	14.533	12
Plymouth Tube Company	Warrenville, IL	3499, 3317	1	76.694	*
Renco Group Inc.	New York, NY	3312	2	204.629	7
Republic Engineered Steels	Massillon, OH	3312	4	193.662	3
Roanoke Electric Steel Corp.	Roanoke, VA	3312	1	476	***

Exhibit 20: SIC 331 Facilities Participating in the EPA's 33/50 Program

Parent Company	City, State	SIC Codes Reported	Number of Participating Facilities	1993 Releases and Transfers (lbs)	% Reduction 1988 to 1993
S K W Alloys Inc.	Niagara Falls, NY	3313	1	7,777	*
Slater Steels Corporation	Fort Wayne, IN	3312	1	22,205	50
Swva Inc.	Huntington, WV	3312	1	43,405	27
Talley Industries Inc.	Phoenix, AZ	3312	1	3,804	***
Texas Industries Inc.	Dallas, TX	3312	1	20,964	*
Thomas Steel Strip Corp.	Warren, OH	3471, 3316	1	6,839	50
Timken Co.	Canton, OH	3312	5	278,695	30
Toledo Coke Corporation	Toledo, OH	3312	1	18	90
USS Posco Industries	Pittsburg, CA	3312	1	182,431	56
USX Corporation	Pittsburgh, PA	3312	6	1,510,772	25
Walter Industries Inc.	Tampa, FL	3312	1	859,751	***
Weirton Steel Corporation	Weirton, WV	3312	1	183,497	**
Wheeling-Pittsburgh Corp.	Wheeling, WV	3312	6	560,055	66
Total			115		

* = not quantifiable against 1988 data.
** = use reduction goal only.
*** = no numerical goal.

Source: U.S. EPA, Toxics Release Inventory, 1993.

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and state agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentor programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. In the iron and steel industry, one company (California Steel of Fontana, California) submitted a proposal. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023.)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; federal, state and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at 202-233-9065 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, 202-260-0700 or the

WasteWi$e Hotline at 1-800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, 202-260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. The program has worked with the iron and steel industry to evaluate the feasibility of an on-site hydrochloric acid recovery system for galvanizers and small- to medium-sized steel manufacturers. (Contact: Bill Ives at DOE's Golden Field Office, 303-275-4755)

VII.B. EPA Voluntary Programs

Strategies for Pulp & Paper and Steel Industries

The U.S. Department of Energy is examining the relationships between productivity, energy efficiency and environmental compliance in the pulp & paper and steel industries. Productivity and energy efficiency investments often complement each other, but can conflict with end-of-pipe emission control projects designed to reduce regulated pollutants. By sponsoring this project, the DOE seeks to better understand such conflicts and use this information to help identify ways DOE and other federal agencies can help industry meet mutual goals in these important areas. The project consists of two phases: 1) industry field consultations will be conducted to discuss and clarify the issues; and 2) quantitative analysis will evaluate the interplay between productivity, energy efficiency, and pollution abatement investments. (Contact: Jeff Dowd at 202-586-7258)

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Industry Research Programs

Without technological changes, the requirements of the Clean Air Act affecting coke ovens may force the shutdown of many facilities. To avoid possible facility closings, the industry is actively investigating alternatives to the conventional coke-oven/blast furnace method of making iron. One promising technology, the direct steelmaking project which was jointly funded by the American Iron and Steel Institute (AISI) and the U.S. Department of Energy (DOE), concluded on March 31, 1994. This technology reduces, melts, and refines iron in a single reactor. An opt-in. DOE cost-sharing program for the smelting of steel plant waste oxides began on April 1, 1994. Based on the success of recent trials, and the further knowledge that was gained from this follow-on program, the technology is now well understood and fully developed. A feasibility study for a demonstration plan is being developed. Under a related project, the AISI and member companies are working with the U.S. Bureau of Mines on a jointly funded research project to improve the dewatering of a variety of steel plant sludges. Currently, the sludges contain too much moisture to permit economic recycling to recover metal values. (Contact: Dave Rice 801-584-4130).

Another cokeless ironmaking technology, called the Cipcor or Corex process, eliminates the need for a coke plant, has integral coal desulfurizing, is amenable to a variety of coal types, and produces a gas that can be used to fire a cogeneration plant. This project will begin in 1995; capital outlays are expected to reach $800 million. Under the DOE Clean Coal Technology Demonstration Program, the Corex construction project may receive a $150 million grant. For more information on the DOE project, contact J. Lee Bailey (216) 447-3235.

Instead of eliminating coke production, two research projects run by Bethlehem Steel are focused on reducing coke process emissions. The Sparrows Point facility on Chesapeake Bay was the proposed site for one project. At this facility, the Davy Still Autoprocess for pre-combustion cleaning of coke ovens was to be demonstrated. This process utilizes coke oven battery process water to strip ammonia and hydrogen sulfide from coke oven emissions. The facility was constructed but is not in operation due to a suspension of coke-making operations by Bethlehem Steel at that facility. Discussions are ongoing over re-establishment of coke production at Sparrows Point. The other Bethlehem Steel project is a demonstration plant of the British Steel blast furnace granulated coal injection process. In this process, granulated coal is used instead of oil and natural gas in the blast furnace. Unlike natural gas, granulated coal does not cause furnace temperature reductions when it is introduced and thus improves process efficiency. Pollutant outputs are reduced as coal sulphur is removed by flux and bound in the slag. The process replaces natural gas usage and reduces 40 percent of the coke requirement. The project facility, located in Burns Harbor, Indiana, is expected to be complete in January of 1995. The EPA project manager for the Bethlehem Steel projects is Jeff Summers (301) 903-4412.

Another project focussing on reduced emissions from cokemaking is a process under development by Calderon Energy. A small scale oven was constructed and operated in Alliance, Ohio and a full scale oven is under consideration for funding by the Department of Energy (DOE). For further DOE information, contact John Augustine (412) 892-4524.

VIII.C.2. Summary of Trade Associations

American Iron and Steel Institute
1101 17th Street, NW
Washington, DC 20036-4700
Phone: (202) 452-7100
Fax: (202) 463-6573

Members: 50 companies
Staff: 44
Budget:
Contact: Bruce Steiner,
VP-Environment and Energy

The American Iron and Steel Institute (AISI), founded in 1908, mainly represents integrated iron and steel manufacturers. Based on tonnage of production, AISI represents the companies responsible for 70 percent of U.S. steel manufacture. As the major trade group for the industry, AISI has a diverse agenda. The AISI conducts market development by working with major customer groups (e.g., automotive, machinery) to maintain and promote steel as the material of choice. The AISI is also involved in legislative and regulatory activities; AISI members rely on the organization to keep them abreast of legislative and regulatory developments. The AISI conducts research on manufacturing technology, basic materials, environmental quality control, energy, and fuel consumption. The AISI also compiles industry (including non-members) statistics through surveys. AISI publications are the *American Iron and Steel Institute-Annual Statistical Report*, as well as technical manuals and pamphlets on steel. The AISI holds several meetings and other workshops and seminars for member company representatives.

Specialty Steel Industry North America
3050 K Street, NW
Suite 400
Washington, DC 20007
Phone: 202-342-8630
Fax: 202-338-5534

Members: 21 companies

The Specialty Steel Industry of North America (SSINA) is a national trade organization comprised of 21 producers of specialty steel products, including stainless, electric, tool, magnetic, and other alloys. SSINA represents over 90 percent of the North American specialty steel industry. The primary purpose of SSINA is to promote and encourage a better understanding between members of the North American specialty steel industry and federal and state officials, and to provide and encourage governmental action in support of the continued growth of a strong North American specialty steel industry. SSINA is comprised of a number of task forces and committees which pursue issues of interest to the North American specialty steel industry, including domestic and international trade, environmental, critical materials matters, manufacturing and standards issues, and other government-related matters. The SSINA committees meet quarterly, normally alternating between Washington, D.C. and Pittsburgh.

Steel Manufacturers Association (SMA)
1730 Rhode Island Avenue, NW
Suite 907
Washington, DC 20036-3101
Phone: 202-296-1515
Fax: 202-296-2506
email: steelnet@aol.com
World Wide Web home page:
http://www.steelnet.org
Members: 55

The SMA is the primary trade association of electric arc furnace steelmakers. Last year, EAF steelmakers recycled 38.2 million metric tons of iron and steel scrap. Purchased scrap accounts for almost 100% of the feedstocks used in an EAF to make new steel. Other SMA companies are reconstituted integrated (ore-based) steelmakers, with management practices similar to those of the EAF companies. The SMA Environment Committee meets frequently to address issues affecting the steel industry and works with the EPA and other government agencies to implement effective environmental programs. The SMA also has technical and human resources committees which meet to exchange information and develop public policy positions, as well as ad-hoc task forces to handle specific matters such as radioactive scrap detection, development of emission monitoring protocols, and the EPA's Common Sense Initiative. With 44 U.S., 8 Canadian, and 3 Mexican member companies geographically dispersed across the continent, the SMA is the largest steel trade association in North America in terms of membership. In 1994, the SMA membership accounted for approximately 40% of all steel shipments in the U.S., and as a growing segment of the industry, the SMA share of total U.S. steel production is expected to account for 50% within one decade.

International Iron and Steel Institute
Institut International du Fer et de l'Acier
120, rue Colonel Bourg, B-1140
Brussels, Belgium 32 2 726 50 95
Members: 165
Staff: 20
Budget:
Contact: Ian Christmas, Deputy Secretary General

The International Iron and Steel Institute (IISI) is comprised of steel-producing companies, affiliated federations, and technical societies in 48 countries. The IISI seeks to contribute to the steel industry worldwide. Major functions are: to provide a forum for free and open discussions of the industry's problems and opportunities; to undertake research in scientific, technological, economic, financial, governmental, sociological, legal, environmental, and other aspects of the industry; to collect, evaluate, and disseminate statistics and information concerning matters affecting the steel industry; to establish and maintain liaisons with other organizations related to steel; to promote the use of steel. Some IISI committees include Economic Studies, Environmental Affairs, and Industrial Relations. The IISI publishes the monthly *Iron and Crude Steel Production* (in English) and the annuals *Steel Statistical Yearbook* (in English) and *World Steel in Figures* (in English). IISI also publishes conference proceedings and reports on the following issues: environment, economics, raw materials, technology, market promotion, and public relations. The IISI holds an annual world conference.

Association of Iron and Steel Engineers
3 Gateway Center, Suite 2350
Pittsburgh, PA 15222
Phone: (412) 281-6323
Fax: (412) 281-4657

Members: 10,000
Staff: 19
Budget: $2,500,000

The Association of Iron and Steel Engineers (AISE) consists of engineers, operators, and suppliers in the steel industry. Founded in 1907, this association works to improve the technical phases of the production and processing of iron and steel via technical reports and industry awards. Divisions include Environmental Engineering, Steel Producing, and Continuous Casting. AISE publications include a monthly, *Iron and Steel Engineer* and a *Directory of Iron and Steel Plants*. Conferences are semi-annual.

Additional Related Associations

ASM International
9639 Kinsman Rd.
Materials Park, OH 44073-0002
Phone: (216) 338-5151

Society for Mining, Metallurgy, and Exploration, Inc. (SME, Inc.)
P.O. Box 625002
Littleton, CO 80162-5002
Phone: (303) 973-9550

The Mining Metals and Materials Society (TMS)
420 Commonwealth Drive
Warrendale, PA 15086
(412) 776-9000

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the iron and steel industry a list of contacts and publications are provided below.

Contacts[e]

Name	Organization	Telephone	Subject
Maria Malave	EPA/OECA (Office of Enforcement and Compliance Assurance)	202-564-7027	Regulatory requirements and compliance assistance
Steve Sisk	NEIC (National Enforcement Investigations Center)	303-236-3636 ext. 540	Regulatory requirements and industrial processes
James Maysilles	EPA/OAR (Office of Air and Radiation)	919-541-3265	Regulatory requirements (air)
Bernard Caton	EPA/OW (Office of Water)	202-260-7849	Regulatory requirements (water)
Gobind Jagtiani Jeff Dowd	DOE (Department of Energy)	202-586-1826 202-586-7258	Energy efficiency and environmental compliance
Bruce Steiner	AISI (American Iron and Steel Institute)	202-452-7100	Environment and energy
Javier Garcia	EPA/Region IV	404-347-3555	Inspections, regulatory requirements (RCRA)
Ed Wojciechowski	EPA/Region V	312-886-6785	Inspections, regulatory requirements (air)
Gerald Houck	U.S. Bureau of Mines	202-501-9439	Industrial processes
	U.S. Bureau of Mines: Center for Health and Safety	412-892-6602	Health and safety issues

[e] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

General Profile

U.S. Department of Commerce, *U.S. Industrial Outlook 1994*.

U.S. Department of Commerce, *1987 Census of Manufactures Industry Series: Blast Furnaces, Steel Works, and Rolling and Finishing Mills*, 1990.

U.S. Department of Commerce, *1992 Census of Manufactures Preliminary Report Industry Series: Blast Furnaces, Steel Works. and Rolling and Finishing Mills*, MC92-I-33A(P), May 1994.

American Iron and Steel Institute, *Annual Statistical Report*, Washington, D.C., 1993.

Barnett, Donald F. and Robert W. Crandall, *Up From the Ashes*, The Brookings Institution, Washington D.C., 1986.

Process Descriptions and Chemical Use Profiles

American Iron and Steel Institute, *Report on Steel Industry Waste Generation, Disposal Practices, and Potential Environmental Impact*, Washington, D.C., February, 1992.

Lankford, William T., et. al., *The Making, Shaping, and Treating of Steel*, Tenth Edition, United States Steel Corporation, Pittsburgh, PA, 1985. (Available from the Association of Iron and Steel Engineers, Pittsburgh, PA).

Organization for Economic Co-operation and Development, *The Role of Technology in Iron and Steel Developments*, 1989.

Russell, Clifford S. and William J. Vaughan, *Steel Production: Processes, Products, and Residuals*, John Hopkins University Press, Baltimore, 1976.

Regulatory Profile

Sustainable Environmental Law, Environmental Law Institute, West Publishing Co., St. Paul, Minn., 1993.

U.S. EPA, Office of Solid Waste, *Hazardous Waste Generation: 2. Iron and Steel Manufacturing*, February, 1994.

U.S. EPA, Office of Pollution Prevention and Toxics, *Toxics Release Inventory, Public Data Release, 1992*, April, 1994. (EPA 745-R-94-001).

U.S. EPA, Solid Waste and Emergency Response, *Report to Congress on Metal Recovery, Environmental Regulation & Hazardous Waste*, February 1994. (EPA 530-R-93-018).

U.S. EPA, Office of Solid Waste, *Report to Congress on Special Wastes from Mineral Processing*, February 1990.

U.S. EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources. Metallurgical Industry*, Research Triangle Park, NC, U.S. Government Printing Office, Washington, D.C., September 1985.

U.S. EPA, *Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category*, Washington, D.C., May 1982 (EPA 440/1-82-024).

Pollution Prevention

Grieshaber, K. W., C. T. Philipp, and G.F. Bennett, *"Process for Recycling Spent Potliner and Electric Arc Furnace Dust into Commercial Products using Oxygen Enrichment."* Priorities in Pollution Prevention, Annual Gulf Coast Environmental Conference Proceedings, pp. 84-95, March, 1994.

Freeman, Harry, *Pollution Prevention Research at EPA's Risk Reduction Engineering Laboratory: Cleaner Production Processes and Cleaner Products for a Cleaner Environment*. Priorities in Pollution Prevention, Annual Gulf Coast Environmental Conference Proceedings, pp.1-9, March, 1994.

U.S. EPA, Office of Research and Development, *Industrial Pollution Prevention Opportunities for the 1990s*, EPA/600/8-91/052, August, 1991.

Drabkin, Marvin and Edwin Rissmann, *Waste Minimization Opportunities at an Electric Arc Furnace Steel Plant Producing Specialty Steels*, Environmental Progress, vol.8, no.2, pp. 88-97, May, 1989.

U.S. EPA, Region III, Pollution Prevention Program, *Pollution Prevention Opportunities in the Steel Industry*, October 1990.

Center for Hazardous Materials Research, *Pollution Prevention: Strategies for the Steel Industry*, CHMR Fact Sheet, University of Pittsburgh.

Rimer, A.E. and L.A. Reinders, *A Practical Guide to Pollution Prevention Planning for the Iron and Steel Industries*, Blasland, Bouck & Lee, Chapel Hill, N.C., 1992.

Air & Waste Management Association, *Hazardous Waste Minimization Industrial Overviews*, 1989.

Trade Journals

New Steel (formerly Iron Age)
Iron and Steelmaker
Iron and Steel Engineer
Metal Bulletin, (212) 213-6202
World Steel Dynamics, (212) 713-2498
Iron Age Manufacturing Management, (215) 741-4000
Steel: Semiannual Monitoring Report, (202) 205-2000

Endnotes

1. Variation in facility counts occur across data sources due to many factors including, reporting and definitional differences. This notebook does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source. Only preliminary data is available from the *1992 Census of Manufactures*. The final version which includes all data will not be available until mid-1995. *Census of Manufactures*, U.S. Department of Commerce, Bureau of the Census, Preliminary Report Industry Series, MC92-I-33A(P) (Industries 3312, 3313, 3315, 3316, and 3317), 1994.

2. *Annual Statistical Report*, American Iron and Steel Institute, Washington, D.C., 1993.

3. *Net Shipments of Steel Mill Products*, table, American Iron and Steel Institute, Washington, D.C., 1994.

4. *Report on Steel Industry Waste Generation, Disposal Practices, and Potential Environmental Impact*, American Iron and Steel Institute, Washington, D.C., February, 1992.

5. *Census of Manufactures*, U.S. Department of Commerce, Bureau of the Census. Industry Series, MC87-I-33A (Industries 3312, 3313, 3315, 3316, and 3317), 1987.

6. *U.S. Industrial Outlook*, U.S. Department of Commerce. Washington, D.C., 1994, p. 13-1.

7. Ibid, p.13-1.

8. Ibid, 13-3.

9. Ibid, p. 13-5.

10. *Annual Statistical Report*, American Iron and Steel Institute, Washington D.C., 1993. p.73.

11. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Metallurgical Industry*, U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, NC, U.S. Government Printing Office, Washington, D.C., September 1985.

12. *Report on Steel Industry Waste Generation, Disposal Practices, and Potential Environmental Impact*, American Iron and Steel Institute, Washington, D.C., 1992, p.8.

13. *The Making, Shaping, and Treating of Steel*, Tenth Edition, McGannon, Harold E., ed., United States Steel Corporation, Pittsburgh, PA, 1971.

14. *Report on Steel Industry Waste Generation, Disposal Practices, and Potential Environmental Impact*, American Iron and Steel Institute, Washington, D.C., 1992, p.14.

15. *The Making, Shaping, and Treating of Steel*, Tenth Edition, McGannon, Harold E., ed., United States Steel Corporation, Pittsburgh, PA, 1971, p.189.

16. *Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category*, U.S. EPA, Washington, D.C., May 1982 (EPA 440/1-82-024).

17. *Report on Steel Industry Waste Generation, Disposal Practices, and Potential Environmental Impact, American Iron and Steel Institute*, Washington, D.C., 1992, p.17.

18.*Report to Congress on Metal Recovery, Environmental Regulation and Hazardous Waste*, U.S. EPA, Office of Solid Waste and Emergency Response, 1994, p. 3 (EPA 530-R-93-018).

19.Comment from Bruce Steiner, American Iron and Steel Institute, Washington, D.C., May 5, 1995.

20.*U.S. Steel Industry at a Glance*, American Iron and Steel Institute, Washington, D.C., 1992.

21. *Report on Steel Industry Waste Generation, Disposal Practices, and Potential Environmental Impact, American Iron and Steel Institute*, Washington, D.C., 1992, p.21.

22. *The Making, Shaping, and Treating of Steel*, Tenth Edition, McGannon, Harold E., ed., United States Steel Corporation, Pittsburgh, PA, 1971, p.565.

23. Ibid, p. 121.

24. Ibid.

25. Ibid.

26. Ibid.

27. Amoco - U.S. EPA Pollution Prevention Project, Yorktown, Virginia, Project Summary, January 1992.

28. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Chapter 9, Petroleum Industry*. U.S. EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, U.S. Government Printing Office, Washington, D.C., September 1985.

27. *Report to Congress on Metal Recovery, Environmental Regulation and Hazardous Waste*. U.S. EPA, Office of Solid Waste and Emergency Response, 1994, p.20 (EPA 530-R-93-018).

28. *Hydrochloric Acid Recovery System for Galvanizers and Steel Manufacture*. U.S. Department of Energy, NICE[3] (National Industrial Competitiveness through Energy, Environment, Economics), DOE/CH10093-233, October 1993.

29.*Sustainable Environmental Law*, Environmental Law Institute, West Publishing Co., St. Paul, Minn., 1993.

29.*Report to Congress on Metal Recovery, Environmental Regulation and Hazardous Waste.* U.S. EPA, Office of Solid Waste and Emergency Response, 1994, p.20 (EPA 530-R-93-018)

30. Ibid.

31. *Sustainable Environmental Law,* Environmental Law Institute, West Publishing Co., St. Paul, MN, 1993, p.1238.

32.*Report to Congress on Metal Recovery, Environmental Regulation and Hazardous Waste.* U.S. EPA, Office of Solid Waste and Emergency Response, 1994, p.20 (EPA 530-R-93-018).

33. Ibid, p. 23.

34. Ibid, p. 44.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies: environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

R0075638

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy! VISA MasterCard DISCOVER NOVUS

Fax your orders (202) 512–2250
Phone your orders (202) 512–1800

Order Processing Code:
* 3212

Qty.	Stock Number	Published in 1995 Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	Published in 1997 Title	Price Each	Total Price
	055–000–00570–2	Air Transportation Industry, 90 pages	$ 7.50	
	055–000–00571–1	Ground Transportation Industry, 130 pages	10.00	
	055–000–00572–9	Water Transportation Industry, 90 pages	7.50	
	055–000–00573–7	Metal Casting Industry, 150 pages	13.00	
	055–000–00574–5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055–000–00575–3	Plastic Resin & Man–made Fiber Industry, 180 pages	15.00	
	055–000–00576–1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055–000–00577–0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055–000–00578–8	Textile Industry, 130 pages	10.00	
	055–000–00579–6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account ☐☐☐☐☐☐☐–☐

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

☐☐☐☐ (expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0075639

EPA
United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Profile Of The Lumber And Wood Products Industry

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-006

EPA Office of Compliance Sector Notebook Project

Profile of the Lumber and Wood Products Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048273-9

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, U.S. EPA.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

LUMBER AND WOOD PRODUCTS
(SIC 24)
TABLE OF CONTENTS

Page

R0075646

LUMBER AND WOOD PRODUCTS
(SIC 24)
TABLE OF CONTENTS (CONT'D)

Page

LUMBER AND WOOD PRODUCTS
(SIC-24)
EXHIBITS INDEX

Page

LUMBER AND WOOD PRODUCTS
(SIC-24)
EXHIBITS INDEX (CONT'D)

Page

LUMBER AND WOOD PRODUCTS
(SIC 24)
LIST OF ACRONYMS

ACZA - Ammoniacal Copper Zinc Arsenate
AFS - AIRS Facility Subsystem (CAA database)
AIRS - Aerometric Information Retrieval System (CAA database)
BIFs - Boilers and Industrial Furnaces (RCRA)
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CCA - Chromated Copper Arsenate
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CO - Carbon Monoxide
CWA - Clean Water Act
D&B - Dun and Bradstreet Marketing Index
EPA - United States Environmental Protection Agency
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
HAPs - Hazardous Air Pollutants (CAA)
HB - Hardboard
IDEA - Integrated Data for Enforcement Analysis (Enforcement Database)
LDR - Land Disposal Restrictions (RCRA)
LVL - Laminated Veneer Lumber
MACT - Maximum Achievable Control Technology (CAA)
MDI - Methylenediphenyl Diisocyanate
MDF - Medium density Fiberboard
NAAQS - National Ambient Air Quality Standards (CAA)
NaOH - Sodium Hydroxide
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP - National Emission Standards for Hazardous Air Pollutants
NSPS - New Source Performance Standards (CAA)
NO_x - Nitrous Oxides
NPDES - National Pollution Discharge Elimination System (CWA)
OAR - Office of Air and Radiation
OPA - Oil Pollution Act
OECA - Office of Enforcement and Compliance Assurance
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSB - Oriented Strand Board
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention

LUMBER AND WOOD PRODUCTS
(SIC 24)
LIST OF ACRONYMS (CONT'D)

PB - Particleboard
PCP - Pentachlorophenol
PCS - Permit Compliance System (CWA Database)
PF - Phenol-Formaldehyde
PM - Particulate Matter
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SDWA - Safe Drinking Water Act
SO_X - Sulfur Oxides
TGNMO Total Gaseous Nonmethane Organics
TRI - Toxic Release Inventory
TRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
UF - Urea-Formaldehyde
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

LUMBER AND WOOD PRODUCTS (SIC 24)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a

manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE LUMBER AND WOOD PRODUCTS INDUSTRY

II.A. Introduction, Background, and Scope of the Notebook

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the lumber and wood products industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

The lumber and wood products industry includes establishments engaged in cutting timber and pulpwood; sawmills, lath mills, shingle mills, cooperage stock mills (wooden casks or tubs), planing mills, plywood mills; and establishments engaged in manufacturing finished articles made entirely or mainly of wood or related materials such as reconstituted wood panel products manufacturers. The categorization corresponds to the Standard Industrial Classification (SIC) code 24 established by Department of Commerce's Bureau of the Census to track the flow of goods and services within the economy. It should be noted that silviculture (development and care of forests) and the preparation of forested areas for logging is covered by SIC 08 (forestry) and is not addressed in this industry profile.

In this profile, the industry's processes are divided into four general groups: logging timber; producing lumber; panel products and wood preserving. The Bureau of the Census estimates that in 1992, employment in these principal categories totaled approximately 306,700 (See Exhibit 1 for facility employment size distribution). This does not include the additional employment generated by the wood container, structure wood member, wood kitchen cabinet, and wood building/mobile home sectors. Shipments increased less than one percent in 1993, to an estimated $78.1 billion. Sawmills and planing mills (SIC 242) accounted for $24.8 billion (31 percent) of industry shipments in 1993. Logging (SIC 241) added an additional $15.6 billion (17.8 percent).

The Department of Commerce provides the following three-digit breakout for lumber and wood products industries in SIC 24:

- SIC 241 - Logging
- SIC 242 - Sawmills and Planing Mills
- SIC 243 - Millwork, Veneer, Plywood, and Structural Wood Members
- SIC 244 - Wood Containers
- SIC 245 - Wood Buildings and Mobile Homes

SIC 249 - Miscellaneous Wood Products.

The main end use market for the industry's products is the new construction and remodeling sectors.

This profile covers logging, sawn lumber production, panel products including veneer and plywood manufacture and reconstituted wood panel manufacture (which includes particleboard (PB), hardboard (HB), medium density fiberboard (MDF), and oriented strand board(OSB)), engineered lumber, and wood preserving. Each of these are discussed in greater detail later in the profile. This profile does not address production processes, pollution outputs, or regulatory information for the following three-digit industries contained in SIC 24: Wood Containers (SIC 244), Wood Buildings and Mobile Homes (SIC 245), and some areas of Miscellaneous Wood Products (SIC 249).

II.B. Characterization of the Lumber and Wood Products Industry

The discussion of the characterization of the lumber and wood products industry is divided into the following topics: industry size and geographic distribution; identification of the largest U.S. facilities in the industry by capacity; and industry economic trends.

II.B.1. Industry Size and Distribution

Variation in facility counts occur across data sources due to many factors, including reporting and definition differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Geographic Distribution

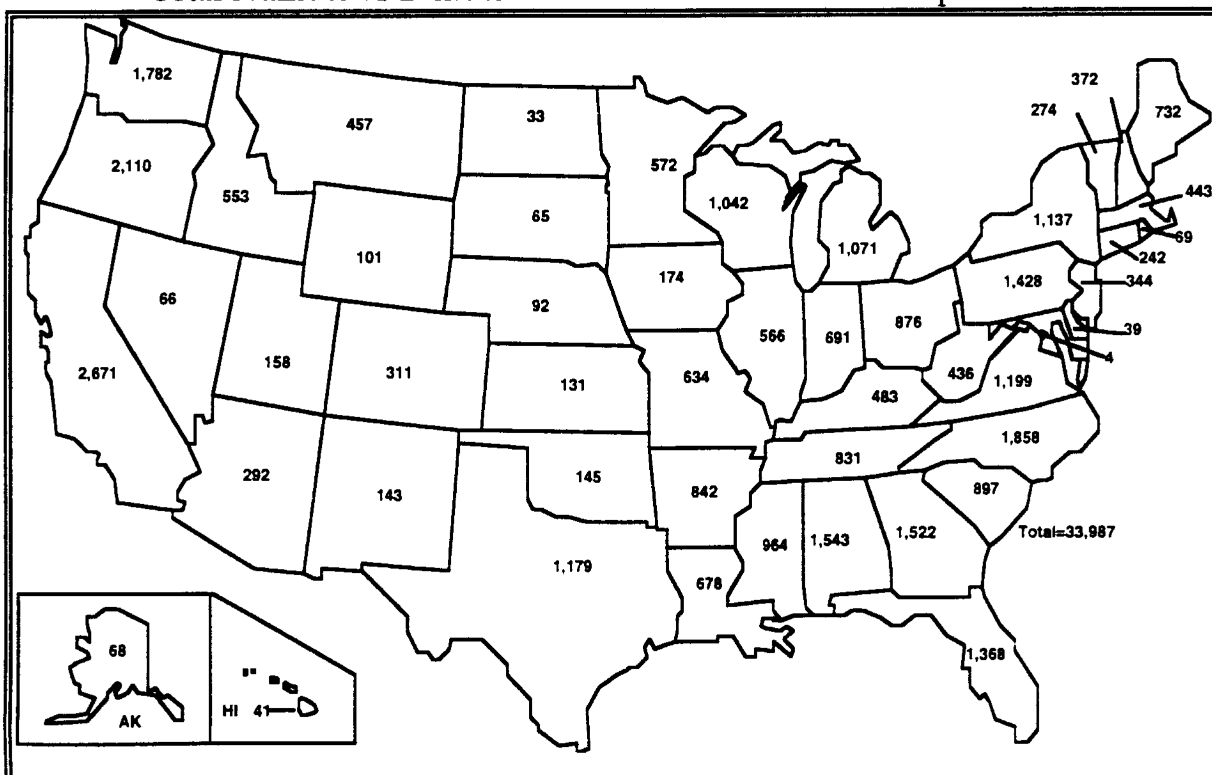
Most of the wood products industry is concentrated in the Pacific Northwest and the Southeast. However, concentrations are also found across the Midwest, the Northeast, and in Appalachia (See Exhibits 2 and 3). Approximately 1/3 of the U.S. is forested. Of this forested area, two-thirds (480 million acres) contain at least 20 cubic feet of commercially usable wood per year per acre, the threshold for determining whether timberland could be commercially productive. The area east of the Mississippi still contains a significant amount of forested acreage; 155 million acres are in the Northern States and 195 million acres are in the South. About 130 million acres of forested land is in Western States. Exhibit 4 illustrates the largest lumber and wood products facilities in the U.S. by capacity.

Exhibit 1
Industry Facility Size Distribution - 1992

Type of Facility	Facilities with 1 to 19 employees	Facilities with 20 to 99 employees	Facilities with 100 or more employees	Total
SIC 2411 - Logging	12,283	691	36	13,010
SIC 2421 - Lumber	4,400	1,283	321	6,004
SICs 2435 & 2436 - Hardwood, Softwood Plywood, Veneer	147	208	164	519
SIC 2491 - Wood Preserving	307	168	11	486
SIC 2493 - Reconstituted Wood Products	108	80	100	288

Source: Based on 1992 Bureau of the Census Data.

Exhibit 2
Geographic Distribution of Industry
Total Number of Lumber and Wood Products Facilities per State*



Source: Based on 1987 Bureau of the Census Data. 1992 Bureau of the Census Data on State breakdown was not available at the time of publication.
**Note: Exhibit represents all industries within SIC 24.*

R0075657

Exhibit 3
Geographic Distribution of Industry
Breakdown of Lumber and Wood Facilities by State

Type of Facility	Number of Facilities Per State
Logging	AL-957, AK-37, AR-403, CA-525, FL-346, GA-796, ID-321, KY-95, LA-413, ME-439, MI-341, MN-176, MS-531, MT-312, NH-130, NH-130, NY-209, NC-677, OH-128, OR-1,293, PA-257, SC-559, TN-128, TX-297, VA-444, WA-597, WV-185, WI-384
Sawmills and Planning Mills	AL-212, AZ-17, AR-218, CA-278, CO-48, CT-34, FL-94, GA-216, ID-100, IL-75, IN-155, KY-185, LA-104, ME-141, MD-58, MA-89, MI-219, MN-96, MS-213, MO-237, MT-68, NH-83, NM-27, NY-231, NC-554, OH-172, OK-50, OR-309, PA-448, SC-126, SD-17, TN-345, TX-116, UT-26, VT-78, VA-370, WA-381, WV-188, WI-206, WY-28
Millwood, Plywood and Structural Members	AL-158, AZ-146, AR-85, CA-1,145, CO-140, CT-122, FL-661, GA-260, ID-66, IL-224, IN-213, IA-54, KS-70, KY-78, LA-77, ME-31, MD-86, MA-172, MI-192, MN-165, MS-73, MO-144, MT-30, NE-47, NV-42, NH-47, NJ-165, NM-62, NY-378, NC-294, OH-225, OK-49, OR-298, PA-315, RI-28, SC-105, SD-21, TN-153, TX-412, UT-82, VT-30, VA-185, WA-273, WV-26, WI-206
Wood Containers	AL-56, AR-39, CA-204, FL-37, GA-69, IL-13, IN-103, KY-71, MI-144, MN-36, MS-39, MO-85, NJ-46, NY-82, NC-80, OH-172, OR-26, PA-155, SC-38, TN-87, TX-85, VA-54, WA-30, WI-83
Wood Buildings and Mobile Homes	AL-46, AZ-20, CA-87, CO-11, DE-2, FL-68, GA-53, ID-13, IL-25, IN-55, KS-12, ME-12, MD-13, MA-18, MI-34, MN-20, MS-12, MO-21, NE-7, NH-20, NY-27, NC-51, OH-36, OR-23, PA-72, TN-32, TX-74, VA-31, WA-18, WI-34
Miscellaneous Wood Products	AL-113, AR-84, CA-432, FL-161, GA-128, ID-43, IL-147, IN-96, IA-27, KY-46, LA-58, ME-91, MD-36, MA-93, MI-141, MN-79, MS-96, MO-102, NH-72, NJ-71, NM-16, NY-210, NC-202, OH-143, OK-26, OR-159, PA-181, SC-68, TN-88, TX-195, VT-115, WA-123, WV-36, WI-119

*Source: Based on 1987 Bureau of the Census Data.**

**1992 Bureau of Census Data on State breakdown was not available at the time of publication.*

Exhibit 4
Largest U.S. Lumber and Wood Products Facilities by Capacity (1993)

	Lumber Production
1.	Weyerhaeuser Co.
2.	Georgia-Pacific Corp.
3.	Louisiana-Pacific Corp.
4.	Sierra Pacific Industries
5.	International Paper Co.
6.	Boise Cascade Corp.
7.	Pope & Talbot Inc.
8.	MacMillan Bloedel Ltd.
9.	WTD Industries Inc.
10.	Simpson Timber Co.

	Softwood Veneer
1.	Scotch Plywood Co. of Alabama
2.	Stone Forest Industries Inc.
3.	Freres Lumber Co. Inc.
4.	Sun Studs Inc.
5.	Plum Creek Manufacturing, L.P.
6.	Hunt Plywood Co. Inc.
7.	Omak Wood Products, Inc.
8.	Roseburg Forest Products
9.	Green Veneer Inc.
10.	WTD Industries Inc.

	Softwood Plywood
1.	Georgia-Pacific Corp.
2.	Willamette Industries Inc.
3.	Boise Cascade Corp.
4.	Louisiana-Pacific Corp.
5.	Roseburg Forest Products Co.
6.	Weyerhaeuser Co.
7.	Champion International
8.	International Paper Co.
9.	Stimson Lumber Co.
10.	Stone Forest Industries Inc.

	OSB/Waferboard
1.	Louisiana-Pacific Corp.
2.	Potlatch Corp.
3.	Georgia-Pacific Corp.
4.	Weyerhaeuser Co.
5.	J.M. Huber Corp.
6.	Norbord Industries
7.	Roy O. Martin Lumber Co. Inc.
8.	International Paper Co.
9.	Langdale Forest Products Co.

	Particleboard
1.	Georgia-Pacific Corp.
2.	Willamette Industries Inc.
3.	Weyerhaeuser Co.
4.	Louisiana-Pacific Corp.
5.	Temple-Inland Forest Products Corp.
6.	Roseburg Forest Products Co.
7.	Masonite Corp.
8.	Allegheny Particleboard Corp.
9.	Boise Cascade Corp.
10.	Timber Products Co.

	Medium-density Fiberboard
1.	Willamette Industries Inc.
2.	Louisiana-Pacific Corp.
3.	Medite Corp.
4.	Masonite Corp.
5.	Plum Creek Manufacturing, L.P.
6.	Georgia-Pacific Corp.
7.	Sierra-Pine, Ltd.
8.	Weyerhaeuser Co.
9.	Norbord Industries
10.	Bassett Industries

Source: American Forest & Paper Association, Wood Technology's 1994-95 North American Factbook.

R0075659

Exhibit 4 (cont'd)
Largest U.S. Lumber and Wood Products Facilities by Capacity (1993)

	Hardboard
1.	Georgia-Pacific Corp.
2.	Masonite Corp.
3.	Weyerhaeuser Co.
4.	Wood Fiber Industries Inc.
5.	Louisiana-Pacific Corp.
6.	Stimson Lumber Co.
7.	Evanite Fiber Corp.
8.	Dee Forest Products Inc.

	Laminated Veneer Lumber, I-joists
1.	Louisiana-Pacific Corp.
2.	Willamette Industries Inc.
3.	Georgia-Pacific Corp.
4.	Tecton Laminates
5.	South Coast Lumber Co.

	Parallel, Laminated Strand Lumber
1.	Trus Joist MacMillian

	Glulam Beams
1.	Willamette Industries Inc.
2.	Anthony Forest Products Co.

	Panelboard
1.	Georgia-Pacific Corp.

	Composite Panels
1.	Oregon Strand Board Co.

Source: American Forest & Paper Association, Wood Technology's 1994-95 North American Factbook.

II.B.2. Economic Trends

The lumber and wood products industry is heavily dependent upon the health of the U.S. residential construction and household furniture industries. Lumber and wood product shipments increased less than one percent in 1993 and this low level of growth is expected to continue in 1994. Domestic wood products shipments over the next five years are expected to remain constant.

Since the mid-1980's, timber harvests from publicly-owned lands have declined by more than 50 percent. The decline is due to new land management policies by the Federal government that have reduced the amount of land available for harvesting.

According to the Hardwood Plywood and Veneer Association, there has been a substantial decline in the use of hardwood plywood prefinished wall paneling due to shifts in consumer preference, a decline in promotion and advertising by major manufacturers, changes in the cost of plywood paneling related to gypsum wallboard, and the public's concern about real or perceived formaldehyde releases from wall paneling. With respect to reconstituted wood panel products shipments of PB, OSB, and MDF are all increasing rapidly. U.S. shipments of MDF were at record levels in 1993.

The engineered lumber sector of the industry (reconstituted wood substitutes for sawn lumber), is currently seeing a rapid rise in production. The production of glulam beams and laminated veneer lumber (LVL), two types of engineered lumber, is increasing rapidly and this increased growth is expected to continue. By 2003, the North American output of LVL is expected to reach 98 million ft^3 (the American Plywood Association's production estimate for LVL in 1995 is 33 million ft^3).

III. INDUSTRIAL PROCESS DESCRIPTION

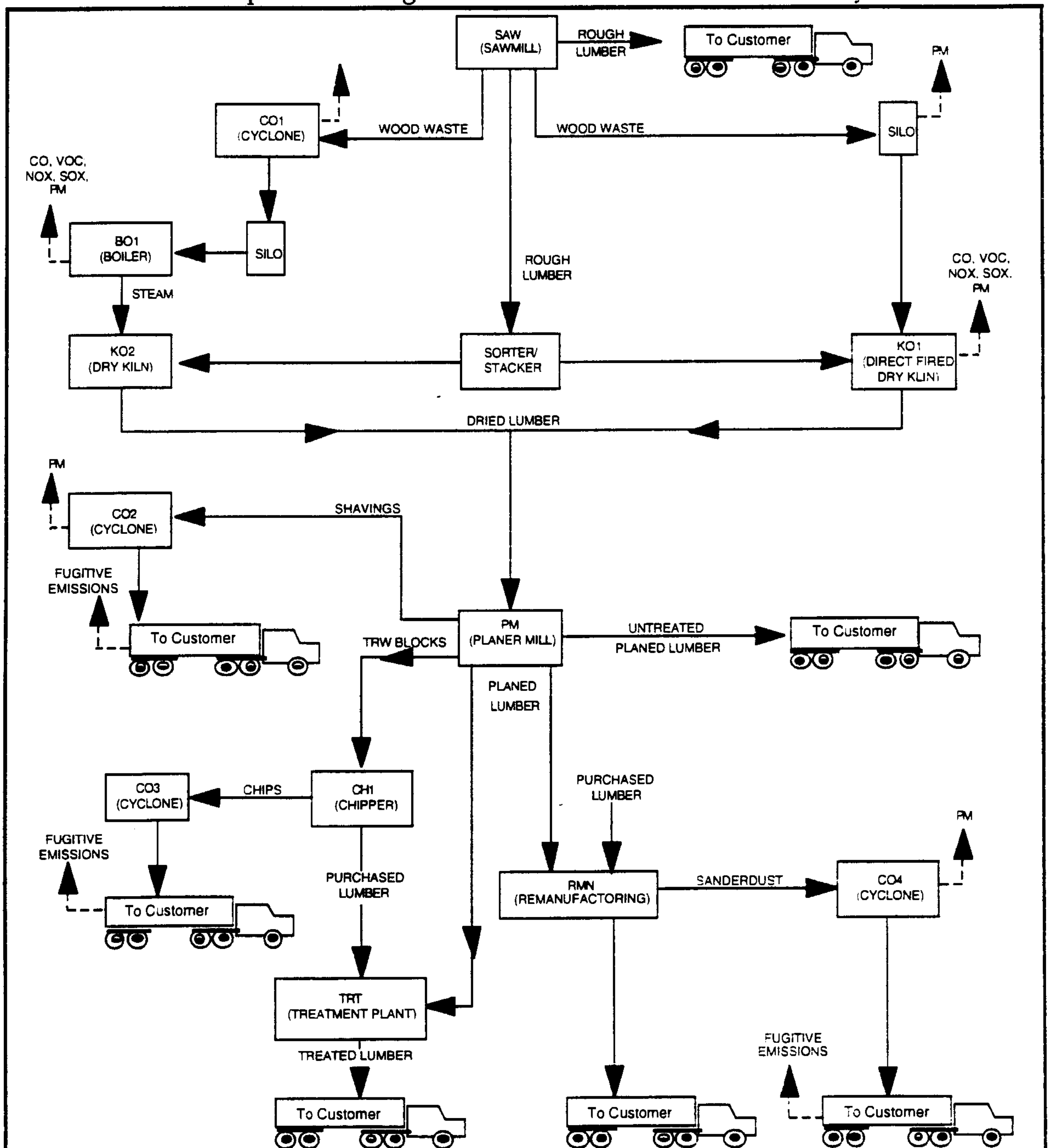
This section describes the major industrial processes within the lumber and wood products industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the by-products produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Lumber and Wood Industry

This section describes the major processes used by the lumber and wood products industry. It is divided into the following sections: logging, sawn lumber, paneling (including veneer and plywood and reconstituted wood panel products), engineered lumber, and wood preserving. Information for these descriptions was obtained from a variety of sources including *Characterization of Manufacturing Processes, Emissions, and Pollution Prevention Options for the Composite Wood Industry* (Martin and Northeim, 1995), *Forest Products and Wood Science* (Haygreen and Bowyer, 1989), and *Guide to Pollution Prevention: Wood Preserving Industry* (U.S. EPA, 1993).

Exhibit 5
Example Flow Diagram For a Lumber Production Facility



Source: Southern Lumber Manufacturing Association, 1995.

Logging

Timber harvesting may be accomplished by either manual or mechanical means. However, the traditional methods of hand sawing or ax use are almost never used. Chain saws powered by gasoline engines or large felling machines are currently used to cut down

R0075663

standing trees. The felling machines use hydraulically-activated shears that cut the tree at its base and transport it to a collection point. The logs are transported by motorized cable or by tractor to larger collection areas for transportation (usually by motor trucks or water) to the sawmill.

Sawn Lumber

Sawn lumber is softwood or hardwood trimmed at a sawmill and destined for a future use such as construction, industrial, or furniture products. Most of the commercially important softwood species such as Southern Yellow Pine, Western Pines, Western Hemlock, Spruce, and Douglas Fir grow in the South or West. Softwood boards are used primarily for framing light construction such as homes, schools, churches, and farm buildings. Hardwood species such as Maple and Oak, are grown and processed mainly in the Eastern portion of the U.S. and are used for flooring, furniture, and crating.

Exhibit 5 illustrates the lumber production process. Logs are delivered to sawmills from the forest and stored in ponds or on land. Most wood is stored on land. Logs are sometimes stored at intermediate points between the forest and the sawmill. If stored on land, the logs are usually sprayed with water to keep them moist and prevent cracking. The raw logs are debarked and then cut into cants (partially cut lumber), which are trimmed into raw lumber. As the logs are debarked, bark is used as hog fuel for boilers or sold as mulch. Shavings, sawdust, and chips can also be used at paper mills and reconstituted wood panel manufacturing plants.

The cants are cut to specific lengths or finished further depending on the final destination of the lumber product. Most lumber is dried to a specific moisture content (conditioned) through air or kiln drying. Air drying, which entails stickering (spacing) and stacking the cut lumber in open storage areas, usually requires several months to a few years. Kiln drying is more time efficient because it uses controlled air flow within a vented closed chamber to quickly dry the lumber to a specified moisture content. Whether lumber is air- or kiln-dried depends upon variables such as the moisture content of the species and the humidity of the region.

Sawmills frequently perform surface protection operations to protect lumber against sapstaining that may occur during temporary storage. Sapstains do not attack the structural components of the wood but do affect the surface, coloring it with dark blue or black stains. This discoloration is often objectionable to the buyer and may decrease the value of the wood and its acceptance of finishes.

Surface protection is typically conducted at mills that process hardwoods; however, softwoods cut for export may also be surface protected. Plants typically treat their lumber with surface protectants only during humid months, depending on the region of the country in which they operate. Wood that is kiln-dried is not normally surface-protected. All green wood to be exported is protected. The most popular surface protectant currently used by approximately 85% of all major U.S. mills who treat lumber is a solution composed of 3-iodo-z-propynyl butyl carbamate (IPBC), didecyl dimethyl ammonium chloride (DDAC), and inert ingredients. The solution is diluted with water to a ratio of 35-1 for spray box application and 100-1 for dip tank applications.

Three major processes are used by sawmills to apply surface protectant to wood: the dip process, the spray process, and the green chain process. Typically the sawmill will use only one process to surface protect; however, some plants use a combination of processes to protect lumber at different locations throughout a mill. Dipping is a batch process; green chain and spray operations are continuous processes. The process used influences the amount of control a plant has over the waste it generates during the surface protection process.

Dip operations offer the best opportunity to control drippage since an owner or operator has the ability to keep the wood over the tank until it stops dripping. Dipping operations can lead to uncontrolled drippage when mills do not allow the treated loads to stop dripping before the next load is dipped. Lumber is dipped in horizontal bundles, and as a result, liquid is often trapped between pieces of wood. When forklifts remove the lumber, large quantities of protectant can drip from the wood onto the ground if the lumber is tipped.

Unlike dipping, the spray operation is a continuous process. Individual pieces of lumber are fed end-to-end by chain, roller, or conveyor belt through a spray box. The spray box is often equipped with flexible brushes or curtains at both ends to isolate the formulation spray and minimize drippage. A drip pan is usually incorporated into the design of the spray box allowing formulation to return to the work tank.

Green-chain systems represent another type of continuous operation. The green-chain is so-named because chains drag fresh cut (or "green") lumber through a tank of protectant formulation and back out again for sorting and grading. A dip vat containing anti-stain formulation is typically located at the head of the green chain and the wood falls into this vat from the cutting operations. Some systems utilize wheels or

R0075665

rollers just above the formulation surface to force the wood pieces into the solution. As the wood is drawn from the vat and along the green chain, excess formulation is released from the wood onto the return drip pan. Green-chain operations are typically the least controllable with respect to drippage.

Panel Products

This section describes two classes of panel products: (1) hardwood veneer, softwood veneer, and plywood; and (2) reconstituted wood products.

Hardwood Veneer and Softwood Veneer and Plywood

Veneer is a thin sheet of wood peeled or sliced from blocks of lumber called flitches or logs. Veneer is glued together to form plywood. Hardwood found in the Western and Southern U.S. is generally used to manufacture hardwood plywood. Softwood logs from the Northwest and Eastern U.S. are used to make softwood plywood. Softwood plywood is primarily used for construction. Softwood veneer and plywood is typically used for structural and industrial applications and represents over 90 percent, by volume, of U.S. production. Hardwood veneer and plywood is used typically for decorative applications and for making interior paneling, components for furniture and cabinets, and specialty products. There are several other important differences between softwood plywood and hardwood plywood: softwood plywood is generally made with relatively thick faces (1/10" and thicker) and with exterior or intermediate glue (for protected construction and industrial uses where moderate delays in providing protection might be expected or conditions of high humidity and water leakage may exist). Hardwood plywood is made with face veneers generally 1/32" and thinner. Because of its nature and the use of decorative thin face veneers, the glues used for hardwood plywood tend to be colorless or light in color so as not to discolor the surfaces if the adhesive bleeds into and through the thin faces. While most hardwood plywood is all veneer, some is made with particleboard and medium density fiberboard core.

The general processes for making softwood and hardwood plywood are the same: log debarking, log steaming and or soaking, veneer cutting, veneer drying, veneer preparation, glue application, pressing, panel trimming, and panel sanding. These basic processes are illustrated in Exhibit 7. Nevertheless, there are differences in details in these softwood and hardwood plywood processes. Because of its greater volume, this section primarily describes softwood veneer and plywood manufacturing. However, it is noted where details of the

R0075666

manufacturing process are substantially different for hardwood plywood.

Most softwood plywood plants also produce veneer. Most hardwood plywood plants purchase components for making plywood from outside sources. Logs received at the plant are debarked and cut into lengths appropriate for the plant's processing equipment. Almost all hardwood and many softwood blocks are heated prior to cutting or peeling the veneer to soften the wood. The cut logs are heated by steaming, soaking in hot water, spraying with hot water, or combinations of these methods. The heating time required depends on the diameter of the log, specific gravity, moisture content, and the temperature needed to properly peel that particular species of wood.

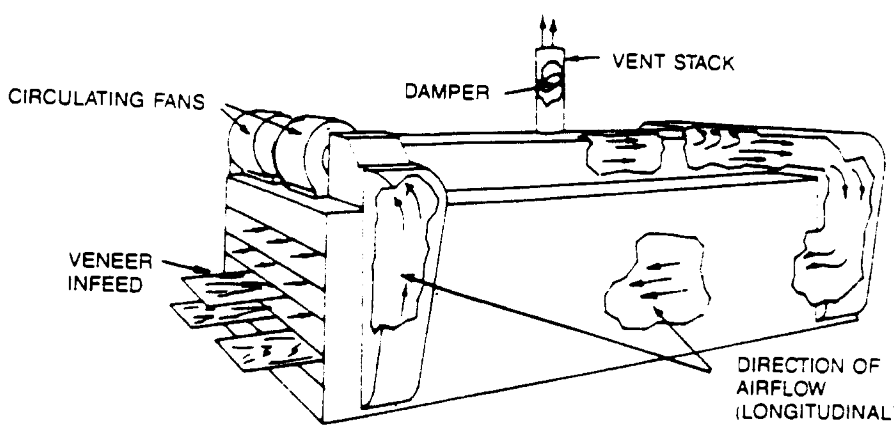
The major methods for producing veneer are slicing and peeling. The majority of veneer is produced by peeling (rotary cutting) on a veneer lathe into sheets of uniform thickness. Slicing is used to produce hardwood decorative veneers from a flitch generally in thicknesses of 1/24" and thinner, and is seldom used with softwood. In either case, the wood is forced under a pressure bar that slightly compresses the wood as it hits the cutting edge of a knife. On a rotary lathe, the block, or log section, continuously rotates against the knife and the pressure bar and peels a sheet of veneer from the heated block.

The veneer is peeled at a rate of 300 to 800 lineal feet/min. A series of 120-foot long trays is used in many softwood plywood plants to gently handle these long sheets of wood as they are peeled from the chuck. In softwood mills and some hardwood mills, high-speed clippers automatically chop the veneer ribbons to usable widths at speeds of 1500 lineal feet/min. In hardwood mills, clipping may be done manually to obtain the maximum amount of clear material from the flitch.

After the veneer is peeled and clipped, it must be dried. Two types of dryers are used in softwood veneer mills: roller resistant dryers, heated by forced air; and platen dryers, heated by steam. In older roller dryers, also still widely used for hardwood veneer, air is circulated through a zone parallel to the veneer (see Exhibit 6). Most plants built in recent years use jet dryers (also called impingement dryers) that direct a current of air, at a velocity of 2,000 to 4,000 feet/min., through small tubes on the surface of the veneer.

Veneer dryers may be heated indirectly with steam, generated by a separate boiler, which is circulated through internal coils in contact with dryer air. Dryers may also be heated directly by the combustion gases of a gas- or wood-fired burner. The gas-fired burner is located inside the dryer, whereas combustion gases from a wood-fired burner are mixed with recirculating dryer air in a blend box outside the dryer and then transported into the dryer. Veneer dryers tend to release organic aerosols, gaseous organic compounds, and small amounts of wood fiber into the atmosphere.

Exhibit 6
Veneer Dryer (Longitudinal)



Source: *Basic Plywood Processing.*

From the dryer, the sheets of veneer travel to a glue application station. Narrow pieces of hardwood veneers are often joined with an adhesive and/or string to maximize recovery. In the gluing process, also known as layup, adhesive is applied to the individual sheets of veneer which are later assembled into plywood. Various adhesive application systems are used including hard rolls, sponge rolls, curtain coaters, sprayers, and foam extruders. The most common application for softwood plywood is an air or airless spray system, which generally uses a fixed-head applicator capable of a 10-foot wide spray at a nozzle pressure of 300 pounds per square inch (psi). Roller applications are most common in the manufacture of hardwood plywood.

With spray systems, control of glue spreads is achieved by adjusting the veneer conveyor speed, or by changing the size of the spray nozzle orifice. Wastes generated in the layup process include adhesive waste (typically overspray), and off-spec plywood.

R0075668

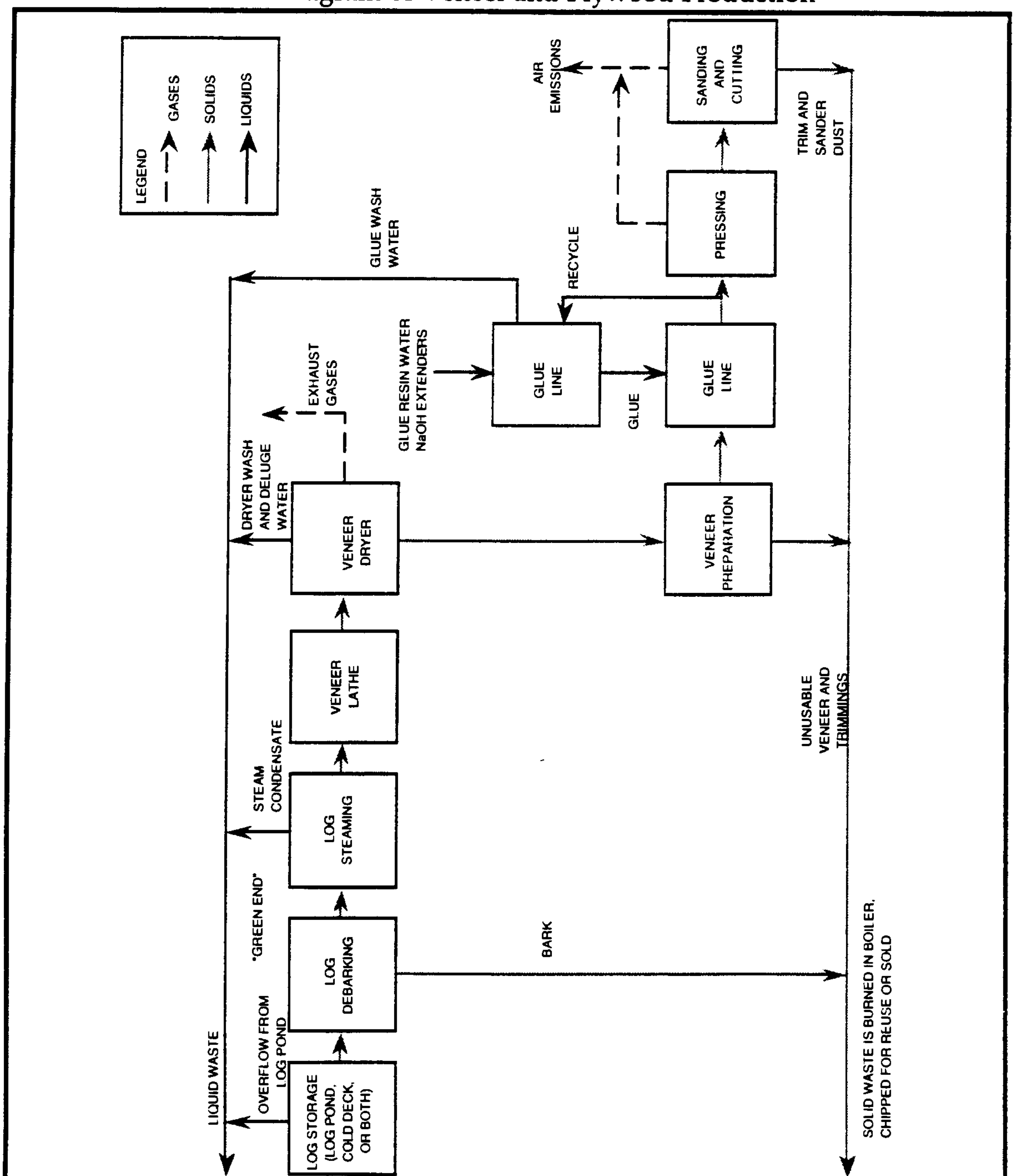
The phenol-formaldehyde (PF) typical in softwood plywood manufacturing and urea-formaldehyde (UF) adhesions typically used in hardwood plywood are made from resins synthesized in regional plants and shipped to individual plywood mills. At the mills, the resins are combined with extenders, fillers, catalysts, and caustic to make a glue mixture. The addition of these ingredients modifies the viscosity of the adhesive and allows it to be compatible with the glue application method (curtain, roll, spray, foam); allows for better adhesive distribution; increases the cure rate; and lowers cost.

Following the application of glue, the panels must be pressed. The purpose of the press is to bring the veneers into close contact so that the glue layer is very thin. At this point, resin is heated to the temperature required for the glue to bond. Most plywood plants prepress the panels in a cold press at lower pressure prior to final pressing in the hot press. This allows the wet adhesive to "tack" the veneers together, permits easier loading of the hot-press, and prevents shifting of the veneers during loading. Pressing is usually performed in multiopening presses, which can produce 20 to 40 4x8-foot panels in each two to seven minute pressing cycle.

One of the goals of the pressing process is to use enough pressure to bring the veneer surfaces together without overcompressing the wood. Less pressure is required if the lathe has cut smooth veneer of a uniform thickness.

After pressing, stationary circular saws trim up to one inch from each side of the pressed plywood to produce square-edged sheets. Approximately 20 percent of annual softwood plywood production is then sanded. Over 90 percent of the hardwood plywood production is sanded. As sheets move through enclosed automatic sanders, pneumatic collectors above and below the plywood continuously remove the sanderdust. Sawdust in trimming operations is also removed by pneumatic collectors. The plywood trim and sawdust are burned as fuel or sold to reconstituted panel plants. Exhibit 7 illustrates the veneer and plywood manufacturing process.

Exhibit 7
Flow Diagram of Veneer and Plywood Production



Source: *Estimating Chemical Releases from Presswood and Laminated Wood Products Manufacturing,* *U.S. EPA, Office of Pesticides and Toxic Substances, March 1988.*

Note: Many veneer and plywood plants are dry.

R0075670

Reconstituted Wood Products

Reconstituted wood products, such as particleboard (PB), medium density fiberboard (MDF), hardboard (HB), and oriented strand board (OSB), is composed of furnish, or raw wood, that is combined with resins and other additives and formed into a mat, which is then pressed into a board. The manufacturing processes of these boards differ, as do the raw materials used. For example, the furnish (raw materials) used for particleboard consists of finely ground wood particles of various sizes, while OSB is manufactured using specially-prepared strands of wood. In general, the manufacturing processes involve wood size reduction followed by drying (except for wet process boards), adhesive application, pressing at elevated temperatures. Because these products are based on use of all parts of the sawn log, very little solid waste is generated. Instead, air emissions from dryers and presses tend to be the principal environmental concern stemming from the production of these products. Exhibit 8 compares the process flows for some reconstituted wood product manufacturing processes.

Particleboard (PB)

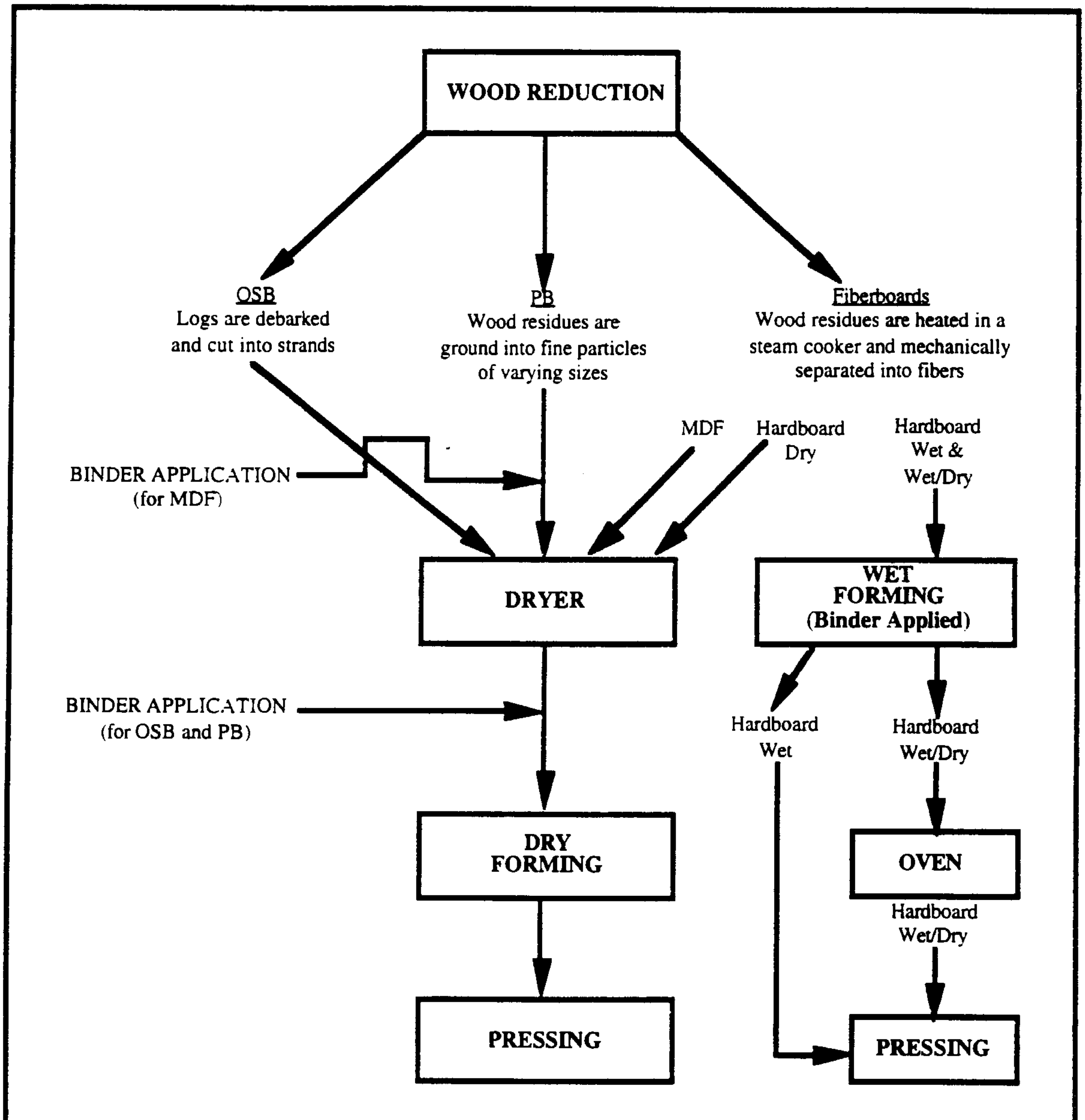
Particleboard is a panel product made from wood particles of various sizes that are bonded together with a synthetic resin such as urea-formaldehyde (UF). The raw materials, or "furnish," that are used to manufacture PB can be either green or dry wood residues. Green residues include planer shavings from green lumber, and green sawdust. Dry process residues include shavings from planing kiln-dried lumber, sawdust, sanderdust and plywood trim. The wood residues are ground into particles of varying sizes using flakers, mechanical refiners, and hammermills. The material may be screened prior to refining.

The furnish is dried to a low moisture content (two to six percent) to allow for moisture that will be gained by the adding of resins and other additives during "blending." Furnishes are generally no warmer than 100°F when blended to avoid precuring and the drying out of the resin.

Most dryers currently in operation in PB and other reconstituted wood panel manufacturing plants use large volumes of air to convey material of varied size through one or more passes within the dryer. Rotating drum dryers requiring one to three passes of the furnish are most common. The use of triple-pass dryers predominates in the United States (see Exhibit 9). Dryer temperatures may be as high as 1100 - 1200°F with a wet furnish. However, dry planer shavings require that dryer temperatures be no higher than 500°F because the ignition point

R0075671

Exhibit 8
Reconstituted Wood Panel Process Flow

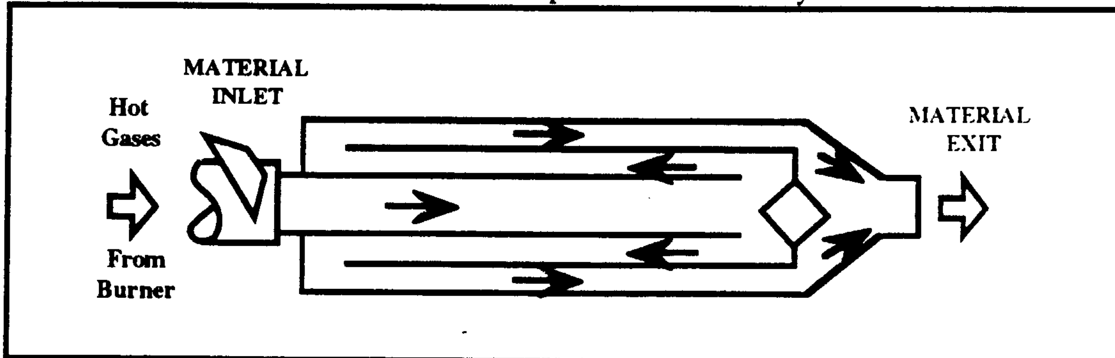


Source: Characterization of Manufacturing Processes, Emissions, and Pollution Prevention - Options for the Composite Wood Industry; Martin and Northeim, Research Triangle Institute Center for Environmental Analysis, 1995.

R0075672

of dry wood is 446°F. Dry material is the predominant furnish in particleboard. Many dryers are directly heated by dry fuel suspension burners. Others are heated by burning oil or natural gas.

Exhibit 9
Schematic of a Triple Pass Drum Dryer



Source: Characterization of Manufacturing Processes, Emissions, and Pollution Prevention - Options for the Composite Wood Industry; Martin and Northeim, Research Triangle Institute Center for Environmental Analysis, 1995.

Direct-fired rotary drum dryers release emissions such as wood dust, combustion products, fly ash, and organic compounds evaporated from the extractable portion of the wood. Steam-heated and natural gas-filled dryers will have no fly ash.

Air classifiers, which separate particles by surface area and weight, may be used alone or in conjunction with screening equipment. Air classifiers perform best if the feed is limited to particles with uniform widths and lengths. The classifier can then efficiently separate particles of different thicknesses due to the weight difference among particles of approximately equal surface area. Undesired material is usually used as fuel for the dryer burner. The screened particles are stored in dry bins until they are conveyed to the blender. Air classifiers have limited use in the industry. Screening systems are typically used to separate fine from coarse material.

The furnish is then blended with a synthetic adhesives, wax, and other additives distributed via spray nozzles, simple tubes, or atomizers. Resin may be added as received (usually an aqueous solution); mixed with water, wax emulsion, catalyst, or other additives. Waxes are added to impart water repellency and dimensional stability to the boards upon wetting.

Particles for PB are mixed with the additive in short retention time blenders in through which the furnish passes in seconds. The blenders consist of a small horizontal drum with high-speed, high shear impellers and glue injection tubes. As the furnish enters the drum,

R0075673

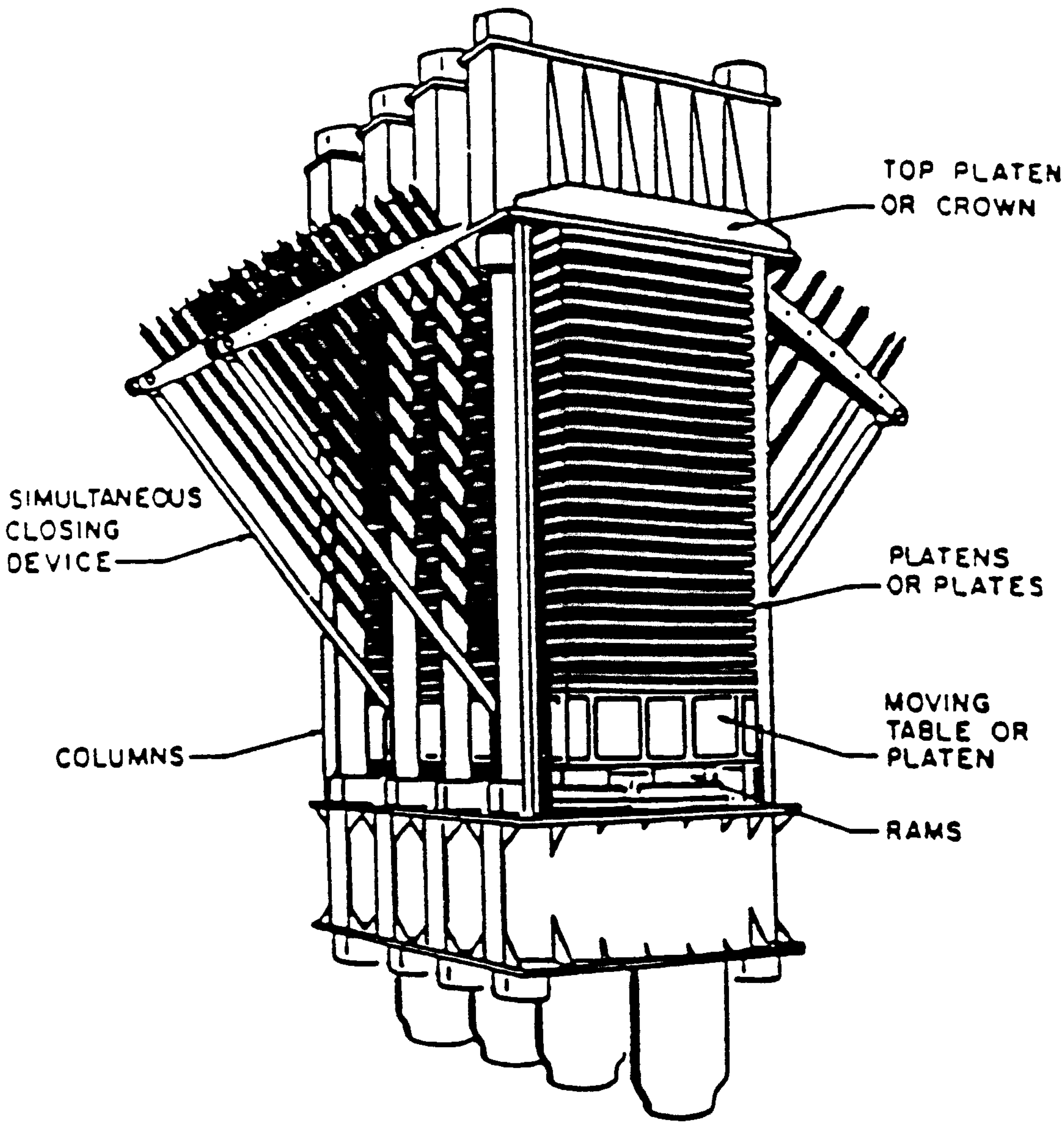
resin is injected, and the impellers hurl the furnish at high speeds to mix it with the resin.

The furnish and resin mixture is then formed into mats using a dry process. This procedure uses air or a mechanical system to distribute the furnish onto a moving caul (tray), belt, or screen. Particleboard mats are often formed of layers of different sized particles, with the larger particles in the core, and the finer particles on the outside of the board.

The mats are hot pressed to increase their density and to cure the resin. Most plants use multiopening platen presses, which typically have 14 to 18 openings (see Exhibit 10). The last ten years has seen the introduction of the continuous press. Though more popular in Europe, the continuous press is currently being used in two PB plants in the United States. Steam generated by a boiler that burns plant residuals runs through a platen passageway to provide the heat in most hot presses. Hot oil and hot water can also be used to heat the platens.

Primary finishing steps for all reconstituted wood panels include cooling or hot stacking, grading, trimming/cutting, and sanding. Cooling is important for UF-resin-cured boards since the resin degrades at high temperatures after curing. Boards bonded using PF resins may be hot-stacked to provide additional curing time. Secondary finishing steps include filling, painting, laminating, and edge finishing. The vast majority of reconstituted panel manufacturers do not apply secondary finishes to their panels; panels are finished primarily by end-users such as cabinet and furniture manufacturers. Panels are also finished by laminators who then sell the finished panels to furniture and cabinet manufacturers.

Exhibit 10
Schematic of a Multi-Opening Board Press



Source: Characterization of Manufacturing Processes, Emissions, and Pollution Prevention - Options for the Composite Wood Industry; Martin and Northeim, Research Triangle Institute Center for Environmental Analysis, 1995.

R0075675

Medium Density Fiberboard (MDF)

The uses for this type of composite wood product are similar to those of PB. The furnish used to manufacture MDF consists of the same type of green or dry wood residues used to manufacture PB and hardboard. Fibers and fiber bundels are generated by first steam-heating the wood, then passing it through a refiner. During this step the wood changes both chemically and physically; becoming less susceptible to the influences of moisture and less brittle as the lignin in the wood softens. This semi-plastic wood is then "rubbed" apart into fibers and fiber bundles in a refiner instead of being mechanically "broken" apart as in the PB manufacturing process.

The furnish is dried to a very low moisture content to allow for moisture to be gained by the addition of resins and other additives. Most MDF furnish is dried in tube dryers.

The blending process for MDF differs from that of PB in that it typically occurs before drying. After refining, the fibers are discharged through a valve known as the blowvalve into the blowline, a larger continuous chamber where the UF resins are mixed with the wood fiber. In the blowline, the fibers are sprayed with a resin which is injected from a line located either immediately after the blowvalve or anywhere along the blowline. Material is dried to an acceptable moisture content in a flash tube dryer at low temperatures after the blowline. If the blending is done mechanically, as in PB, it is done after the flash tube dryer.

MDF is formed using a dry process which uses air to distribute the furnish in a random orientation onto a moving caul (tray), belt, or screen. The mats are then pressed using a multi-opening platen press or a continuous press is currently used in three MDF plants in the United States. The boards are then cooled and finished like other reconstituted wood panels.

Hardboard

Hardboard is a higher-density version of MDF. It is typically used for siding, furniture drawer bottoms, dust stops, sliding doors, and cabinet doors and tops. There are three types of hardboard: wet, wet/dry, and dry process hardboard, each classified by their manufacturing processes. The furnish used to manufacture hardboard consists of the same green or dry process wood residues used to manufacture PB and MDF. The cooked semi-plastic furnish is "rubbed" apart into fiber bundles as in the MDF process. The fibers are all the same size, therefore, they need no screening.

In the manufacture of wet, and wet/dry process hardboard, the furnish is not dried because the forming process uses water. Wet and wet/dry process hardboard mats are formed using a wet process in which fibers are mixed with water and Phenol Formaldehyde adhesive and then metered onto a wire screen. Water is drained away with the aid of suction applied to the underside of the wire. The fiber mat, along with the supporting wire, is moved to a prepress where excess water is squeezed out. Wet/dry process hardboard is dried in an oven before being hot pressed.

In the manufacture of dry process hardboard, the furnish is dried using dryers typical of the reconstituted wood panel industry. As with MDF, the hardboard fibers are discharged through a blowvalve into a blowline after refining. Dry process hardboard mats are formed using a process similar to that of MDF and PB in which air is used to distribute the furnish in a random orientation onto a moving caul (tray), belt, or screen. All reconstituted wood panels are hot pressed to increase their density and to cure the resin.

Oriented Strandboard

The furnish used to manufacture OSB is specially flaked from roundwood. Logs entering OSB plants may be either tree length or cut to 100 inch lengths by a slasher saw. The logs are then debarked and sent to a strander which slices them into strands approximately 0.028 inch thick. The strands are then conveyed to a storage bin to await processing through the dryers. (Note: Some older mills cut the logs into 33 inch blocks before sending them to the strander.)

The strands are dried to a low moisture content to allow for moisture gained by adding resins and other additives. The strands are then blended with additives in long retention time blenders in which the furnish passes through in several minutes. The blenders are very large rotating drums (several feet in diameter and many feet in length) that are tilted on their axes. As the strands are fed into the drums, they are sprayed with either PF or MDI (Methylenediphenyl diisocyanate) resin and either liquid or emulsified paraffin wax. The tumbling action of the strands through the drums allows the strands to mix thoroughly with the resin and wax.

OSB is formed by a dry process, which uses air to distribute the furnish. OSB is produced by deliberate mechanical lining-up of the strands. In the mechanical orientation processes, mats are produced by dropping long slender flakes between parallel plates or disks onto a moving caul (tray), belt, or screen. The boards are then hot pressed and finished.

strand lumber, made from long strands of veneer, is extruded with PF resin into various cross sections and widths. Parallel laminated veneer, or laminated veneer lumber (LVL), is constructed of veneers that are bonded together with phenol-formaldehyde (PF) adhesive resin to form a laminate. The veneers are layered with the wood grain along the long axis of the beam. Laminated veneer lumber is manufactured to typical lumber sizes (2 x 4, 2 x 6, etc.). The length of the beams that can be manufactured is varied using end joints or finger joints. Another application of LVL is in the construction of wood "I" joists (a small beam that resembles the letter "I"). LVL is used to construct the top and bottom (flanges) of the joist and OSB or plywood is used to construct the center (web).

Glulam beams are also emerging as a substitute for lumber. Glulam is short for glued-laminated structural timber – large beams fabricated by bonding layers of specially-selected lumber with Resorcinol or Resorcinol/PF adhesives and timber. End and edge jointing permit production of longer and wider structural wood members than are available naturally. Glulam timbers are used with structural wood panels for many types of heavy timber construction.

Most of the engineered lumber products are used as substitutes for structural softwood lumber of large sizes and in applications where uniform strength is essential. I-beams, however, are finding wide application, with extensive use as floor joists and beams for various structures. There are several advantages of composite lumber when compared with sawn softwood lumber. First, these products allow production of large sizes of lumber from small, low-grade logs. Normally, relatively large and high-grade sawlogs are needed for production of lumber of this size. Second, composite lumber compares advantageously to solid sawn lumber in terms of both uniformity of quality and straightness. While the quality of lumber is determined to a great extent by the raw material, the quality of the reconstituted product is dependent upon the manufacturing process. It is likely, however, that use of composite lumber will increase in the future.

Wood Preserving

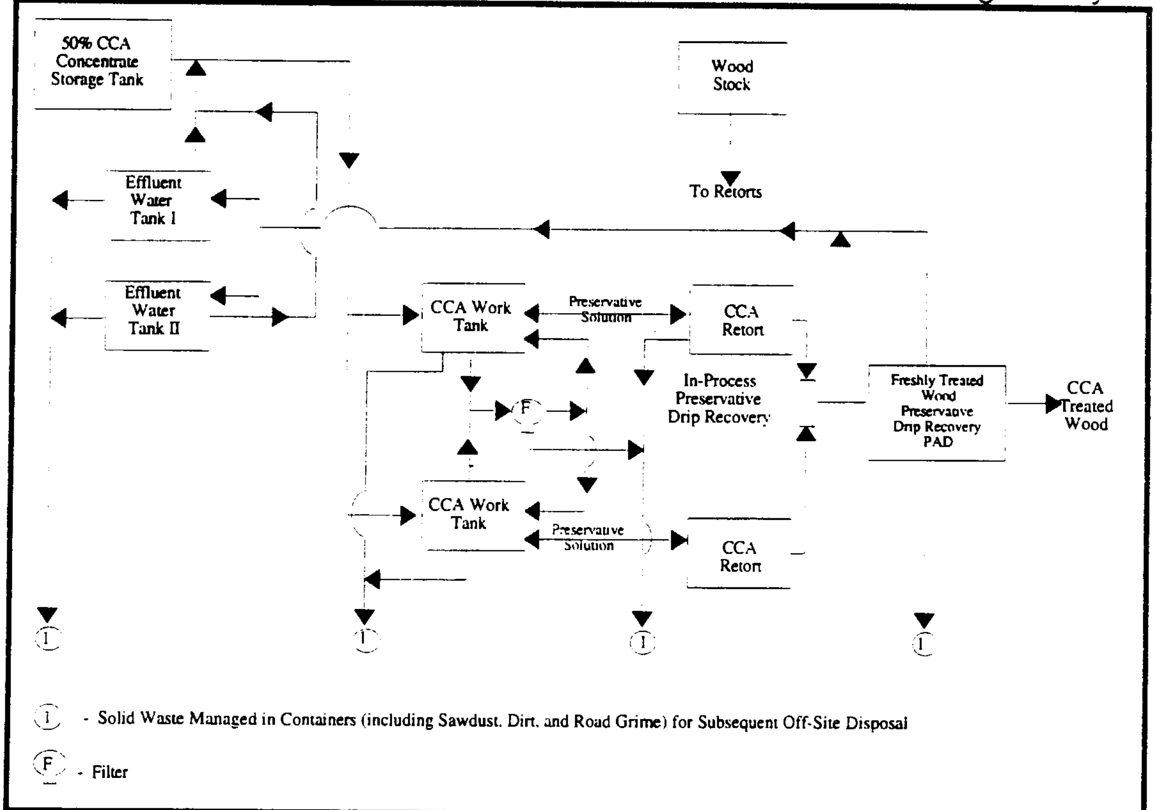
Wood is treated with preservatives to protect it from mechanical, physical, and chemical influences. Preserved wood is used primarily in the construction, railroad, and utilities industries to prevent rotting when wood is exposed to damp soil, standing water, or rain, and as protection against termites and marine borers. The most common preservatives include water-borne inorganics like chromated copper arsenate (CCA) and ammoniacal copper zinc arsenate (ACZA), and oil-borne organics like pentachlorophenol (PCP) and creosote. Generally, protection against termites and marine borers. The most common preservatives include water-borne inorganics like chromated copper arsenate (CCA) and ammoniacal copper zinc arsenate (ACZA), and oil-borne organics like pentachlorophenol (PCP) and creosote. Generally, water-borne inorganic solutions constitute approximately 78 percent of all preservatives used, while oil-borne creosote and PCP comprise 15 percent and 6 percent, respectively.

Creosote, PCP, and inorganic wood preservatives are all applied using similar processes. More than 90 percent of the wood preservation in the U.S. is performed using pressure treatment processes. Exhibit 10 illustrates a two-cylinder pressure treatment process for CCA. A limited quantity of wood is preserved using non-pressure treatment processes in which the preservative is allowed to diffuse into the wood. This process is used with some oil-borne preservatives, but not with waterborne inorganics.

The penetration required to adequately preserve wood can be achieved only if the wood has been conditioned properly; that is, if the moisture content of the freshly-cut wood is reduced to a point where the preservative can penetrate and be retained by the wood. Wood is usually conditioned in the open air or conditioned in the cylinder (retort) in which the pressure treatment is performed. The sawn lumber is sometimes incised to increase preservative penetration. Open air drying is typically used to prepare large stock for treatment with oil-borne preservatives. Other methods for conditioning wood prior to treatment with oil-borne preservatives include steaming, heating, and vapor drying. Kiln drying is used primarily for water-borne treatment. Conditioning is a major source of wastewater in the wood preserving industry.

After the moisture content of the wood has been reduced, the wood is preserved using either non-pressure or pressure methods. Non-pressure processes include brushing, spraying, dipping, soaking, and thermal processes. These processes involve the repeated use of preservative in a treatment tank with fresh preservative solution added to replace consumptive loss. The continual reuse of preservative leads to the accumulation of wood chips, sand, stones, and other debris contaminated with various hazardous constituents in the bottom of the treating tanks. This contaminated debris is a major source of process waste for non-pressure processes.

Exhibit 11
Example Flow Diagram For a Two-Cylinder CCA Pressure-Treating Facility



Source: *Title III, Section 313 Release Reporting Guidance; Office of Pesticides and Toxic Substances; March 1983.*

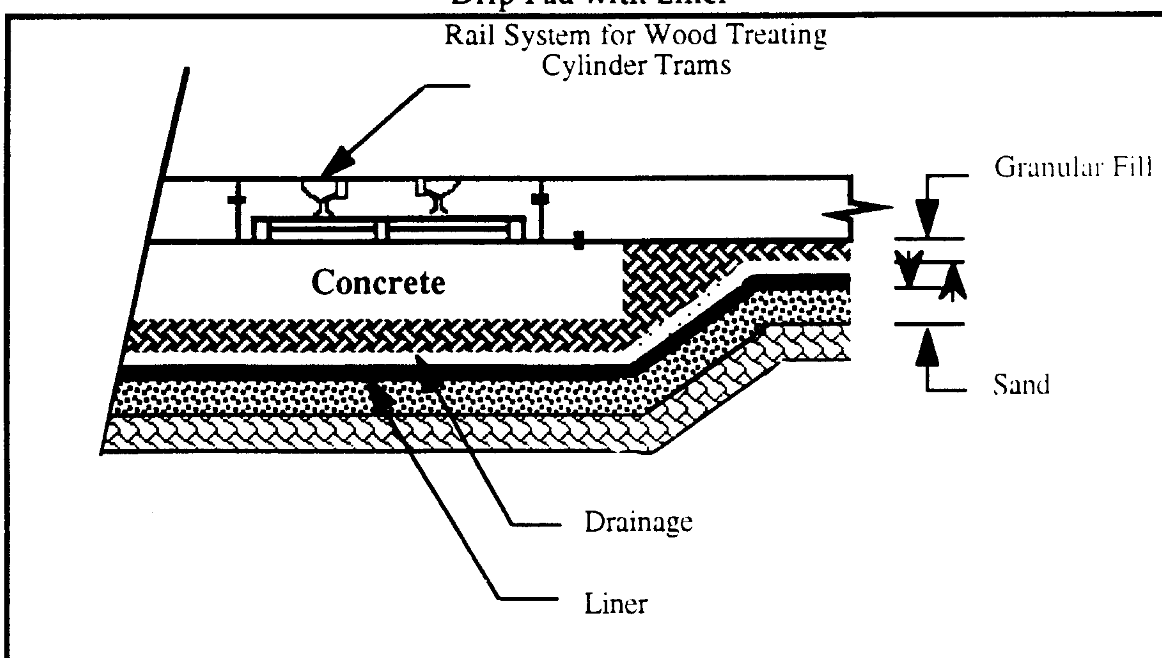
There are two basic types of pressure treatment processes, distinguished by the sequence in which vacuum and pressure are applied. These are "empty-cell" and "full-cell" or "modified full cell" processes. The terms "empty" and "full" are measures of the level of preservative retained by the wood cells.

"Empty-cell" processes obtain relatively deep penetration with limited absorption of preservative. In the Reuping empty-cell process, air pressure is applied to the wood as preservative is pumped into the treating cylinder. Once the desired level of retention has been achieved, the unused preservative is drained off and the excess preservative is vacuum pumped away from the wood. The process is the same in the Lowry empty-cell process, except no initial pressure is applied. In both processes, air compressed in the wood drives out part of the preservative absorbed during the pressure period when pressure is released.

R0075680

The second method, know as the "full-cell" (Bethel) process, results in higher retention of preservative but limited penetration compared to the empty-cell process. The full-cell or modified full cell procedures are used with both oil- and water-borne preservatives. A vacuum is created in the treating cylinder and preservative is pumped in without breaking the vacuum. Once full, hydrostatic or pneumatic pressure is applied until the wood will retain no more preservative. A final vacuum may then be applied to remove excess preservative, which is returned to the work tank for reuse. The treated wood is removed from the cylinder and placed on a drip pad where it remains until dripping has ceased (see Exhibit 12). Preservative solution, washdown water, and rainwater are collected on the drip pad and maintained in the process. At waterborne plants, these materials are transferred to a dilution water tank where they are blended with additional concentrate to make fresh treating solution. At oil-borne plants, these materials are processed to recover preservative and usable process water. Excess waste water is treated either on-site in a wastewater treatment unit or off-site at a publicly owned treatment works.

Exhibit 12
Drip Pad with Liner



Source: U.S. EPA.

R0075681

III.B. Raw Material Inputs and Pollution Outputs

Exhibit 13 provides an overview of the material inputs and pollution outputs for different processes in the lumber and wood products industry.

Logging

With the exception of concerns for species and ecosystem preservation, harvesting practices have minimal environmental impacts. Harvesting practices often cause discharges of materials into surrounding waters, threatening water quality standards. The Federal Water Protection Control Act regulates these discharges. In addition, road construction for access to timber areas is of concern, due to impacts on surrounding ecosystems.

R0075682

Exhibit 13
Process Materials Inputs and Pollution Outputs

Process	Material Input	Air Emissions	Process Waste	Other Waste
Logging	Trees, diesel, gasoline	PM-10, VOCs, CO, NOx	Not applicable	Waste wood particles
Sawing	Wood logs, diesel, gasoline	PM-10, VOCs, CO, NOx	Not applicable	Waste wood particles
Surface Protection	Wood, 3-Iodo-2-Propynyl Butyl Carbamate (IPBC), Didecyl Dimethyl Ammonium Chloride (DDAC)	IPBC, DDAC, ethyl alcohol, petroleum naphtha	Dripped formulation mixed with rainwater and facility washdown water	Sawdust, wood chips, sand, dirt, stones, tar, emulsified or polymerized oils
Plywood and Veneer	Veneer, phenol-formaldehyde resins, urea-formaldehyde resins, melamine-formaldehyde resins, sodium hydroxide, ammonium sulfate, acids, ammonia	PM-10, VOCs, CO, CO_2, NOx, formaldehyde, phenol, wood dust, condensable hydrocarbons, terpenes, methanol, acetic acid, ethanol, furfural	Not applicable	Waste wood particles, adhesive residues
Reconstituted Wood Products	Wood particles, strands, fiber, same resins as plywood and veneer, methylenediphenyl diisocyanate resins	PM-10, VOCs, CO, CO_2, NOx, formaldehyde, phenol, wood dust, condensable hydrocarbons, terpenes, methanol, acetic acid, ethanol, furfural	Not applicable	Waste wood particles, adhesive residues
Wood Preserving	Wood, pentachlorophenol, creosote, borates, ammonium compounds, inorganic formulations of chromium, copper, and arsenic, carrier oils	Pentachlorophenol, polycyclic organics, creosote, ammonia, boiler emissions, air-borne arsenics, VOCs	Dripped formulation mixed with rainwater and facility washdown water, kiln condensate, contact cooling water	Bottom sediment sludges, process residuals

Sawn Lumber

Most of the residual wood from sawn lumber production is reused as mulch, pulp, and furnish for some types of reconstituted wood panels; some is burned to produce steam or electricity. Studies cited by the Western Wood Products Association indicate that approximately 70 percent of a sawn log is utilized for lumber and other parts are used for co-products. Some of the small residuals are gathered with pneumatic systems for combination with larger amounts destined for use in other products. While there is virtually no waste from the manufacturing process because all parts of the log are used for one product or another, wood residuals are high in organic matter and can threaten aquifers if improperly handled.

A major emission of concern from wood boilers is particulate matter (PM), although other pollutants, particularly CO and organic compounds, may be emitted in significant quantities under poor operating conditions. Boilers that burn wood waste produce: fly ash, carbon monoxide, and volatile organic compounds (VOCs). New boilers must meet new source performance standards (NSPS) for air pollutants. In addition, mills are potential sources of toxic manganese air emissions.

Two types of primary waste streams are typically generated during the surface protection phase of sawn lumber production operations: process residuals and drippage. Secondary waste streams include spent formulations and wastewaters.

Typical process residuals from surface protection are tank sludges that accumulate in the dip tank and/or mix tank as a result of continuous reuse of the protectant. Some plants use spray systems that generate a sludge when recovered formulation is filtered. Periodically, the accumulated sludge must be removed, and is typically placed on sawdust or wood chip piles on-site. The ultimate destination of the sludge is dependent upon the management of the sawdust piles. Plants have reported burning sawdust on-site or shipping it off-site for use as boiler feed for energy recovery. Depending upon the particle size, some wood chips may be shipped to a pulp or paper mill.

Some plants generate little or no tank sludge as a result of certain process variations. Dip tank operations sometimes utilize an internal circulation system to enhance mixing and promote penetration into the packed bundles. The agitation does not allow any particulates to settle, and when the bundles are removed, some of the suspended solids are also removed. Green-chain operations sometimes use a system of rollers that are partially submerged into the dip tank. These rollers force the pieces of lumber under the surface of the formulation to ensure thorough coverage of the exposed surfaces. Forcing the lumber deeper into the tank physically drags the lumber through any sludge that has settled in the tank and this sludge leaves the tank with the treated lumber.

Another wastestream results from the excess formulation drippage from freshly surface protected lumber. In the absence of a drip pad, excess drippage can fall on the ground when the wood is transported from the dip tank or green chain to stacking and packaging areas. Spray operations tend to result in less excess formulation on the wood than either the dipping or green-chain operations. Some plants utilize simple recovery systems to minimize the loss of formulation. For example, pack dip operations hold the wood over the dip tank at an angle to collect excess formulation prior to transfer to storage. Green chain and spray operations may utilize a collection pan under the conveyor to collect formulation as the freshly treated lumber runs along the green chain.

Panel Products

In mills where chips or other furnish is generated on-site, operations such as debarking, sanding, chipping, grinding, and fiber separation generate PM emissions in the form of sawdust and wood particulate matter. The following discussion of pollution outputs from panel production is not divided along product lines. Instead, due to similarities in manufacturing process, this section describes pollution outputs during the drying and pressing stages, where most emissions occur.

Dryers

Organic aerosols and gaseous organic compounds, along with a small amount of wood fiber are found in the emissions from veneer impingement dryers. A mixture of organic compounds is driven from the green wood veneer as its water content is converted to steam in the drying process. Aerosols begin to form as the gaseous emissions are cooled below 302°F. These aerosols form visible emissions called blue haze.

Emissions from the rotating drum wood chip dryers used in reconstituted wood panel plants are composed of wood dust, condensable hydrocarbons, fly ash, organic compounds evaporated from the extractable portion of the wood, and may include products of combustion such as CO, CO_2, and NO_x if direct-fired units are used. The organic portion of industry emissions includes terpenes, resin and fatty acids, and combustion and pyrolysis products such as methanol, acetic acid, ethanol, formaldehyde, and furfural. The condensable hydrocarbons and a portion of the VOCs leave the dryer stack as vapor but condense at normal atmospheric temperatures to form liquid particles that create the blue haze. Both the VOCs and the liquid organic mist are combustion products and compounds evaporated from the wood. Quantities emitted are dependent on wood species, dryer temperature, and fuel used.

R0075685

One significant cause of blue haze is overloading a dryer by attempting to remove too much moisture within a given time. Overloading results in the introduction of green material to a high-temperature flame or gas stream causing a thermal shock that results in a rapid and excessive volatilizing of hydrocarbons that condense upon release to ambient air, causing the characteristic blue haze.

Another factor affecting the composition of the effluent from rotary drum dryers is inlet dryer temperatures. A study conducted in 1986 by The National Council of the Paper Industry for Air and Stream Improvement (NCASI) with data from five different mills using rotary drum dryers concluded that at inlet gas temperatures greater than 600°F, the emission rate of the total condensable portion of total gaseous nonmethane organics (TGNMO) increased as a function of temperature. The report concluded that the concentration of formaldehyde in the dryer exhaust was also directly related to dryer inlet temperature.

The type of wood species ~~burned~~ being dried also affects the composition of the effluent from rotary drum dryers. A second NCASI study concluded that high TGNMO emission rates from the dryers occurred when the wood species processed had high turpentine contents, such as Southern Pine. In a separate study on formaldehyde emissions, NCASI showed that dryers processing hardwood or a mixture of hardwood and softwood species had a moderate to dramatic increase in formaldehyde emissions at dryer inlet gas temperatures greater than 800°F, but dryers processing only softwood species had only a slight increase in formaldehyde emissions with increasing temperatures.

Presses

Emissions from board presses are dependent upon the type of resin used to bind the wood furnish together. Emissions from hot presses consist primarily of condensable organics. When the press opens, vapors that may include resin ingredients such as formaldehyde, phenol, MDI, and other organic compounds are released to the atmosphere through vents in the roof above the press. Formaldehyde emitted through press vents during pressing and board cooling operations is dependent upon the amount of excess formaldehyde in the resin as well as press temperature and cycle time.

Mole ratios are used to measure the number of moles of one compound to another in an adhesive. For example, the F:U (formaldehyde to urea) mole ratio measures the number of moles of formaldehyde to the number of moles of urea in the principal adhesive used for PB and MDF. The nature of the product and the process dictates the mole ratio of resin used. The ratio directly impacts the ultimate strength the resin will produce in the board, i.e., certain products require higher mole ratio resins to attain an adequate level of bond strength. The higher the mole ratio, the higher the board emissions of formaldehyde. Thus lowering the F:U mole ratio is one way of lowering press and board emissions of formaldehyde. However, mole ratio is only one of several variables that can effect formaldehyde emissions. Other variables include application rates, process rates, and the nature of the specific resin formations.

Higher press temperatures generally result in higher formaldehyde emissions. In an NCASI study, emissions of formaldehyde and phenol from PF resins (used mainly for OSB) and structural plywood were not found to be related to any operating procedures, but were affected by different resin compositions. The types of resins used can effect the amount of emissions. There was little information on emissions from the curing of MDI resins (used for OSB along with PF resins).

Wood Preserving

The chemicals used in the wood preserving process and the drip pads used to collect preservative drippage after treatment of wood have been the subject of considerable regulatory action. EPA has issued final regulations regarding wood preserving wastewater, process residuals, preservative drippage, and spent preservatives from wood preserving processes at facilities that use chlorophenolic formulations, creosote formulations, and inorganic preservatives containing arsenic or chromium.

There are six EPA-classified hazardous wastes from wood preserving operations. These are: U051, discarded unused creosote, F027, discarded unused pentachlorophenol-formulation; K001, bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote or PCP; F032, wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations; F034, wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations; and F035, wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium.

Drips and spills during the oilborne preservative process may occur during chemical delivery, chemical storage and mixing, freshly-treated wood storage on bare ground (if RCRA guidelines are not followed), and dry-treated wood storage on ground. Aerosols and vapors may be released to ambient air during chemical storage and mixing, solution storage, and during pressure treatment (once the cylinder is opened). Sludges result if filters are used prior to solution reuse from wastewater treatment, and from the collection sumps at the facility.

During the inorganic treatment process, additional vapors such as arsenic, may be released to ambient air during the pressure treating process, such as from the process tank or work vent during the initial vacuum stage, the flooding via vacuum, pressure relief and blow back, and the final vacuum. Aerosols and vapor may also be released from the cylinder door area during pressure treating and door opening.

Wood preserving facilities generate wastewater during the conditioning of the wood prior to its treatment and as a result of the condensation removed from the treatment cylinder. Rainwater, spills collected from the area around the treatment cylinder, and drip pad wash down water also contribute to wastewater volume. Typical air emissions sources are volatilization of organic chemicals during wastewater evaporation, vapors released from the treating cylinder during unloading and charging operations, and emissions from the vacuum vent during the treating cycle.

After both pressure and non-pressure treatment, some unabsorbed preservative formulation adheres to the treated wood surface. Eventually, this liquid drips from the wood or is washed off by precipitation. If the wood has been pressure treated, excess preservative will also exude slowly from the wood as it gradually returns to atmospheric pressure. This is known as "kickback." Current regulations specify that all wood must be drip-free prior to transfer from a drip pad to a storage yard. Also, storage-yard drippage resulting from "kickback" must be cleaned up within 72 hours of the occurrence. Preservative formulation may continue to exude from pressure and non-pressure treated wood for long periods, even after the wood is shipped off-site and installed for its intended end use. (See Exhibit 11 for schematic of wood preserving process and waste generation)

R0075688

III.C. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R. beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention and compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 14 shows that the lumber and wood products industry managed about 69 million pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 17 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 84 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (13.2 percent), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has increased and the portions treated or managed through energy recovery on-site have decreased between 1992 and 1995 (projected).

R0075689

Exhibit 14
Source Reduction and Recycling Activity for SIC 24

A	B	C	D	E	F	G	H	I	J
Year	Production Related Waste Volume (10^6lbs.)*	% Reported as Released and Transferred	On-Site			Off-Site			Remaining Releases and Disposal
			% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	
1992	33	45%	55.17%	0.10%	11.02%	0.06%	1.84%	2.12%	29.69%
1993	69	17%	78.30%	0.05%	5.90%	0.07%	1.36%	1.09%	13.23%
1994	66	—	79.59%	0.07%	5.32%	0.08%	0.86%	0.59%	13.50%
1995	63	—	79.15%	0.03%	5.63%	0.09%	0.74%	0.62%	13.72%

R0075690

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds.

Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Lumber and Wood Products Industry

TRI Release amounts listed below are not associated with non-compliance with environmental laws. These facilities appear based on self-reported data submitted to the Toxic Release Inventory program.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear in Exhibit 15. Exhibit 16 contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, Exhibit 16 includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Operations in Exhibit 16 include: 2621 - paper mills, 2611 - pulp mills, 2631 - paper mills, and 2812 - industrial inorganic chemicals. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibits 17-19 illustrate the TRI releases and transfers for the lumber and wood products industry (SIC 24). For the industry as a whole, VOCs (such as formaldehyde, xylene, toluene, and methanol) comprise the largest number of TRI releases. A large amount of VOC releases, both fugitive and point source emissions, result in part from the extensive use of glues and resins in this industry. VOCs are primarily released during the drying and pressing phases of most wood panel product manufacturing processes. VOC emissions are also associated with solvents used to coat cabinets, decorative panels, and toys.

Exhibit 15
Top 10 TRI Releasing Lumber and Wood Product Facilities (SIC 24 only)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	638,622	Merillat Ind. Inc.	Mount Jackson	VA
2	386,994	Component Concepts Inc.	Thomasville	NC
3	383,100	Child Craft Inc. Co. Inc.	Salem	IN
4	341,200	Afco Ind. Inc.	Holland	MI
5	261,000	Decolam Inc.	Orangeburg	SC
6	241,010	Abt Co. Inc.	Roaring River	NC
7	234,697	Weyerhaeuser Particleboard Mill	Adel	GA
8	199,000	J. H. Baxter & Co.	Weed	CA
9	197,800	Georgia-Pacific Corp. Monticello Panelboard	Monticello	GA
10	179,000	Northwood Panelboard Co.	Solway	MN

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 16
Top 10 TRI Releasing Lumber and Wood Product Facilities

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
2621, 2611, 2812, 2421	1,273,125	Weyerhaeuser Co.	Longview	WA
2621, 2421, 2436	1,187,356	MacMillian Bloedel Inc.	Pine Hill	AL
2611, 2621, 2631, 2421	1,059,615	Potlatch Corp. Pulp & Paperboard Group	Lewiston	ID
2631, 2436, 2499	768,369	Weyerhaeuser Co. Containerboard Packaging Div.	Springfield	OR
2426	638,622	Merillat Ind. Inc.	Mount Jackson	VA
2493	386,994	Component Concepts Inc.	Thomasville	NC
2435	383,100	Child Craft Inc. Co. Inc.	Salem	IN
2493	341,200	AFCO Ind. Inc.	Holland	NH
2439	261,000	Decolam, Inc.	Orangeburg	SC
2493	241,010	Abt Co. Inc.	Roaring River	NC

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on these lists does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 17
TRI Reporting Lumber and Wood Product Facilities (SIC 24) by State

State	Number of Facilities	State	Number of Facilities
AL	43	ND	1
AR	18	NH	1
AZ	2	NJ	4
CA	19	NM	1
CO	3	NV	1
CT	1	NY	6
FL	19	OH	8
GA	35	OK	3
HI	4	OR	24
ID	3	PA	19
IL	9	PR	3
IN	11	RI	1
KY	8	SC	20
LA	17	SD	2
MA	3	TN	12
MD	6	TX	27
ME	4	UT	1
MI	13	VA	24
MN	12	VT	1
MO	6	WA	10
MS	28	WI	18
MT	2	WV	5
NC	31	WY	2

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 18
Releases for Lumber and Wood Products (SIC 24) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	#/Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Arsenic Compounds	225	392	387	1661	0	5	2445	11
Chromium Compounds	223	397	392	2043	0	0	2832	13
Copper Compounds	222	397	397	2098	0	5	2897	13
Formaldehyde	69	318332	1832467	3500	0	1333	2155632	31241
Creosote	68	377646	641954	8016	0	943	1028559	15126
Arsenic	66	270	260	1451	0	5	1986	30
Copper	65	265	260	1192	0	250	1967	30
Chromium	63	255	245	1779	0	0	2279	36
Pentachlorophenol	36	5605	4206	2531	0	255	12597	350
Sulfuric Acid	25	10	48151	10	0	0	48171	1927
Ammonia	24	361205	264070	78011	0	7460	710746	29614
Methylenebis (Phenylisocyanate)	24	658	9857	0	0	0	10515	438
Phenol	18	20855	210255	2850	0	5	233965	12998
Methanol	14	130145	554849	0	0	8	685002	48929
Toluene	14	215435	715331	0	0	0	930766	66483
Xylene (Mixed Isomers)	12	52437	1005851	0	0	0	1058288	88191
Acetone	10	205915	180720	0	0	0	386635	38664
Methyl Ethyl Ketone	9	8469	481703	0	0	0	490172	54464
Phosphoric Acid	9	0	20	0	0	0	20	2
Hydrochloric Acid	8	0	0	0	0	0	0	0
Methyl Isobutyl Ketone	8	70864	121782	0	0	0	192646	24081
Zinc Compounds	5	0	0	255	0	5	260	52
Ammonium Sulfate (Solution)	4	0	0	5	0	0	5	1
Glycol Ethers	4	34600	65400	0	0	0	100000	25000
N-Butyl Alcohol	4	3199	89582	0	0	0	92781	23195
Naphthalene	4	10529	4852	0	0	1	15382	3846
Anthracene	3	2000	0	0	0	1	2001	667
Dibenzofuran	3	850	0	0	0	1	851	284
Ethylbenzene	2	1300	64644	0	0	0	65944	32972
Ethylene Glycol	2	1000	52900	0	0	0	53900	26950
Nitric Acid	2	0	1173	0	0	0	1173	587
Quinoline	2	272	0	0	0	1	273	137
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Antimony Compounds	1	0	0	0	0	0	0	0
Butyl Benzyl Phthalate	1	5	5	0	0	0	10	10
Chlorine	1	5	0	10	0	0	15	15
Di(2-Ethylhexyl) Phthalate	1	0	0	0	0	0	0	0
Dibutyl Phthalate	1	0	0	0	0	0	0	0
Dichloromethane	1	37000		0	0	0	37000	37000
Methyl Methacrylate	1	250	0	0	0	0	250	250
Styrene	1	0	0	0	0	0	0	0
Tetrachloroethylene	1	2	0	0	0	0	2	2
Toluene-2,4-Diisocyanate	1	68	36529	0	0	0	36597	36597
Zinc (Fume Or Dust)	1	5	5	5	0	0	15	15
Totals	**491**	**1,860,637**	**6,388,247**	**105,417**	**0**	**10,278**	**8,364,579**	**17,036**

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0075697

Exhibit 19
Transfers for Lumber and Wood Product (SIC 24) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Disharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Arsenic Compounds	225	0	90677		11192		101869	453
Chromium Compounds	223	0	82702		9494		92446	415
Copper Compounds	222	0	77164		9123		86287	389
Formaldehyde	69	120	1304		750	195	2369	34
Creosote	68	11502	1296906	18667	446558	636818	2410451	35448
Arsenic	66	16	81038		11910		92964	1409
Copper	65	35	54935		8090		63060	970
Chromium	63	7	99933		16200		116390	1847
Pentachlorophenol	36	1125	34860	1010	68963	40981	146939	4082
Sulfuric Acid	25	0					0	0
Ammonia	24	72250	1775				74025	3084
Methylenebis (Phenylisocyanate)	24	600	511		1300		2411	100
Phenol	18	750	15	500	1100		2365	131
Methanol	14	598	2550	4700		5800	13648	975
Toluene	14	0	4300	4800	17700	43400	70200	5014
Xylene (Mixed Isomers)	12	5		16333	1750	78619	96707	8059
Acetone	10	0				9242	9242	924
Methyl Ethyl Ketone	9	0	1700	1800		25990	29490	3277
Phosphoric Acid	9	250					250	28
Hydrochloric Acid	8	0					0	0
Methyl Isobutyl Ketone	8	0				109577	109577	13697
Zinc Compounds	5	0	1505		250		1755	351
Ammonium Sulfate (Solution)	4	0					0	0
Glycol Ethers	4	3060				4500	7560	1890
N-Butyl Alcohol	4	0		750	250	9447	10447	2612
Naphthalene	4	0			751		751	188
Anthracene	3	0			255		255	85
Dibenzofuran	3	0			751		751	250
Ethylbenzene	2	0		1737		3420	5157	2579
Ethylene Glycol	2	0					0	0
Nitric Acid	2	0					0	0
Quinoline	2	0			251		251	126
Ammonium Nitrate (Solution)	1	0					0	0
Antimony Compounds	1	0					0	0
Butyl Benzyl Phthalate	1	0					0	0
Chlorine	1	0					0	0
Di(2-Ethylhexyl) Phthalate	1	0					0	0
Dibutyl Phthalate	1	0					0	0
Dichloromethane	1	0				750	750	750
Methyl Methacrylate	1	300					300	300
Styrene	1	0			250		250	250
Tetrachloroethylene	1	0					0	0
Toluene-2,4-Diisocyanate	1	0					0	0
Zinc (Fume Or Dust)	1	5	5				10	10
Totals	**491**	**90,623**	**1,831,880**	**50,297**	**606,888**	**968,739**	**3,548,927**	**7,228**

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[1]. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

---

1 TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

The top TRI releases for the lumber and wood products industry (SIC 24) as whole include:

Acetone
Ammonia
Creosote
Formaldehyde
Methanol
Methyl ethyl ketone
Methyl isobutyl ketone
Phenol
Toluene
Xylenes (mixed isomers).

Acetone

Toxicity. Acetone is irritating to the eyes, nose, and throat. Symptoms of exposure to large quantities of acetone may include headache, unsteadiness, confusion, lassitude, drowsiness, vomiting, and respiratory depression.

Reactions of acetone (see environmental fate) in the lower atmosphere contribute to the formation of ground-level ozone. Ozone (a major component of urban smog) can affect the respiratory system, especially in sensitive individuals such as asthmatics or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released into water, acetone will be degraded by microorganisms or will evaporate into the atmosphere. Degradation by microorganisms will be the primary removal mechanism.

Acetone is highly volatile, and once it reaches the troposphere (lower atmosphere), it will react with other gases, contributing to the formation of ground-level ozone and other air pollutants. EPA is reevaluating acetone's reactivity in the lower atmosphere to determine whether this contribution is significant.

Physical Properties. Acetone is a volatile and flammable organic chemical.

Note: Acetone was removed from the list of TRI chemicals on June 16, 1995 (60 FR 31643) and will not be reported for 1994 or subsequent years.

Ammonia

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Formaldehyde

Toxicity. Ingestion of formaldehyde leads to damage to the mucous membranes of mouth, throat, and intestinal tract; severe pain, vomiting, and diarrhea result. Inhalation of low concentrations can lead to irritation of the eyes, nose, and respiratory tract. Inhalation of high concentrations of formaldehyde causes severe damage to the respiratory system and to the heart, and may even lead to death. Other symptoms from exposure to formaldehyde include: headache, weakness, rapid heartbeat, symptoms of shock, gastroenteritis, central nervous system depression, vertigo, stupor, reduced body temperature, and coma. Repeated contact with skin promotes allergic reactions, dermatitis, irritation, and hardening. Contact with eyes causes injuries ranging from minor, transient injury to permanent blindness, depending on the concentration of the formaldehyde solution. In addition, menstrual disorders and secondary sterility have been reported in women exposed to formaldehyde.

R0075701

Carcinogenicity. Formaldehyde is a probable human carcinogen via both inhalation and oral exposure, based on limited evidence in humans and sufficient evidence in animals.

Environmental Fate. Most formaldehyde is released to the environment as a gas, and is rapidly broken down by sunlight and reactions with atmospheric ions. Its initial oxidation product, formic acid, is a component of acid rain. The rest of the atmospheric formaldehyde is removed via dry deposition, rain or dissolution into surface waters. Biodegradation of formaldehyde in water takes place in a few days. Volatilization of formaldehyde dissolved in water is low. Bioaccumulation of formaldehyde does not occur.

When released onto the soil, aqueous solutions containing formaldehyde will leach through the soil. While formaldehyde is biodegradable under both aerobic and anaerobic conditions, its fate in soil and groundwater is unknown.

Although formaldehyde is found in remote areas, it is probably not transported there, but rather is likely a result of the local generation of formaldehyde from longer-lived precursors which have been transported there.

Methanol

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed 1 mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain.

Methanol is readily degraded by microorganisms in soils and surface waters.

Physical Properties. Methanol is highly flammable.

Methyl Ethyl Ketone

Toxicity. Breathing moderate amounts of methyl ethyl ketone (MEK) for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes, nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. No agreement exists over the carcinogenicity of MEK. One source believes MEK is a possible carcinogen in humans based on limited animal evidence. Other sources believe that there is insufficient evidence to make any statements about possible carcinogenicity.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a flammable liquid.

Toluene

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also affect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene is a volatile organic chemical.

Xylene (Mixed Isomers)

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylenes can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylenes (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur.

Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years.

Xylenes are volatile organic chemicals. As such, xylenes in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

IV.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 20 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 20
Pollutant Releases (Short Tons/Years)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97.208.000	23.402.000	45.489.000	7.836.000	21.888.000	23.312.000
Metal Mining	5.391	28.583	39.359	140.052	84.222	1.283
Nonmetal Mining	4.525	28.804	59.305	167.948	24.129	1.736
Lumber and Wood Products	**123,756**	**42.658**	**14,135**	**63,761**	**9.149**	**41.423**
Wood Furniture and Fixtures	2.069	2,981	2.165	3,178	1.606	59.426
Pulp and Paper	624.291	394.448	35.579	113.571	341.002	96.875
Printing	8,463	4.915	399	1,031	1.728	101.537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182.189	52,091
Organic Chemicals	146,947	236,826	26,493	44.860	132.459	201.888
Petroleum Refining	419.311	380.641	18.787	36,877	648.153	309.058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29.364	140.741
Stone, Clay, Glass, and Concrete	58.043	338.482	74.623	171,853	339.216	30.262
Iron and Steel	1.518.642	138.985	42.368	83.017	238.268	82.292
Nonferrous Metals	448.758	55.658	20.074	22.490	373.007	27.375
Fabricated Metals	3.851	16.424	1.185	3.136	4.019	102.186
Electronics	367	1.129	207	293	453	4.854
Motor Vehicles, Bodies. Parts. and Accessories	35.303	23,725	2.406	12.853	25.462	101.275
Dry Cleaning	101	179	3	28	152	7.310

Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

R0075705

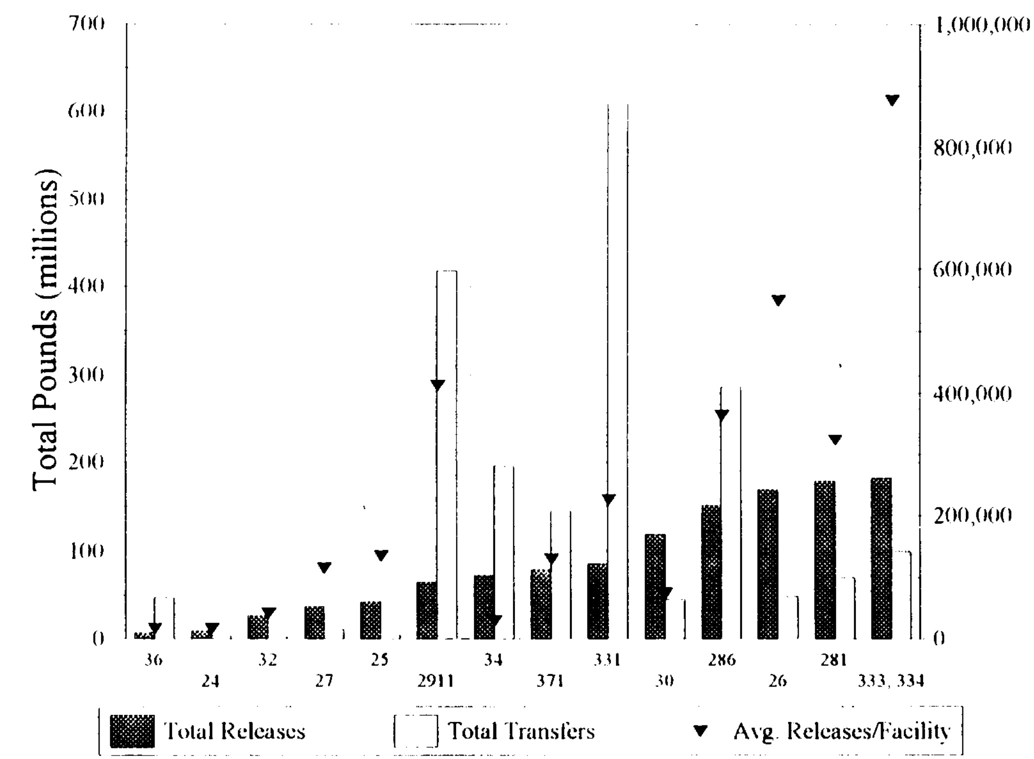
IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 21 is a graphical representation of a summary of the 1993 TRI data for the Lumber and Wood Products Industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 22 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of Lumber and Wood Products Industry, the 1993 TRI data presented here covers 491 facilities. These facilities listed SIC 24 Lumber and Wood Products as a primary SIC code.

R0075706

Exhibit 21: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accecessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0075707

Exhibit 22
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases: Total Releases (10^6 pounds)	Releases: Average Releases per Facility (pounds)	Transfers: 1993 Total (10^6 pounds)	Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (10^6 pounds)	Average Release+ Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	**24**	**491**	**8.4**	**17,036**	**3.5**	**7,228**	**11.9**	**24,000**
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronic Equipment	36	406	6.7	16,520	47.1	115,917	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	371	609	79.3	130,158	145.5	238,938	224.8	369,000
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72.0	30,476	195.7	82,802	267.7	123,000
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,269	98.2	472,335	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. Pollution Prevention Opportunities

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the lumber and wood products industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

Surface Protection

Several alternative manufacturing methods are part of the industry's pollution prevention efforts. One common alternative is to replace chemical treatment with another type of treatment to achieve surface protection. For example, the need for surface treatment would be decreased if efforts were made to dry the wood to reduce water content (high water content leads to sapstain). Due to economies of scale, this option may not be economically viable for a smaller mill.

Another pollution prevention option is the use of high velocity spray systems that generate fewer process residuals and less drippage. However, a small production volume may not favor this option since spray systems require a larger flow of wood through the systems to be economically or technically feasible.

Other pollution prevention strategies relating to surface protection include: 1) local and general ventilation within the cutting process area to reduce dust which would accumulate on wood; 2) blowing wood with air to further reduce sawdust on wood prior to surface protection; and 3) the use of drainage collection devices on roof tops to keep rainwater away from process wastes. For wastes that cannot be reduced at the source, generators may consider used surface protectant recycling as the next best option.

Panel Products

Air emissions from panel manufacturing are significantly greater than releases to water or land. The following information on pollution prevention options for the wood panel products industry (including veneer/plywood and reconstituted wood products) is from Martin and Northeim's summary.

Alternative Fiber Sources

One pollution prevention opportunity for the reconstituted wood panel industry is to search for alternative sources of wood fiber. This can be done in two ways: utilizing recycled wood waste and using existing agricultural fibers.

Increasing prices for raw wood furnish have led some firms to develop programs to recycle wood waste into chips for PB production. These firms collect construction site debris, discarded household items, crates, and used pallets for eventual use as PB furnish. Beyond finding sources, an ideal fiber recycling program includes extensive training and research on what materials are suitable, careful quality control of the recycled materials, and cleaning materials to remove foreign matter. There are many hurdles to properly cleaning the material because it is difficult to process different kinds of material and maintain a quality product.

A second alternative source for fiber is agricultural fiber, which can come from two sources: agricultural crops grown expressly for fiber (e.g., kenaf and bagasse) and residues of crops grown for other purposes (e.g., corn stalks/cobs and cotton stalks). Currently, two plants are being built in the U.S. that will use agricultural fiber to manufacture composite panels. In terms of potential availability, the amount of residual fiber generated by U.S. agriculture far exceeds present and future fiber requirements for composite panel manufacture. The feasibility of such a substitution, however, depends on many factors such as product quality, cost, and current uses of agriculture residues.

Alternative Adhesives

Other pollution prevention options in the panel products industry involve adhesive substitution. This involves replacing existing adhesives with less toxic formulations. There are a number of innovative adhesive options currently available for use in the panel products industry.

MDI Substitution

Based on price alone, there seems to be little incentive for manufacturers to switch from PF or UF to MDI adhesives. However, since the early 80's, one third of the OSB industry has switched from PF to MDI adhesives. According to their manufacturers, there are several environmental advantages to using these adhesives. Because MDI adhesives are capable of bonding wood flakes with a higher moisture content, less dryer energy is required to dry flakes suitable for MDI bonding. Other advantages to using MDI adhesives are lower press temperatures and shorter press cycles, both of which may lead to reduced press emissions. However, there are other concerns with respect to the use of MDI adhesives. Some companies are opposed to MDI substitution for reasons such as worker toxics exposure, potential acute impacts of possible spills, and inconsistency with toxic use reduction objectives. Manufacturers of MDI state that safe exposure levels are obtainable through good engineering controls which include making sure that blenders are well sealed, and that the blending and forming areas are well ventilated.

High Moisture Adhesives

Switching to an adhesive that is capable of bonding a high moisture furnish eliminates the need to dry wood to a low moisture content. Dryer energy and temperature can be reduced because less water must be removed from the wood. Press temperature can also be lowered since heat transfer is more efficient in high moisture furnish, reducing VOC emissions.

The gluing of high moisture content wood has become an established practice in plywood manufacture. Many OSB plants are switching to high moisture bonding adhesives with the primary goals of reducing dryer emissions and possibly reducing wood drying costs. Efforts have been made to improve phenolic resin technology to allow better bonding in the presence of water. The primary incentive for bonding high moisture veneer is a reduction in adhesive consumption. In the Southern plywood industry; where dryout is a problem, a dramatic reduction in adhesive use has been achieved by gluing high moisture veneer.

Naturally-derived Adhesives

Spurred by rapid price increases of petroleum-derived chemicals in adhesives such as PF and UF, chemical material suppliers, forest products companies, and wood adhesive/binder suppliers are expending research and development funds to search for renewable raw material sources. Substitutes could replace entirely, or at least partially, petroleum-derived chemicals now used in the manufacture of wood adhesives. Naturally-derived adhesives are included in this profile as a pollution prevention opportunity because of the potential to use renewable resources, which in many cases are by-products of other processes.

Furfuryl Alcohol Resins

Resins manufactured from furfuryl alcohol are being evaluated as an alternative low-VOC binder to substitute for PF resins. Unlike PF resins, furfuryl alcohol resins are stored stable at ambient temperatures, without refrigeration. As delivered, furfuryl alcohol resin contains very low amounts of volatile components. Upon curing, it reduces 80 to 90 percent of total VOC emissions, and reduces Hazardous Air Pollutants (HAPs) by the same amount. The furfuryl alcohol system offers the same relative speed of cure as the PF resin systems.

Furfuryl alcohol resin is currently in the experimental stage of development. The industry has shown little interest in the resin because of its high cost; which is twice that of a PF resin. However, cost analyses performed for the insulation industry show that using the resin to meet future HAP standards is cheaper than purchasing and operating control devices such as scrubbers. The same is likely true for the wood products industry.

Lignin Adhesives

Lignin is an aromatic polymer that makes up one of the three major components of wood (cellulose and hemicellulose are the others). The abundance of lignin as a waste product in pulp mills has made it a desirable raw material alternative to nonrenewable petroleum-derived chemicals in the production of wood adhesives.

Until recently, no more than 20 to 30 percent of lignin could be substituted into PF resins because cure times increased as the amount of lignin increased. Another drawback is that lignin adhesives have low cross-linking and strength. However, a new approach has recently been developed that can substitute large amounts of kraft lignin for PF adhesives while actually increasing cure speed and board strength.

Currently, Westvaco is the only company in the U.S. that operates a commercial lignin extraction facility. The capital cost of a new commercial lignin extraction facility compared to the capital cost of a new phenol plant is estimated to be almost equal per pound of product produced. However, because the selling price of lignin is only $0.32-0.34, compared to the selling price of phenol which is $.45/solid pound and rising, there is more of an economic incentive to build a new phenol plant than a lignin extraction facility.

Polyvinyl acetate (PVA)

There have been some mill trials and some small quantities of hardwood plywood made with cross-linked polyvinyl acetate (PVA) adhesives. Blends of PVA and UF are also sometimes used in the manufacture of hardwood plywood. Cross-linked PVAs are light in color, are compatible with the hardwood plywood manufacturing process, and don't require additional equipment. Concerns have been expressed about the potential of airborne release of vinyl monomers. PVA adhesives are considerably higher in cost than UF adhesives.

Alternative Manufacturing Processes

Veneer and Plywood Adhesive Reduction

In the softwood plywood industry, a common waste generated by the typical spray-line layup system is over-spray. A more efficient way of applying adhesive to veneer is by foam extrusion, a process in which foamed adhesive is forced under pressure to the extrusion head. This process better concentrates the glue stream onto the veneer, resulting in less wasted adhesive and less chance of adhesive dryout before pressing. In terms of economics, the combination of less waste and lower spread rates when using foam extruders can add up to savings in the 20 to 31 percent range, depending on the type of equipment used.

Another pollution prevention option in the softwood plywood industry is the variable application rate strategy (VARS). The amount of adhesive required to bond veneer varies with moisture content. For example, high moisture veneer requires less glue than low moisture veneer because there is less migration of water from the glue into the veneer. Although the moisture content of veneer varies at a typical plywood mill, glue is applied at a constant rate to prevent dryout of low moisture veneer. A 1992 study by Faust and Borders outlined in Forest

Products Journal, investigated the use of the glue application rate with respect to improved bond quality and reduced resin consumption. The variable application rate strategy (VARS) they developed adjusted the glue spread rate for each individual plywood panel according to its moisture content. Process-sensing and control technology has been developed for the practical application of VARS. Sensor technology is currently available for on-line adjustment and measurement of veneer moisture content and temperature. In addition to compensating for problem bonding conditions that occur unexpectedly during production, the greatest benefit of VARS from a pollution prevention standpoint is a reduction in adhesive consumption and, consequently a reduction in plant emissions.

Alternative Dryers

There are other process modifications that may be implemented to reduce emissions while drying green furnish for reconstituted wood panel manufacture. Researchers are currently investigating the use of alternative drying methods for raw wood furnish.

Rotary drum dryers are used in the OSB industry. These are typically characterized by high-temperature drying air, aggressive handling of strands, and short product-retention times. The adverse affects of these characteristics include VOC emissions and strand degradation. Research has shown that low-temperature drying reduces VOC emissions. However, this requires that the furnish be retained in the dryer for a longer period of time which is difficult to achieve in a rotary dryer. It has been found that conveyor belt dryers generate less VOC emissions than rotary dryers. Temperatures of less than 400°F and very low volumes of exhaust gases are possible with conveyor dryers, resulting in low emission levels of VOC, while virtually eliminating strand damage within the dryer. Conveyor dryers can also be used to dry PB furnish.

The three pass high velocity (3PHV) rotary drum dryer is a major breakthrough in rotary drum drying technology that has the potential to reduce VOC emissions significantly (see Exhibit 9). The 3PHV is a rotating cylindrical drum consisting of three, concentric, interlocking cylinders. Hot gases enter the outermost cylinder with the wood chips and progress through the intermediate and then the inner drum shells in a serpentine flow path. This flow path direction is the opposite of that in the conventional three-pass dryer. This reverse air flow may reduce VOC emissions.

In the first pass, the 3PHV dryer allows smaller, dried particles to pass through the slower moving mass of larger, wetter particles in an area bounded by the outer and intermediate drum cylinders. This area is much larger than the area of the inner drum of conventional triple pass dryers. As the larger particles are dried, they will "catch up" with the smaller faster moving particles in an area bounded by the intermediate (second pass) drum cylinder. Here, airflow velocities become high enough to convey the entire mass of particles out of the drying portion of the drum and into the inner (third pass) drum cylinder where they will be conveyed out of the dryer. This action prevents the product from reaching temperatures in excess of the wet bulb temperature, thus reducing carbon monoxide and hydrocarbon emissions associated with pyrolysis and combustion of the wood chips.

Wood Preserving

Water-borne preservatives produce less waste than oil-borne preservatives because process wastewater is reused rather than discharged. In addition, well designed treatment plants, good treatment practices, effective housekeeping, and employee training also help reduce waste at the source.

Well designed treatment plants may have enclosed treatment buildings, covered drip pads with liners, automatic lumber handling systems, centralized tank farms with spill containment, and air ventilation systems. The RCRA standards in 40 CFR 264 and 265 require that drip pads must contain drippage, be free of cracks and gaps, and be cleaned and inspected. Plants can also be designed to minimize mist or droplet emissions from cylinders and work tanks through the use of air exchange systems and cylinder and tank venting.

Treatment practices are also important for preventing pollution. Ensuring that wood stock is clean prior to treatment will prevent dirt, sawdust, and other debris from accumulating in the treatment system. To prevent debris buildup, wood can be covered during shipment and/or power-washed when necessary before it enters the treatment plant. Strip pumps may be installed to continuously return residual chemical solutions to the work tank, resulting in less dripping when the cylinder doors are opened. If treating cylinders are tilted slightly away from the drip pad, there is also less spillage when opening the cylinder doors.

Housekeeping is an integral part of waste minimization efforts. All tanks, mixing systems, treating cylinders, drip pads, and spill containments should be inspected regularly for leaks. Drip pads and collection areas should be kept clean. Storage yards should be inspected daily, and any drippage detected should be cleaned up within 24 hours.

Several other preservatives have been proposed as alternatives to traditional preservatives. For example, wood can be treated with borates using both pressure and non-pressure processes. However, because they are highly susceptible to leaching, borates cannot be used to preserve wood that will be in contact with the ground or exposed to the weather (e.g., decking).

Ammoniacal copper/quarternary ammonium (ACQ) is another proposed alternative. Initial above-ground field test data show that ACQ is effective for softwood and hardwood protection. Other alternative preservatives may include copper-8-quinolinolate (Cu_8), copper naphthanate, zinc naphthanate, quarternary NH_4 compounds (QAC), and zinc sulfate.

Treatment processes may vary in their ability to minimize waste. For example, the empty-cell process uses less carrier oil than the full-cell process for oil-borne preservatives. The modified full-cell treatment reduces the uptake of treating solution and minimizes the amount of dripping for water-borne preservatives.

Pollution Prevention Case Studies

Reconstituted Wood Products

By late 1995, CanFibre hopes to start up its first plant to produce MDF using 100 percent post-consumer waste and PF adhesives. The plant (the first of its kind in North America) will be located near Toronto, Ontario. Approximately 1.2 million ft^3 per year of structural MDF will be produced from recycled urban waste such as waste wood, cardboard, drink containers, newspaper, etc. The plant will have two significant cost advantages over conventional MDF plants: (1) the costs of post-consumer waste is currently negative, and (2) savings in freight costs due to the plant's location near an urban site (most existing MDF plants are remotely located and the cost of hauling wood waste back to these mills is high). The net mill cost for the process used by the firm's Toronto plant is estimated to be $183/million square feet (MSF) versus $228/MSF for a conventional plant. The company plans to build a total of nine plants in North America: six in the U.S. and three in Canada. All plants will use 100 percent post-consumer waste and PF adhesives.

Wood Preserving

Perry Builders, Inc. employs 20 people at its Henderson pressure wood preserving manufacturing facility. Perry Builders recognizes that each wood treater has an important responsibility in properly handling and disposing of the wastes it produces and is committed to meeting this challenge. Perry uses a water-borne chemical preservative; chromated copper arsenate, to treat lumber, plywood, timbers, and other wood products for decks, fences, and other outdoor uses. Hazardous waste results from contact of sawdust, wood chips, and dirt with the preservative. It has successfully minimized its hazardous waste generation by 80 percent in two years with the implementation of a low-cost waste minimization program. In 1987, Perry Builders generated 15 drums of hazardous waste with a disposal cost of $2,380. By 1989 Perry Builders reduced its disposal cost to $310 by generating only two drums.

This reduction was achieved by changing both equipment and processes to achieve a fully integrated closed system in which the application, receipt, transfer, and storage of the preservation takes place in a contained area.

The goal is to apply the preservative to the wood while minimizing the loss of the preservative as a waste. By holding the lumber in the treatment chamber longer to allow drippage, and by using a vacuum pump to further dry the lumber, the treatment solution remains in the chamber and does not come into contact with scrap material and dirt. As an incentive to employees to assure adequate drying time, management instituted pay based on hourly wages rather than an amount of lumber treated. A roof over the area housing the treated lumber prevents runoff during rainfall.

Perry Builders estimates that the cost of the vacuum pump, the roof, and the increased drying time will be recovered in five years through reduced disposal costs. There is also another economic benefit-since the drier lumber weighs less, more footage of lumber can be shipped on each truck, thereby reducing freight costs.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

R0075718

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.
- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.
- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.
- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.
- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.
- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund

Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.
- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.
- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.
- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The

Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Requirements

Clean Air Act (CAA)

Under the Clean Air Act, PM_{10}, (particulate matter with an aerodynamic diameter of 10 microns or less) and volatile organic compounds (VOCs) are regulated to ensure attainment with the National Ambient Air Quality Standards for PM_{10} and ground level ozone (VOCs contribute to the formation of ground level ozone). Wood products have the potential to emit PM_{10} and VOCs in significant quantities.

As required by §110 of the CAA, State Implementation Plans (SIPs) must be developed to identify sources of air pollution and determine what reductions are required to meet Federal standards. An important compliance component of these SIPs are generic opacity limits, which dictate that no stack shall have emissions above a certain percent opacity. Within the wood products industry, these regulations apply to hog fuel boilers and veneer dryers. The standard limit for emissions of all kinds is 20 percent opacity, meaning that only 80 percent of light is able to pass through the plume. However, some States provide exceptions to the opacity limits for certain industries or manufacturing processes depending on the state's SIP.

Also written into each SIP are provisions that require all new stationary sources constructed in a National Ambient Air Quality Standards (NAAQ) attainment area and that have the potential to emit above a specified tonnage per year to install best available control technology (BACT). In addition, these facilities need to obtain a Prevention of Significant Deterioration (PSD) permit (40 CFR 52.21).

Standards of Performance for Fossil Fuel Fired Steam Generating Units (40 CFR 60.40, subpart D), apply to any fossil fuel-fired and wood residue fired steam generating unit that commences construction modification or reconstruction after August 17, 1971, and that has a heat input capacity derived from fossil fuels of greater than 73 megawatts (250 mm BTU/hr). Unlike subparts Db and Dc, descriptions of which follow, the contribution of heat from wood fuels is not considered in determining the heat input capacity since it is not a fossil fuel. The regulation addresses emission standards, compliance and performance test methods, monitoring requirements (including continuous opacity monitoring systems), and reporting requirements for particulate matter, nitrogen oxides, and sulfur dioxide.

Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units (40 CFR 60.40b, subpart Db), apply to any steam generating unit that commences construction, modification, or reconstruction after June 19, 1984 and that has a heat input (heat derived from combustion of fuel only, not exhaust gases, etc.) capacity of at least 29 MW. This includes steam generating units that use wood as a source of fuel. The regulation addresses emission standards, compliance and performance test methods, monitoring requirements, and reporting requirements for particulate matter, nitrogen oxides, and sulfur dioxide. Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units (40 CFR 60.40c, Subpart Dc), apply to any small steam generating unit (2.9 MW to 29 MW) that commences construction, modification, or reconstruction, after June 9, 1989. The regulation addresses requirements for particulate matter and sulfur dioxide emissions.

In addition to applying to steam generating units in general (including wood-fueled plants), the subparts make several specific references to wood-fueled plants. With regard to small units, the regulation provides:

- A formula for allowable sulfur dioxide emissions (based on the amount of fuel used) that excludes wood from the calculation of fuel used
- Particulate matter standards for facilities that combust wood
- Opacity standards for facilities that combust wood
- Nitrogen oxide standards for facilities that combust combinations of wood and other fuels
- Compliance procedures for facilities that combust combinations of wood and other fuels.

Clean Water Act (CWA)

Facilities in the lumber and wood products industry that discharge treated wastewaters from point sources to surface waters of the U.S. must obtain a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit program is authorized by Section 402 of the CWA and is implemented through 40 CFR Parts 122 through 124. Other parts of the CFR affecting the NPDES program include Part 125 (technology-based standards), Part 129 (toxic pollutant standards), and Part 130 (water quality-based standards). Discharges to publicly-owned treatment works (POTWs) are subject to the pretreatment standards in 40 CFR Part 403.

Technology-based permit limits are derived from effluent limitation guidelines and standards (ELG); 40 CFR Part 429 for this industry. These limitations incorporate both technology-based and water quality-based limits, depending on which is more protective. Effluent guidelines subdivide the industry based on the following production operations:

- Veneer
- Plywood
- Dry process hardboard
- Wet process hardboard
- Wood preserving—water-borne or nonpressure
- Wood preserving—steam
- Wood preserving—Boulton.

The guidelines set limitations for the pollutants of concern (i.e., BOD_5, TSS, pH, COD, phenols, and oil and grease for those facilities in the wood preserving subcategory).

Resource Conservation and Recovery Act (RCRA)

Wood Preserving Final Rule

EPA amended regulations under RCRA (57 Federal Register 61502, December 30, 1992) by listing as hazardous three categories of wastes generated by wood preserving operations that use chlorophenolic, creosote, and/or inorganic (arsenical and chromium) preservatives.

The listed wastes include wastewaters, process residuals, preservative drippage, and spent preservatives from wood preserving processes at facilities that use or have previously used chlorophenolic formulations, facilities that use creosote formulations, and facilities that use inorganic preservatives containing arsenic or chromium.

Specifically, the following RCRA-regulated hazardous wastes are related to wood preserving operations:

- K001 (bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote or PCP),
- F032 (wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations),
- F034 (wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations), and
- F035 (wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium).

The rule includes permitting and interim status standards for the drip pads used to assist in the collection of treated wood drippage. These standards include requirements for drip pad design, operation, inspection, and closure.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), of 1947 (7 U.S.C. 136) requires registration of pesticides to protect consumers from mislabeled, defective, and ineffective pesticides and to identify products that might be harmful to public health or the environment even when used properly. FIFRA has been amended several times: in 1972, 1975, 1978, 1980, 1988, and 1991. The primary purpose of the 1972 amendments was to ensure that pesticide use would be subject to a thorough review of environmental and human health hazards. The 1988 amendments established schedules and duties for re-registration of pesticides.

Under FIFRA, a registered pesticide must be used in a manner consistent with its label. A registered pesticide may be used in a manner inconsistent with its label in the following situations, unless specifically prohibited by the label:

- Applying a pesticide at a dosage, concentration, or frequency less than that specified on the label
- Applying a pesticide against a pest not specified on the label if the application is to a crop, animal, or site that is specified on the label
- Employing a method of application not specifically prohibited by the label
- Mixing a pesticide with a fertilizer
- Applying a pesticide in conformance with an experimental use permit, or a specific exemption of a Federal or State agency
- Applying a pesticide in a manner that the Administrator determines is consistent with the purposes of FIFRA.

Use of a registered pesticide in a manner inconsistent with its label is unlawful in all other situations.

In addition, the Administrator has the authority to classify pesticides as being for general use or for restricted use only. Pesticides classified as for restricted use only include creosote, pentachlorophenol, and inorganic salts such as chromated copper arsenate, all of which are used in wood-preserving solutions. Such pesticides must be applied only by a certified applicator or under the direct supervision of a certified applicator (section 136j(a)(1)(F)). Standards for certification are established by the Federal government or by State governments with Federal approval.

In a notice published in the Federal Register on January 10, 1986 (Vol. 51, No. 7, January 10, 1986, p. 1334-1348), the EPA established several conditions for registering creosote, pentachlorophenol, and inorganic arsenicals for use in wood preserving, to ensure that such use would not endanger human health standards. EPA and the wood preserving industry agreed that the industry would establish a voluntary Consumer Awareness Program to educate consumers in the proper use of and precautionary practices regarding wood treated with creosote, pentachlorophenol, and inorganic arsenicals, to ensure that such uses would not endanger health standards. Through the program, information about treated wood is disseminated in an information sheet provided to end-users at the time of sale or delivery. An earlier Federal Register notice of July 13, 1984 established terms of registration under which the wood preserving industry agreed to establish air monitoring systems at facilities using formulations containing arsenic.

VI.C. Pending and Proposed Regulatory Requirements

RCRA

As part of EPA's groundwater protection strategy, RCRA prohibits the land disposal of most hazardous wastes until they meet a waste specific treatment standard. While most hazardous wastes have already been assigned treatment standards, EPA must still promulgate two additional rule makings to address newly listed wastes and to make changes to the land disposal restrictions (LDR) program.

When finalized, the Phase III LDR rulemaking will establish treatment standards for some newly listed wastes and will mandate RCRA equivalent treatment be performed upon certain characteristically hazardous wastes that are injected into UIC wells under the Safe Drinking Water Act (SDWA) or managed in Subtitle D surface impoundments prior to discharge pursuant to the Clean Water Act (CWA). By consent decree, EPA must promulgate the final rule for Phase III by January 1996.

Phase IV will similarly restrict other newly listed or identified wastes from land disposal and create influent treatment standards to mitigate the impact of sludges, leaks, and air emissions from surface impoundments that manage decharacterized wastes. Of particular significance to wood preserving industries, Phase IV will restrict the land disposal of F032, F034, and F035. Once the prohibitions for these wastes become effective, they will need to meet numeric treatment levels for specific hazardous constituents commonly found in F032, F034, and F035. Phase IV will also restrict the land disposal of the previously exempt Bevill wastes and adjust the treatment standards applicable to wastes that exhibit the toxicity characteristic for a metal

R0075734

constituent. Subject to the same consent decree, Phase IV has been assigned a final judicial deadline of June 1996.

Clean Air Act

Many of the chemicals used for wood preserving are listed as hazardous air pollutants (HAPs) in Section 112 of the Clean Air Act Amendments of 1990. Treatment processes have been identified as potentially significant sources of these HAPs and, as such, are source categories for which national emission standards may be necessary.

Three emissions standards based on "maximum achievable control technology" (MACT) will be developed for products covered by SIC 24: a wood treatment MACT standard is due by November 15, 1997; a plywood/PB manufacturing MACT standard is due by November 15, 2000; and a flat wood paneling (surface coating) MACT standard is due by November 15, 2000. The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

R0075736

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[2] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS

2 EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

R0075737

identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

R0075738

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Lumber and Wood Products Industry Compliance History

Exhibit 23 provides a Regional breakdown of the five-year enforcement and compliance activities for the lumber and wood products industry. Region IV conducted almost 50 percent of the inspections of lumber and wood product manufacturing facilities performed in the U.S. This large percentage is due to the concentration of lumber and wood product manufacturers in the Southeastern U.S. The exhibit also indicates that 100 percent of the enforcement actions in Regions II and VII were lead by the State while 100 percent of the enforcement actions in Region VIII were lead by EPA.

R0075740

Exhibit 23
Five Year Enforcement and Compliance Summary for the Lumber and Wood Industry

A	B	C	D	E	F	G	H	I	J
Lumber and Wood SIC 24	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	11	9	29	24	4	3	0%	100%	0.10
Region II	13	11	49	17	1	6	100%	0%	0.12
Region II	60	40	276	14	11	25	88%	12%	0.09
Region IV	189	123	1,072	11	40	105	88%	12%	0.10
Region V	74	44	203	23	14	29	59%	41%	0.14
Region VI	67	39	239	18	23	59	80%	20%	0.25
Region VII	5	4	31	10	2	2	100%	0%	0.06
Region VIII	12	6	32	24	2	—	0%	0%	0
Region IX	26	20	126	13	9	19	58%	42%	0.15
Region X	37	27	120	19	7	10	60%	40%	0.08
Total/Average	494	323	2,177	14	113	258	79%	21%	0.12

R0075741

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 24-27 contain summaries of the one and five year enforcement and compliance activities for the lumber and wood products industry, as well as for other selected industries. As indicated in Exhibits 24 and 25, the lumber and wood products industry has an average enforcement to inspection rate compared to other industries. Exhibits 26 and 27 provide a breakdown of inspection and enforcement activities by statute. Of all inspections of lumber and wood products industry facilities, approximately 59 percent were performed under the Resource Conservation and Recovery Act, while approximately 31 percent were conducted under the Clean Air Act. The large percentages of RCRA and CAA inspections for this industry are due in part to facility construction requirements for wood preserving facilities under RCRA, and emissions standards under CAA.

Exhibit 24
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	**464**	**301**	**1,891**	**15**	**78**	**232**	**79%**	**21%**	**0.12**
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 25
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	**464**	**142**	**268**	**109**	**77%**	**18**	**13%**	**42**	**0.15**
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics/Computers	405	60	87	80	133%	8	13%	21	0.24
Motor Vehicle Assembly	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 26
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	**301**	**1,891**	**232**	**31%**	**21%**	**8%**	**7%**	**59%**	**67%**	**2%**	**5%**
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

* Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Chemical Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

Exhibit 27
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	**142**	**268**	**42**	**29%**	**20%**	**8%**	**13%**	**63%**	**61%**	**<1%**	**6%**
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

*Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Chemical Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

R0075746

VII.C. Review of Major Legal Actions

VII.C.1. Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* publications, nine significant enforcement cases were resolved between 1991 and 1993 for the lumber and wood products industry. CAA violations comprised four of these cases, the most of any statute. The remaining cases were distributed fairly evenly, with CERCLA cited twice, RCRA cited twice, and FIFRA cited once.

Three of the CAA violations involved excessive hog fuel (waste wood) boiler emissions. Each of these settlements include Supplemental Environmental Projects (SEPs), such as the installation of boiler precipitators, and penalties were usually under $100,000. A notable exception, however, is *U.S. v. Louisiana-Pacific Corporation and Kirby Forest Industries* (1993). The case involved numerous violations of State Implementation Plans, Prevention of Significant Deterioration requirements, New Source Review requirements, and State permit requirements at its Louisiana-Pacific facilities. The penalty assessed in this case represents the largest CAA civil penalty ever collected by EPA, and the second largest penalty recovered under any environmental statute. Under the terms of a consent decree, Louisiana-Pacific was required to pay $11.1 million in civil penalties and was required to install state-of-the-art pollution control equipment valued at $70 million.

The remaining enforcement actions (under CERCLA, RCRA, and FIFRA) involved sites with contamination caused by wood treatment processes. Penalties assessed against responsible parties at these sites ranged from $68,000 to $350,000. In addition, a CERCLA settlement at the Koppers NPL site required Beazer East, Inc. to perform design, construction, operation, and maintenance of an operable unit valued at approximately $77 million.

VII.C.2. Supplemental Environmental Projects (SEPs)

Supplementary Environmental Projects (SEPs) are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement to provide information on the number and type of SEPs entered into by the Regions. Exhibit 28 contains a representative sample of the Regional responses addressing the lumber and wood products industry. The information contained in the chart is not comprehensive and provides only a sample of the types of SEPs developed for the lumber and wood products industry.

R0075748

Exhibit 28
Supplemental Environmental Projects
Lumber/Wood (SIC 24)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Louisiana-Pacific Corporation Moyie Springs, ID	10	CAA-SIP	Pollution Reduction	$ 102,950	Installation of electrified filter bed to reduce particulate emissions.	$ 67,972	$ 33,986
Merritt Brothers Lumber Company Priest River, ID	10	CAA-SIP	Pollution Reduction	$ 213,881	Installation of electrostatic precipitator to reduce particualte emissions.	$ 20,208	$ 10,104
Rosboro Lumber Company Springfield, OR	10	TSCA	Pollution Reduction	$ 37,230	Early disposal of PCB and PCB-contaminated electrical equipment.	$ 37,230	$ 18,615
JD Lumber, Inc. Priest River, ID	10	CAA-SIP	Pollution Prevention	$ 58,000	Purchase and installation of "hog" machine to reduce particulate emissions.	$ 17,500	$ 8,750
Riley Creek Lumber Company Laclede, ID	10	CAA-SIP	Pollution Reduction	$ 254,000	Purchase and installation of electrostatic precipitator to reduce particulate emissions.	$ 20,000	$ 10,000
Georgia Pacific Zachary, LA	6	CERCLA	Equipment Donation	$ 6,000	Donate emergency and/or computer equipment to the Local Emergency Planning Committee (LEPC) to respond to and/or plan for chemical emergencies. Participate in LEPC activities.	$ 25,000	$ 5,000

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Initiatives

EPA Region X conducted the "Idaho Rule Effectiveness Study" from March 1991 through October 1992 in the Idaho Panhandle. The study focused on sources of PM and was designed to evaluate the effectiveness of Idaho rules regulating particulate emissions: the sources selected for the study, which included many wood products facilities, were located in or near suspected PM10 non-attainment areas. Inspections evaluated the compliance status of 26 sources with respect to Idaho rules concerning emissions limitations, visible emissions limitations for wigwam burners, permits to construct, operating permits, and particulate standards for combustion sources.

EPA's impression following completion of the study was that existing controls were not adequate to comply with applicable regulations. A majority of sources used multiclones as their primary control device. Equipment was not routinely maintained; sources did not appear to have a routine operation and maintenance program (O&M); and many mill managers had little knowledge of the air quality regulations that applied to their facility.

A second conclusion reached by EPA was that environmental responsibilities were secondary to those related to the operation of the mill. Even at the largest facilities, the manager of the mill was also responsible for environmental compliance and reported to a production-oriented management structure.

The study resulted in the following actions and lessons learned:

- Five facilities installed air pollution control equipment that will permanently reduce PM10 emissions by 415 tons/year. These installations were in response to enforcement actions issued by the Region during the study. Two additional facilities eliminated wood waste incineration entirely, reducing PM10 emissions by over 250 tons/year;

R0075750

- General industry awareness of environmental regulations has been improved substantially as a result of the initiated inspections, subsequent enforcement actions, and meetings with EPA;
- It is important for a regulatory agency to conduct unannounced inspections;
- After meeting with EPA, an industry group sponsored an opacity certification school in October 1991 which was attended by numerous industry representatives. Additional certifications have been held each April and October since then;
- The problem of wood waste disposal is not only an air quality problem. Resolution of the enforcement cases developed in this study showed that recognition should be given to multimedia environmental impacts;
- Most of the sources will need to obtain operating permits.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who met their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

Twenty-four companies and 43 facilities listed under SIC 24 (lumber and wood products) are currently participating in the 33/50 program. They account for approximately nine percent of the 491 companies under SIC 24. This is lower than the average for all industries of 14 percent participation. (Contact: Mike Burns 202-260-6394 or the 33/50 Program 202-260-6907)

Exhibit 29 lists those companies participating in the 33/50 program that reported under SIC code 24 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to Lumber and Wood Products manufacturing. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 29
Lumber and Wood Facilities Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Blue Circle America Inc	Marietta	GA	2491	1	250	*
C. M. Tucker Lumber Corp.	Pageland	SC	2491	2	1,000	*
Elco Forest Products Inc	Opelousas	LA	2491	1	0	75
Flagship Trading Corp	Cleveland	OH	2491	1	250	***
Georgia-Pacific Corporation	Atlanta	GA	2493	3	2,722,182	50
Hagerwood Inc	Grand Rapids	MI	2491	2	1,000	*
Honolulu Wood Treating Co.	Ewa Beach	HI	2491	1	256	50
Hutchens Industries Inc	Springfield	MO	3799, 3325, 2421	1	298,000	68
International Paper Company	Purchase	NY	2435	5	2,784,831	50
Julian Lumber Co Inc	Antlers	OK	2491	1	250	50
Louisiana-Pacific Corporation	Portland	OR	2421, 2435	5	294,823	50
Mascotech	Taylor	MI	2426	1	3,163,830	35
Potlatch Corporation	San Francisco	CA	2431, 2426	2	276,643	60
Premark International Inc	Deerfield	IL	2436	3	140,313	***
R L C Industries Co	Dillard	OR	2435, 2436	1	129,083	48
States Industries Inc	Eugene	OR	2435	1	16,272	50
Tarkett North Amercn Holdings	Parsippany	NJ	2426	1	30,190	35
Taylor-Ramsey Corporation	Madison Heights	VA	2491	1	255	***
Thrift Brothers Lumber Co Inc	Westminster	SC	2491	1	510	*
Tri-State Pole & Piling Inc	Lucedale	MS	2491	1	71,255	*
Union Camp Corporation	Wayne	NJ	2611, 2621,2631	1	835,696	50
Weyerhaeuser Company	Tacoma	WA	2491	5	1,006,356	*
Willamette Industries Inc	Portland	OR	2493	1	677,090	34
Wood Preservers Inc	Warsaw	VA	2491	1	31	50

*** = not quantifiable against 1988 data.**
**** = use reduction goal only.**
***** = no numerical goal.**

R0075752

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at 202-233-9065 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, 202-260-0700 or the WasteWi$e Hotline at 1-800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, 202-260-4407)

NICE³

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE³). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, 303-275-4729)

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Environmental Programs

A consortium of Universities, DOE National Laboratories, Forest Service Researchers, and Industrial partners have submitted a coordinated package of proposals for funding under EPA's "Environmental Technology Initiative" (ETI) program aimed at reducing pollution in wood products production. A total of five proposals were submitted, including: "Diffusion of Pollution Prevention Technology for the Lumber and Wood Products Industry," "Process Control Technology to Mitigate VOC Air Emissions in the Production of Oriented Strand Board," "Improved Wood Adhesives for Reduction of Pollutants for the Wood Panel Manufacturing Industry," "Identification and Quantification of Volatile Organic Compounds Emitted from Lumber Dry Kilns," and "Development of Coupled Biological/Chemical Systems to Reduce VOCs in Lumber and Composite Board Facilities." These projects are currently underway at the Forest Products Laboratory in Madison, Wisconsin.

To explore questions related to potential technologies which might be applicable for control of wood panel plant VOC emissions, the American Forest & Paper Association (AF&PA) Solid Wood Committee and NCASI hosted a workshop in October 1993. It was attended by approximately 100 individuals from industry, State regulatory agencies, EPA, and EPA consultants. At the workshop, the following five control technologies were discussed: ultraviolet oxidation, chemical scrubbing with brominated compounds, furnish dryer exhaust gas recirculation to a wood-fired fuel cell for oxidation of organic compounds, biofiltration, and regenerative thermal oxidation. Topics discussed included: current status of development, performance, problems encountered, potential limitations, energy requirements, and estimated costs. In addition, an EPA representative updated the workshop attendees on the Agency's current efforts to develop a common definition of VOCs and to adopt a standard VOC test method for emissions from solid wood manufacturing plants.

According to the American Forest and Paper Association, wood recycling is on the rise. An estimated 400,000 tons of wood waste were recovered in 1990. This waste included barrels, boxes, brush, Christmas trees, construction and demolition waste, crates, pallets, posts, poles, prunings, railroad ties, sawdust, slab wood, and yard trimmings. The management of wood residue as a component of construction and demolition waste and from urban tree removals is becoming a larger issue as landfill tipping fees rise. Wood residue management is also an increasingly important issue for wood products producers, retailers, and the general public. As virgin wood fiber prices rise, incentives and cost-avoidance pressures are motivating wood users and producers to find ways to fully and most profitably utilize this resource.

The American Forest and Paper Association's American Wood Council is producing a Wood Recycling Reference Handbook to encourage and facilitate wood recycling in the United States. The book will list by state and county where wood residue can be bought for reuse and recycling. The first edition is due out in October, 1995.

VIII.C.2. Summary of Trade Associations

There are numerous trade and professional organizations affiliated with the forest products industry. The largest organization is the American Forest and Paper Association. The smaller associations generally focus on specific types of timber (i.e., hardwoods, pine), or specific types of product (i.e., plywood, particleboard). In addition, there are a number of trade organizations which focus their efforts on specific regions of the country.

General

American Forest and Paper Association 1111 19th Street, NW, Suite 800 Washington, DC 20036 Phone: (202) 463-2700 Fax: (202) 463-2785	Members: 425 Contact: Josephine Cooper

The American Forest and Paper Association (AF&PA) is the national trade association of the forest, pulp, paper, paperboard, and wood products industry. AF&PA represents approximately 500 member companies and related trade associations (whose memberships are in the thousands) which grow, harvest, and process wood and wood fiber; manufacture pulp, paper and paperboard products from both virgin and recovered fiber; and produce solid wood products.

National Council of the Paper Industry for Air and Stream Improvement 260 Madison Avenue New York, NY 10016 Phone: (212) 532-9000 Fax: (212) 779-2849	Members: 100 Staff: 90 Budget: $10,000,000 Contact: Dr. Ronald Yeske, President

Founded in 1943, the National Council of the Paper Industry for Air and Stream Improvement (NCASI) presently conducts research on environmental problems related to industrial forestry and the manufacture of pulp, paper, and wood products. NCASI produces technical documents on environmental issues facing the pulp and paper industry and conducts industry conferences. Publications include: a biweekly bulletin on general issues and a variety of technical bulletins (40/year). NCASI also holds and annual March convention in New York City.

Hardwood

Hardwood Manufactures Association 400 Penn Center Blvd. Pittsburgh, PA 15235 Phone: (412) 346-2222 Fax: (412) 346-2233	Members: 145 Staff: 5 Contact: Susan Regan

Manufacturers of hardwood lumber and hardwood products. Conducts promotion programs; compiles statistics.

National Hardwood Lumber Association PO Box 34518 Memphis, TN 38184-0518 Phone: (901) 377-1818 Fax: (901) 382-6419	Members: 1300 Staff: 40 Contact: Ernest J. Stebbins

United States and Canadian hardwood lumber and veneer manufacturers, distributors, and consumers. Inspects, measures, and certifies hardwood lumber. Maintains inspection training school and conducts short courses at members' lumber yards; conducts management and marketing seminars for the hardwood industry. The organization publishes the National Hardwood Lumber Association-Annual Report and the National Hardwood News, an annual newsletter.

Plywood

Hardwood Plywood & Veneer Association 1825 Michael Faraday Dr. PO Box 2789 Reston, VA 22090 Phone: (703) 435-2537	Members: 150 Staff: 12 Budget: $1,000,000 Contact: E.T. Altman

Manufactures and prefinishers of hardwood plywood; manufacturers of veneer; suppliers of glue, machinery, and other products related to the industry. Conducts laboratory testing of plywood, adhesives, finishes, flamespread, formaldehyde emissions, structural, and smoke density. The association provides public relations, advertising, marketing, and technical services to members. It represents the industry in legislative matters and keep members informed on tariff and trade actions. Publications include the annual *Hardwood Plywood and Veneer News* and *The Executive Brief.*

American Plywood Association PO Box 11700 Tacoma, WA 98411 Phone: (206) 565-6600 Fax: (206) 565-7265	Members: 136 Staff: 180 Budget: $14,000,000 Contact: Gene Zellner

Manufacturers of plywood, oriented strand board and composites. Conducts trade promotion through advertising, publicity, merchandising, and field promotion. The Association provides quality oversight and conducts research to improve products, applications, and manufacturing techniques. Publications include the *Management Report*, and periodic *Plywood Statistics*.

Hardboard

American Hardboard Association 1210 W. Northwest Highway Palatine, IL 60067 Phone: (708) 934-8800 Fax: (708) 934-8803	Members: 4 Staff: Budget: Contact: C. Curtis Peterson

Manufacturers representing major U.S. producers of hardboard.

Particleboard

National Particleboard Association 18928 Premiere Court Gaithersburg, MD 20879 Phone: (301) 670-0604 Fax: (301) 840-1252	Members: 19 Staff: 10 Budget: Contact: Richard Margosian

Mat-formed wood particleboard and medium-density fiberboard manufacturers interested in establishing industry product standards with the American National Standards Institute and quality standards for performance. Sponsors educational programs and publishes promotional and technical bulletins on topics including laminating and veneering.

Wood Preserving

American Wood-Preservers' Association P.O. Box 286 Woodstock, MD 21163-0286 Phone: (410) 465-3169 Fax: (410) 465-3195	Members: 2000 Staff: Budget: Contact: John F. Hall

The association includes processors and users of chemically treated wood and is affiliated with the American Wood Preservers Institute. Publications include the annual *AWPA Book of Standards,* which is a technical handbook covering preservatives and treatments.

American Wood Preservers Institute 1945 Old Gallows Road, Ste. 150 Vienna, VA 22182-3931 Phone: (703) 893-4005 Fax: (703) 893-8492	Members: 150 Staff: 8 Budget: $1,100,000 Contact: Gene Bartlow

The American Wood Preservers Institute is the national trade association representing the wood preserving industry. Its members include manufacturers of treated wood products, manufacturers and distributors of wood preservatives, and providers of allied services. AWPI provides technical forums for the industry, publishes a bi-monthly newsletter, and produces annual Industry Statistical Reports.

Regional

Northeastern Lumber Manufacturers Association 272 Tuttle Rd., Box 87A Cumberland Center, ME 04021 Phone: (207) 829-6901 Fax: (207) 829-4293	Members: 200 Staff: 7 Budget: Contact: Stephen Clark

Northeastern Lumber Manufacturers is an association of hardwood and softwood lumber and timber products manufacturers in New England. The group promotes the interests of the Northeastern lumber manufacturing industry and presents the views of the industry to other organizations, the government, and the public. Publications include the monthly *Northeastern Lumber Manufacturers Association.*

Southeastern Lumber Manufacturers Association PO Box 1788 Forest Park, GA 30051 Phone: (404) 361-1445 Fax: (404) 361-5963	Members: 390 Staff: 10 Budget: $2,000,000 Contact: Ed C. Cone, Jr.

Represents Southeastern hardwood and softwood lumber manufacturers and coordinates efforts of membership to alleviate local, regional, and national problems that affect the regional lumber industry. Publishes a quarterly newsletter, Silva Magazine, and Management Update. SLMA also conducts technical workshops.

R0075760

Southern Forest Products Association PO Box 52468 New Orleans, LA 70152 Phone: (504) 443-4464 Fax: (504) 443-6612	Members: 220 Staff: 31 Budget: $2,856,000 Contact: Karl Lindberg

The Southern Forest Products Association (SFPA) represents Southern pine lumber manufacturers and conducts market development and product promotional programs and government support activities. SFPA publishes a weekly newsletter covering a variety of industry activities.

Western Wood Preservers Institute 601 Main Street, Suite 405 Vancouver, WA 98660 Phone: (360) 693-9958 Fax: (360) 693-9958	Members: 50 Staff: 3 Budget: Contact: Dennis Hayward

WWPI represents the treated wood industry in Western North America. WWPI provides educational information to assist consumers in the selection and proper, safe, and environmentally appropriate use of treated wood products.

Western Wood Products Association Yeon Building 522 SW 5th Ave. Portland, OR 97204-2122 Phone: (503) 224-3930 Fax: (503) 224-3934	Members: 250 Staff: 63 Budget: Contact: Robert Hunt

WWPA is a rules-writing agency (for lumber grades), approved under the American Lumber Standard Committee under the jurisdiction of the Department of Commerce. The Association also provides economic and statistical information on the Western lumber industry, conducts research in wood technology, engineering and performance; provides technical and educational services both domestically and internationally; and published technical and consumer information for Western Lumber end-use.

R0075761

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

General Profile

Compilation of Air Pollutant Emissions Factors (AP-42), U.S. EPA.

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc., Detroit, Michigan, 1992.

Price Prospects for Major Primary Commodities, 1990-2005, The World Bank, March, 1993.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

Sustainable Environmental Law, Campbell-Mohn, Environmental Law Institute, 1993.

U.S. Industrial Outlook 1994, Department of Commerce.

Wood Preserving, U.S. EPA (EPA/530-SW-90-027f).

Wood Products Industry Associations, American Forest and Paper Association, Washington, D.C., January, 1994.

1987 Census of Manufacturers Industry Series 24A: Logging, Camps Sawmills, & Planing Mills, U.S. Department of Commerce, Bureau of the Census, April 1990 (MC87-I-24A).

1987 Census of Manufacturers Industry Series 24B: Millwork, Plywood, & Structural Materials, U.S. Department of Commerce, Bureau of the Census, April 1990 (MC87-I-24A).

1987 Census of Manufacturers Industry Series 24C: Wooden Containers & Miscellaneous Wood Products, U.S. Department of Commerce, Bureau of the Census, April 1990 (MC87-I-24A).

1992 Census of Manufacturers, Industry Series 24-A: Logging Camps ,Sawmills, and Planing Mills, U.S. Department of Commerce, Bureau of the Census, February 1995 (MC92-I-24C).

1992 Census of Manufacturers Industry Series 24B: Millwork, Plywood, and structural Wood Members, Not Elsewhere Classified, Bureau of the Census, February 1995 (MC92-I-24B)

1992 Census of Manufactures Industry Series 24C: Wooden Containers and Miscellaneous Wood Products, February 1995 (MA2-I-24C).

Process Descriptions

Basic Plywood Processing, Ted Demas, American Plywood Association, Tacoma, Washington, December, 1992.

Characterization of Manufacturing Processes, Emissions, and Pollution Prevention Options for the Composite Wood Industry, Cybele Martin and Coleen Northeim, Research Triangle Institute Center for Environmental Analysis, RTP, NC, March 1995.

Encyclopedia of Science and Technology, Wood Finishing (vol. 19), Lumber Manufacture (vol. 10), Logging (vol. 10), 1992.

Estimating Chemical Releases from Presswood and Laminated Wood Products Manufacturing, U.S. EPA, Office of Pesticides and Toxic Substances, March 1988 (EPA 560/4-88-004i).

Forest Products and Wood Science, An Introduction, John G. Haygreen and Jim L. Bowyer, Iowa State University Press, 1989.

Investigation of Emissions from Plywood Veneer Dryers, Appendix B, Plywood Research Foundation, March 1971.

Modern Particleboard & Dry-Process Fiberboard Manufacturing, Thomas M. Maloney, Miller Freemen, Inc., San Francisco, CA, 1993.

Study of the Physical and Chemical Properties of Atmospheric Aerosols Attributable to Plywood Veneer Dryer Emissions, Chemical Engineering Department, Washington State University, June 1981.

Wood Products for Engineered Structures: Issues Affecting Growth and Acceptance of Engineered Wood Products, Donald A. Bender, Ed., Forest Products Society, Madison, Wisconsin, November 1992.

Release Profiles

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Final Modifications to the Wood Preserving Regulations, Environmental Fact Sheet, Office of Solid Waste, U.S. EPA, October, 1992 (EPA/530-F-92-029).

Surface Protection Proposed Rule, 58 Federal Register 25706, April 27, 1993.

Unified Agenda, 57 *Federal Register 21120,* April 1994.

Wood Preserving Final Rule, 57 *Federal Register 61502,* December 30, 1992.

Pollution Prevention

Guides to Pollution Prevention: Wood Preserving Industry, U.S. EPA, Office of Research and Development, November 1993 (EPA/625/R-93/014).

Pollution Prevention 1991: Progress on Reducing Industrial Pollutants, Office of Pollution Prevention, U.S. EPA, 1991 (EPA 21P-3003).

Waste Minimization Practices at Two CCA Wood-Treatment Plants, U.S. EPA, Office of Research and Development, August 1993 (EPA/600/R-93/168).

Contacts*

Name	Organization	Telephone
Michael Caldwell	American Forest and Paper	202-463-2762
Albert Lukban	American Wood Preservers Institute	703-893-4005
Buddy Perry	Perry Builders	919-492-9171
Nicholas Latham	Natural Resources Defense Council	202-624-9363
Jim Yuhas	Western Wood Products	503-224-3930
Bill Wyndes	Louisiana-Pacific	707-443-7511
Mark Rivas	U.S. EPA, Region VII (inspector)	913-551-7669
Chris James	U.S. EPA, Region X (inspector)	206-553-1194
Maria Dixon	U.S. Bureau of the Census	301-763-5895
Kurt Bigbee	American Plywood Association	202-565-6600
John Pinkerton	NCASI	212-532-9047

* Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROSENSE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy!

Order Processing Code
* 3212

Fax your orders (202) 512–2250
Phone your orders (202) 512–1800

Qty.	Stock Number	Published in 1995 Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	Published in 1997 Title	Price Each	Total Price
	055–000–00570–2	Air Transportation Industry, 90 pages	$ 7.50	
	055–000–00571–1	Ground Transportation Industry, 130 pages	10.00	
	055–000–00572–9	Water Transportation Industry, 90 pages	7.50	
	055–000–00573–7	Metal Casting Industry, 150 pages	13.00	
	055–000–00574–5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055–000–00575–3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055–000–00576–1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055–000–00577–0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055–000–00578–8	Textile Industry, 130 pages	10.00	
	055–000–00579–6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0075767

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2223A)

EPA 310-R-97-004
September 1997

EPA

Profile Of The Metal Casting Industry

SECTOR NOTEBOOKS EPA 22

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 18 1997

THE ADMINISTRATOR

Message from the Administrator

Since EPA's founding over 25 years ago, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and those as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper and smarter. As a result, we no longer have rivers catching fire. Our skies are clearer. American environmental technology and expertise are in demand around the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

The Environmental Protection Agency has undertaken its Sector Notebook Project to compile, for major industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with an extensive series covering other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to understand better their regulatory requirements, and learn more about how others in their industry have achieved regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that we together achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-97-004

EPA Office of Compliance Sector Notebook Project:

Profile of the Metal Casting Industry

September 1997

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-049396-X

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, and local governments, and the media from EPA's National Center for Environmental Publications and Information at (800) 490-9198. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph courtesy of American Foundrymen's Society, Inc., Des Plaines, Illinois.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Questions relating to the Sector Notebook Project can be directed to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Jane Engert	564-5021
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Robert Lischinsky	564-2628
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Manmade Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017

Page iv intentionally left blank.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AFS - AIRS Facility Subsystem (CAA database)
AFS- American Foundrymen's Society
AIRS - Aerometric Information Retrieval System (CAA database)
BIFs - Boilers and Industrial Furnaces (RCRA)
BOD - Biochemical Oxygen Demand
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CO - Carbon Monoxide
COD - Chemical Oxygen Demand
CSI - Common Sense Initiative
CWA - Clean Water Act
D&B - Dun and Bradstreet Marketing Index
ELP - Environmental Leadership Program
EPA - United States Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
HAPs - Hazardous Air Pollutants (CAA)
HSDB - Hazardous Substances Data Bank
IDEA - Integrated Data for Enforcement Analysis
LDR - Land Disposal Restrictions (RCRA)
LEPCs - Local Emergency Planning Committees
MACT - Maximum Achievable Control Technology (CAA)
MCLGs - Maximum Contaminant Level Goals
MCLs - Maximum Contaminant Levels
MEK - Methyl Ethyl Ketone
MSDSs - Material Safety Data Sheets
NAAQS - National Ambient Air Quality Standards (CAA)
NAFTA - North American Free Trade Agreement
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NEIC - National Enforcement Investigation Center
NESHAP - National Emission Standards for Hazardous Air Pollutants
NO_2 - Nitrogen Dioxide
NOV - Notice of Violation
NO_X - Nitrogen Oxide
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)

OAR - Office of Air and Radiation
OECA - Office of Enforcement and Compliance Assurance
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
SO_X - Sulfur Oxides
TOC - Total Organic Carbon
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TCRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

METAL CASTING INDUSTRY
(SIC 332 AND 336)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Integrated environmental policies based upon comprehensive analysis of air, water and land pollution are a logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was originally initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded to its current form. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing this system. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not already covered, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE METAL CASTING INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the metal casting industry. Facilities described within this document are described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

The metal casting industry makes parts from molten metal according to an end-user's specifications. Facilities are typically categorized as casting either ferrous or nonferrous products. The metal casting industry described in this notebook is categorized by the Office of Management and Budget (OMB) under Standard Industrial Classification (SIC) codes 332 Iron and Steel Foundries and 336 Nonferrous Foundries (Castings). The die casting industry is contained within the SIC 336 category since die casting establishments primarily cast nonferrous metals. OMB is in the process of changing the SIC code system to a system based on similar production processes called the North American Industrial Classification System (NAICS). (In the NAIC system, iron and steel foundries, nonferrous foundries, and die casters are all classified as NAIC 3315.)

Although both foundries and die casters are included in this notebook, there are significant differences in the industrial processes, products, facility size and environmental impacts between die casters and foundries. Die casting operations, therefore, are often considered separately throughout this notebook.

In addition to metal casting, some foundries and die casters carry out further operations on their cast parts that are not the primary focus of this notebook. Examples include heat treating (e.g. annealing), case hardening, quenching, descaling, cleaning, painting, masking, and plating. Such operations can contribute significantly to a facility's total waste generation. Typical wastes generated during such operations include spent cyanide baths, salt baths, quenchents, abrasive media, solvents and plating wastes. For more information on these processes, refer to the Fabricated Metal Products Industry Sector Notebook.

II.B. Characterization of the Metal Casting Industry

Foundries and die casters that produce ferrous and nonferrous castings generally operate on a job or order basis, manufacturing castings for sale to others companies. Some foundries, termed captive foundries, produce castings as a subdivision of a corporation that uses the castings to produce larger products such as machinery, motor vehicles, appliances or plumbing fixtures.

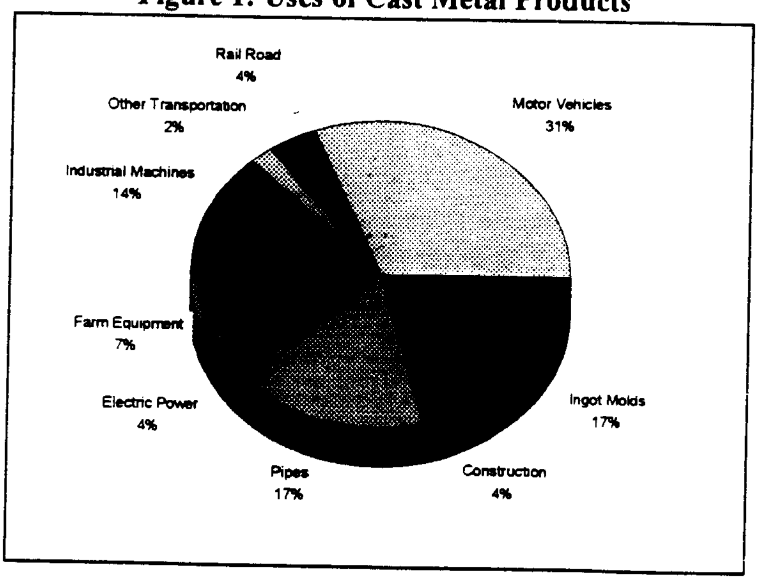
R0075782

In addition, many facilities do further work on castings such as machining, assembling, and coating.

II.B.1. Product Characterization

About 13 million tons of castings are produced every year in the U.S. (U.S. DOE, 1996). Most of these castings are produced from recycled metals. There are thousands of cast metal products, many of which are incorporated into other products. Almost 90 percent of all manufactured products contain one or more metal castings (LaRue, 1989). It is estimated that on average, every home contains over a ton of castings in the form of pipe fittings, plumbing fixtures, hardware, and furnace and air conditioner parts. Automobiles and other transportation equipment use 50 to 60 percent of all castings produced - in engine blocks, crankshafts, camshafts, cylinder heads, brake drums or calipers, transmission housings, differential casings, U-joints, suspension parts, flywheels, engine mount brackets, front-wheel steering knuckles, hubs, ship propellers, hydraulic valves, locomotive undercarriages, and railroad car wheels. The defense industry also uses a large portion of the castings produced in the U.S. Typical cast parts used by the military include tank tracks and turrets and the tail structure of the F-16 fighter (Walden, 1995). Some of other common castings include: pipes and pipe fittings, valves, pumps, pressure tanks, manhole covers, and cooking utensils. Figure 1 shows the proportion of various types of castings produced in the U.S.

Figure 1: Uses of Cast Metal Products



Source: U.S. Department of Energy, 1996.

R0075783

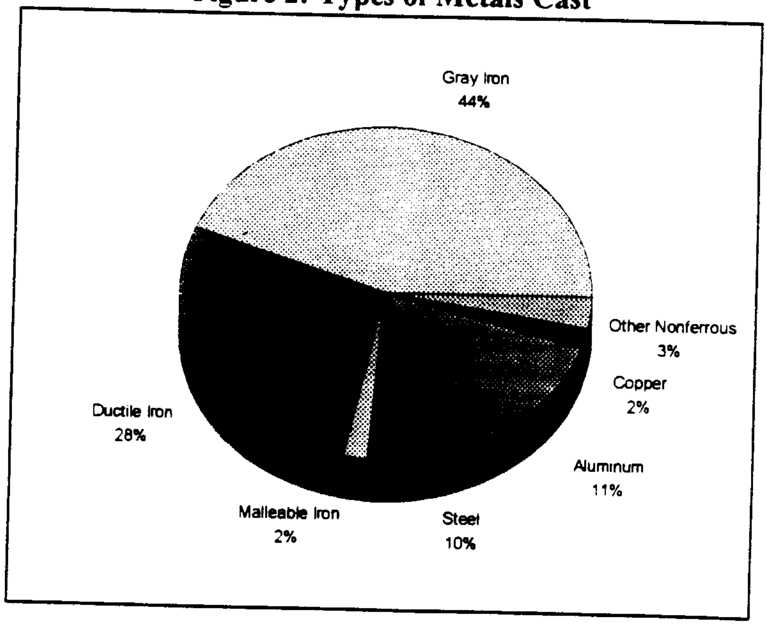
Iron and Steel (Ferrous) Castings

Depending on the desired properties of the product, castings can be formed from many types of metals and metal alloys. Iron and steel (ferrous) castings are categorized by four-digit SIC code by the Bureau of Census according to the type of iron or steel as follows:

SIC 3321 - Gray and Ductile Iron Foundries
SIC 3322 - Malleable Iron Foundries
SIC 3324 - Steel Investment Foundries
SIC 3325 - Steel Foundries, Not Elsewhere Classified

Gray and Ductile Iron make up almost 75 percent of all castings (ferrous and nonferrous) by weight (see Figure 2). Gray iron contains a higher percentage of carbon in the form of flake graphite and has a lower ductility than other types of iron. It is used extensively in the agricultural, heavy equipment, engine, pump, and power transmission industries. Ductile iron has magnesium or cerium added to change the form of the graphite from flake to nodular. This results in increased ductility, stiffness, and tensile strength (Loper, 1985).

Figure 2: Types of Metals Cast



Source: U.S. Department of Energy, 1996.

Malleable iron foundries produce only about two percent of all castings (ferrous and nonferrous). Malleable iron contains small amounts of carbon, silicon, manganese, phosphorus, sulfur and metal alloys to increase strength

R0075784

and endurance. Malleable iron has excellent machinability and a high resistance to atmospheric corrosion. It is often used in the electrical power, conveyor and handling equipment, and railroad industries.

Compared to steel, gray, ductile, and malleable iron are all relatively inexpensive to produce, easy to machine, and are widely used where the superior mechanical properties of steel are not required (Loper, 1985).

Steel castings make up about 10 percent of all castings (ferrous and nonferrous). In general, steel castings have better strength, ductility, heat resistance, durability and weldability than iron castings. There are a number of different classes of steel castings based on the carbon or alloy content, with different mechanical properties. A large number of different alloying metals can be added to steel to increase its strength, heat resistance, or corrosion resistance (Loper, 1985). The steel investment casting method produces high-precision castings, usually smaller castings. Examples of steel investment castings range from machine tools and dies to golf club heads.

Nonferrous Castings

Nonferrous castings are categorized by four-digit SIC code by the Bureau of Census according to the type of metal as follows:

SIC 3363 - Aluminum Die-Castings
SIC 3364 - Nonferrous Die-Castings, Except Aluminum
SIC 3365 - Aluminum Foundries
SIC 3366 - Copper Foundries
SIC 3369 - Nonferrous Foundries, Except Aluminum and Copper

Nonferrous foundries often use the same basic molding and casting techniques as ferrous foundries. Many foundries cast both ferrous and nonferrous metals. Aluminum, copper, zinc, lead, tin, nickel, magnesium and titanium are the nonferrous metals of primary commercial importance. Usually, these metals are cast in combinations with each other or with some of about 40 other elements to make many different nonferrous alloys. A few of the more common nonferrous alloys are: brass, bronze, nickel-copper alloys (Monel), nickel-chromium-iron alloys, aluminum-copper alloys, aluminum-silicon alloys, aluminum-magnesium alloys, and titanium alloys.

Nonferrous metals are used in castings that require specific mechanical properties, machinability, and/or corrosion resistance (Kunsman, 1985). Aluminum and aluminum alloy castings are produced in the largest volumes; 11 percent of all castings (ferrous and nonferrous) by weight are aluminum. Copper and copper alloy castings make up about two percent of all castings by weight (DOE, 1996). Figure 2 shows the proportions of raw material types used in castings in the U.S.

About 9 percent by weight of all cast metal products are produced using die casting techniques (DOE, 1996). Die casting is cost effective for producing large numbers of a casting and can achieve a wide variety of sizes and shapes with a high degree of accuracy. Holes, threads, and gears can be cast, reducing the amount of metal to be machined from the casting. Most die castings are aluminum; however, lead, tin, zinc, copper, nickel, magnesium, titanium, and beryllium alloys are also die cast. Die casts are usually limited to nonferrous metals and are often under ten pounds. A wide variety of products are produced using the die casting process, ranging from tiny wrist watch parts to one-piece automobile engine blocks (Street, 1977). Other typical die castings include: aluminum transmission cases, bearings, bushings, valves, aircraft parts, tableware, jewelry and household appliance parts.

II.B.2. Industry Size and Geographic Distribution

According to the *1992 Census of Manufacturers* data, there are approximately 2,813 metal casting facilities under SIC codes 332 and 336. The payroll for 1992 totaled $5.7 billion for a workforce of 158,000 employees, and value of shipments totaled $18.8 billion. The industry's own estimates of the number of facilities and employment are somewhat higher at 3,100 facilities employing 250,000 in 1994 (Cast Metals Coalition, 1995). Based on the Census of Manufacturers data, the industry is labor intensive. The value of shipments per employee, a measure of labor intensity, is $119,000 that is less than half of the steel manufacturing industry value ($245,000 per employee) and less than seven percent of the petroleum refining industry value ($1.8 million per employee).

Most metal casting facilities in the U.S. are small. About seventy percent of the facilities employ fewer than 50 people (see Table 1). Most metal casting facilities manufacture castings for sale to other companies (U.S. Census of Manufacturers, 1992). An important exception are the relatively few (but large) "captive" foundries operated by large original equipment manufacturers (OEM's) including General Motors, Ford, Chrysler, John Deere, and Caterpillar. OEM's account for a large portion of the castings produced and employ a significant number of the industry's workforce.

Although die casting establishments account for only about 9 percent of cast products by weight, they make up about 20 percent of metal casting establishments and value of sales (U.S. Census of Manufacturers, 1992). In proportion to the industry size, there is very little difference between the size distribution of foundries and die casters.

Table 1: Facility Size Distribution for the Metal Casting Industry

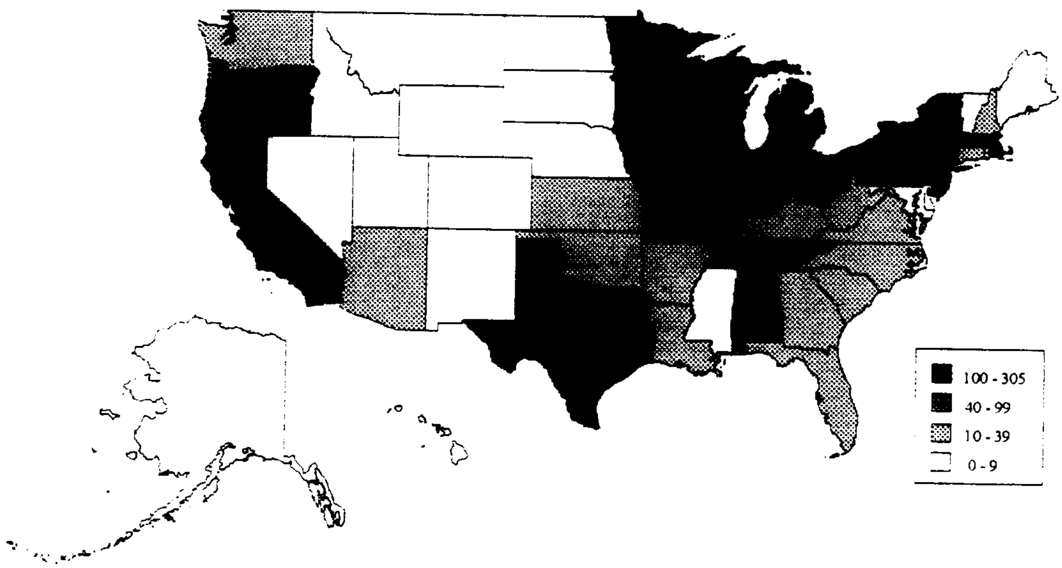
Employees per Facility	Ferrous and Nonferrous Foundries (SIC 332, 3365, 3366, and 3369)		Die Casting Establishments (SIC 3363 and 3364)	
	Number of Facilities	Percentage of Facilities	Number of Facilities	Percentage of Facilities
1-9	742	33%	167	28%
10-49	843	38%	214	36%
50-249	494	22%	186	31%
250-499	90	4%	25	4%
500-2499	43	2%	4	1%
2500 or more	4	0%	0	0%
Total	2216	100%	596	100%

Source: U.S. Department of Commerce, Census of Manufacturers, 1992.

Geographic Distribution

The geographic distribution of the metal casting industry resembles that of the iron and steel industry. The highest geographic concentration of facilities is in the Great Lakes, midwest, southeast regions and California. The top states by number of facilities in order are: California, Ohio, Pennsylvania, Michigan, Illinois, Wisconsin, and Indiana. Figure 3 shows the U.S. distribution of facilities based on 1992 data from the U.S. Census of Manufacturers. Historically, locations for metal casting establishments were selected for their proximity to raw materials (iron, steel, and other metals), coal, and water for cooling, processing, and transportation. Traditional metal casting regions included the Monongahela River valley near Pittsburgh and along the Mahoning River near Youngstown, Ohio. The geographic concentration of the industry is changing as facilities are built where scrap metal and electricity are available at a reasonable cost and there is a local market for the cast products.

Figure 3: Geographic Distribution of Metal Casting Establishments



Source: U.S. Census of Manufacturers, 1992.

Dun & Bradstreet's *Million Dollar Directory,* compiles financial data on U.S. companies including those operating within the metal casting industry. Dun & Bradstreet ranks U.S. companies, whether they are a parent company, subsidiary or division, by sales volume within their assigned 4-digit SIC code. Readers should note that: (1) companies are assigned a 4-digit SIC that resembles their principal industry most closely; and (2) sales figures include total company sales, including subsidiaries and operations (possibly not related to metal casting). Additional sources of company specific financial information include Standard & Poor's *Stock Report Services*, *Ward's Business Directory of U.S. Private and Public Companies*, Moody's Manuals, and annual reports.

R0075788

Table 2: Top U.S. Metal Casting Companies

Rank[a]	Company[b]	1995 Sales (millions of dollars)
1	Howmet Corporation - Greenwich, CT	900
2	Newell Operating Co. - Freeport, IL	796
3	CMI International Inc. - Southfield, MI	561
4	Precision Castparts Corporation - Portland, OR	557
5	Grede Foundries - Milwaukee, WI	460
6	United States Pipe and Foundry - Birmingham, AL	412
7	George Koch Sons, Inc.	390
8	Varlen Corporation - Naperville, IL	387
9	Allied Signal, Inc.	260
10	North American Royalties, Inc.	254

Note: [a]Not all sales can be attributed to the companies' metal casting operations.
[b] Companies shown listed SIC 332, 3363, 3364, 3365, 3369. Many large companies operating captive metal casting facilities produce other goods and are not shown here.

Source: *Dunn & Bradstreet's Million Dollar Directory - 1996.*

II.B.3. Economic Trends

The U.S. metal casting industry experienced an unprecedented drop in production during the 1970's and 1980's. Production of cast metal products declined from 19.6 million tons in 1972 to 11.3 million tons in 1990. During this period over 1,000 metal casting facilities closed (DOE, 1996). A number of reasons have been given for this decline including: decreased U.S. demand for cast metal resulting from decreases in automobile production and smaller, lighter weight vehicles for increased fuel efficiency; increased foreign competition; increased use of substitute materials such as plastics, ceramics, and composites; and increased costs to comply with new environmental and health and safety regulations.

The metal casting industry began to recover in the early 1990's; however, it still produces less than in the early 1970's. The recovery has been attributed to increases in domestic demand in part due to increases in automobile production. In addition, exports of castings have increased and imports have decreased. Between 1993 and 1994 alone the U.S. increased its share of world metal casting production from 18 percent to 20 percent. The increases in production came primarily from increases in capacity utilization at existing facilities rather than an increase in facilities. In fact, the American Foundrymen's Society estimates that the number of metal casting facilities decreased by over 200 between 1990 and 1994 (DOE, 1996).

In 1972, only five percent of all castings were aluminum. Today aluminum accounts for over 11 percent of the market (DOE, 1996). Aluminum castings are steadily comprising a larger share of the castings market as their use in motor vehicle and engine applications continues to grow. To produce lighter weight, more fuel efficient vehicles, the automobile industry is in the process redesigning the engine blocks, heads and other parts of passenger cars and light trucks for aluminum. Cast aluminum is expected to increase from 140 pounds per vehicle in 1995 to 180 pounds per vehicle in 2004. This is primarily at the expense of gray iron which will decrease from 358 pounds per vehicle in 1995 to 215 pounds in 2004 (*Modern Casting*, September, 1995).

The U.S. metal casting industry that emerged from the two decades of decline in the 1970's and 1980's is stronger and more competitive. The industry is developing new markets and recapturing old markets. Research and development has resulted in technological advances that have improved product quality, overall productivity and energy efficiency. Important recent technological advances have included Computer Aided Design (CAD) of molds and castings, the use of sensors and computers to regulate critical parameters within the processes, and the use of programmable robots to perform dangerous, time consuming or repetitive tasks.

To stay competative, the industry has identified the following priority areas for research and development to improve its processes and products:

- improving casting technologies
- developing new casting materials (alloys) and die materials
- developing higher strength and lower weight castings
- improving process controls
- improving dimensional control
- improving the quality of casting material
- reducing casting defects (DOE, March 1996)
- developing environmentally improved materials to meet today's regulations (AFS, 1997)

Research into new casting methods and improvements in the current methods are resulting in improved casting quality, process efficiency, and environmental benefits.

Page 12 intentionally left blank.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the metal casting industry, including the materials and equipment used and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of resource materials and contacts that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the by-products produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Metal Casting Industry

Many different metal casting techniques are in use today. They all have in common the construction of a mold with a cavity in the external shape of the desired cast part followed by the introduction of molten metal into the mold.

For the purposes of this profile, the metal casting process has been divided into the following five major operations:

- Pattern Making
- Mold and Core Preparation and Pouring
- Furnace Charge Preparation and Metal Melting
- Shakeout, Cooling and Sand Handling
- Quenching, Finishing, Cleaning and Coating

All five operations may not apply to each casting method. Since the major variations between processes occur in the different types of molds used, Section III.A.2 - Mold and Core Preparation is divided into subsections describing the major casting processes. In addition to the casting techniques described below, there are numerous special processes and variations of those processes that cannot be discussed here. Nevertheless, such processes may play an important role in a facility's efforts to comply with environmental requirements. Refer to Section IX for a list of references providing more detail on casting processes.

R0075792

Note that die casting operations have been presented separately in Section III.A.6. The different processes, equipment, and environmental impacts of die casting do not fit easily into operations outlined above.

III.A.1. Pattern Making

Pattern making, or foundry tooling, requires a high level of skill to achieve the close tolerances required of the patterns and coreboxes. This step is critical in the casting process since the castings produced can be no better than the patterns used to make them. In some pattern making shops, computer-aided drafting (CAD) is used in the design of patterns. Cutter tool paths are designed with computer-aided manufacturing (CAM). Numerical output from these computers is conveyed to computer-numerical-controlled (CNC) machine tools, which then cut the production patterns to shape. Such computer-aided systems have better dimensional accuracy and consistency than hand methods (LaRue, 1989).

Patterns and corebox materials are typically metal, plastic, wood or plaster. Wax and polystyrene are used in the investment and lost foam casting processes, respectively. Pattern makers have a wide range of tools available including wood working and metal machining tools. Mechanical connectors and glues are used to join pattern pieces. Wax, plastic or polyester putty are used as "fillet" to fill or round the inside of square corners (LaRue, 1989).

<u>Wastes Generated</u>
Very little waste is generated during pattern making compared to other foundry operations. Typical pattern shop wastes include scrap pattern materials (wood, plastics, metals, waxes, adhesives, etc.) and particulate emissions from cutting, grinding and sanding operations. Waste solvents and cleaners may be generated from equipment cleaning.

Table 3: Comparison of Several Casting Methods
(approximate and depending upon the metal)

	Green Sand Casting	Permanent Mold Cast	Die Casting	Sand-Shell CO_2-Core Casting	Investment Casting
Relative cost in quantity	low	low	lowest	medium high	highest
Relative cost for small number	lowest	high	highest	medium high	medium
Permissible weight of casting	up to about 1 ton	100 lbs.	60 lbs.	Shell: ozs. - 250 lbs. CO_2: 1/2 lbs. - tons	Ozs. - 100 lbs.
Thinnest section castable, inches	1/10	1/8	1/32	1/10	1/16
Typical dimensional tolerance, inches (not including parting lines)	.012	0.03	0.01	.010	0.01
Relative surface finish	fair to good	good	best	Shell: good CO_2: fair	very good
Relative mechanical properties	good	good	very good	good	fair
Relative ease of casting complex design	fair to good	fair	good	good	best
Relative ease of changing design in production	best	poor	poorest	fair	fair
Range of alloys that can be cast	unlimited	copper base and lower melting point metals preferable	aluminum base and lower melting preferable	unlimited	limited

Source: American Foundrymen's Society, 1981.

III.A.2. Mold and Core Preparation and Pouring

The various processes used to cast metals are largely defined by the procedures and materials used to make the molds and cores. Table 3 summarizes the major casting methods and their applications. A mold and cores (if required) are usually made for each casting. These molds and cores are destroyed and separated from the casting during shakeout (see Section III.A.4 - Shakeout, Cooling and Sand Handling). (Exceptions include the permanent mold process and die casting process in which the molds are used over and over again.) Most sand is reused over and over in other molds; however, a portion of sand becomes spent after a number of uses and must be removed as waste. Mold and core making are, therefore, a large source of foundry wastes.

Sand Molds and Cores

For most sand casting techniques, the following summary of the process applies (see Figure 4). First, engineers design the casting and specify the metal or alloy to be cast. Next, a pattern (replica of the finished piece) is constructed from either plastic, wood, metal, plaster or wax. Usually, the pattern is comprised of two halves. The molding sand is shaped around the pattern halves in a metal box (flask) and then removed, leaving the two mold halves. The top half of the mold (the cope) is assembled with the bottom half (the drag) which sits on a molding board. The interface between the two mold halves is called a parting line. Weights may be places on the cope to help secure the two halves together. The molten metal is poured or injected into a hole in the cope called a sprue or sprue basin which is connected to the mold cavity by runners. The runners, sprue, gates, and risers comprise the mold's gating system, which is designed to carry molten metal smoothly to all parts of the mold. The metal is then allowed to solidify within the space defined by the mold.

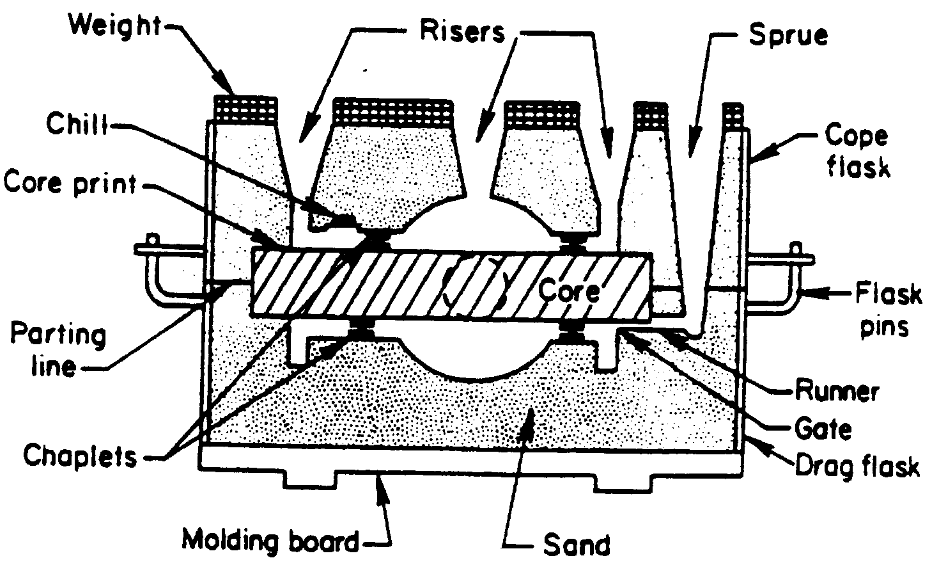
Since the molds themselves only replicate the external shape of the pattern, cores are placed inside the mold to form any internal cavities. Cores are produced in a core box, which is essentially a permanent mold that is developed in conjunction with the pattern. So that molten metal can flow around all sides of the cores, they are supported on core prints (specific locations shaved into the mold) or on by metal supports called chaplets.

Foundry molds and cores are most commonly constructed of sand grains bonded together to form the desired shape of the casting. Sand is used because it is inexpensive, is capable of holding detail, and resists deformation when heated. Sand casting affords a great variety of casting sizes and complexities. Sand also offers the advantage of reuse of a large portion of the sand in future molds. Depending on the quantity of castings, however, the process can be slower and require more man-hours than processes not requiring a separate mold for each casting. In addition, castings from sand molds are dimensionally less accurate than those produced from some other techniques and often require a certain amount of machining (USITC, 1984). The pattern making, melting, cleaning, and finishing operations are essentially the same whether or not sand molds are used. Sand molds and cores will.

however, require the additional operational steps involved with handling quantities of used mold and core sand (see Section III.A.5 - Sand Handling).

In general, the various binding systems can be classified as either clay bonded sand (green sand) or chemically bonded sand. The type of binding system used depends on a number of production variables, including the temperature of the molten metal, the casting size, the types of sand used, and the alloys to be cast. The differences in binding systems can have an impact on the amounts and toxicity of wastes generated and potential releases to the environment.

Figure 4: Sand Mold and Core Cross Section



Source: American Foundrymen's Society, 1981.

Some sand molding techniques utilize chemical binders which then require that the mold halves be heat treated or baked in order to activate the binders. In order to pour molten metal into the mold when the cope and drag are latched together, runners are cut or molded into each half. Runners are connected to the mold cavity with a gate which is usually cut into the cope. A sprue is cut or molded through the cope to the runners such that when molten metal is poured into the hole through the cope, it travels through the runners and gate into the mold. Often risers are also cut into the mold halves. After pouring, risers provide a reservoir of molten metal to areas of the casting that solidify last. If metal is not supplied to these areas, the casting will have shrinkage defects.

Cores require different physical characteristics than molds; therefore, the binding systems used to make cores may be different from those used for molds. Cores must be able to withstand the strong forces of molten metal filling the mold, and often must be removed from small passages in the solidified casting. This means that the binding system used must produce strong, hard cores that will collapse for removal after the casting has hardened. Therefore, cores are typically formed from silica sand (and occasionally olivine or zircon sand), and strong chemical binders (U.S. EPA, 1992). The sand and binder mix is placed in a core box where it hardens into the desired shape and is removed. Hardening, or curing, is accomplished with heat, a chemical reaction, or a catalytic reaction. The major binding systems in use for molds and cores are discussed below.

Green Sand

Green sand is the most common molding process, making about 90% of castings produced in the U.S. Green sand is not used to form cores. Cores are formed using one of the chemical binding systems. Green sand is the only process that uses a moist sand mix. The mixture is made up of about 85 to 95 percent silica (or olivine or zircon) sand, 4 to 10 percent bentonite clay, 2 to 10 percent carbonaceous materials such as powdered (sea) coal, petroleum products, corn starch or wood flour, and 2 to 5 percent water (AFS, 1996). The clay and water act as the binder, holding the sand grains together. The carbonaceous materials burn off when the molten metal is poured into the mold, creating a reducing atmosphere which prevents the metal from oxidizing while it solidifies (U.S. EPA, 1992).

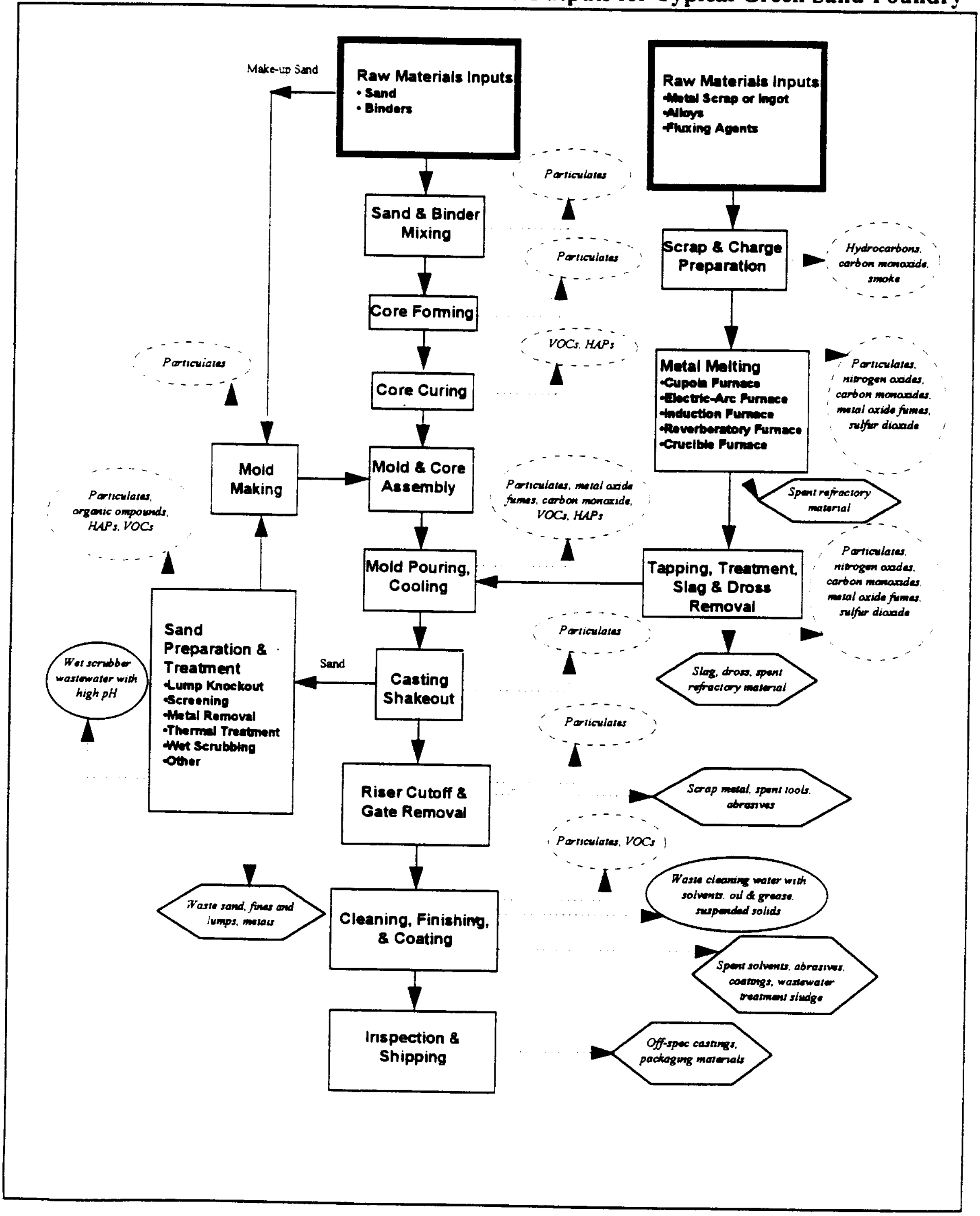
Advantages and Disadvantages

Green sand, as exemplified by its widespread use, has a number of advantages over other casting methods. The process can be used for both ferrous and non-ferrous metal casting and it can handle a more diverse range of products than any other casting method. For example, green sand is used to produce both small precision castings and large castings of up to a ton. If uniform sand compaction and accurate control of sand properties are maintained, very close tolerances can be obtained. The process also has the advantage of requiring a relatively short time to produce a mold compared to many other processes. In addition, the relative simplicity of the process makes it ideally suited to a mechanized process (AFS, 1989).

Wastes Generated

Sand cores that are used in molds break down and become part of the mold sand. Foundries using green sand molds generate waste sand that becomes spent after it has been reused in the process a number of times, as a portion must be disposed of to prevent the build up of grains that are too fine. Waste chemically bonded core sands are also generated. Typically, damaged cores are not reusable and must be disposed as waste.

Figure 5: Process Flow and Potential Pollutant Outputs for Typical Green Sand Foundry



Source: Adapted from Kotzin, Air Pollution Engineering Manual: Steel Foundries, 1992.

R0075798

Particulate emissions are generated during mixing, molding and core making operations. In addition, gaseous and metal fume emissions develop when molten metal is poured into the molds and a portion of the metal volatilizes and condenses. When green sand additives and core sand binders come into contact with the molten metal, they produce gaseous emissions such as carbon monoxide, organic compounds, hydrogen sulfide, sulfur dioxide, nitrous oxide, benzene, phenols, and other hazardous air pollutants (HAPs) (Twarog, 1993). Wastewater containing metals and suspended solids may be generated if the mold is cooled with water.

Chemical Binding Systems

Chemical binding systems are primarily used for core making. Green sand is not used for cores because, chemically bound sand is stronger, harder, and can be more easily removed from the cavity after the metal has solidified. Almost every foundry using sand molds uses one or more of the chemical binding systems described below in constructing sand cores. Although some foundries also use chemical binding systems to construct molds, the much more simple, quick and inexpensive green sand molds described previously dominate the industry in terms of tons of castings produced. When chemical binding systems are used for mold making, the "shell-mold" system is most often used. Chemical bonding systems work through either thermal setting, chemical or catalytic reactions. The major thermal setting systems include: oil-bake, shell core/mold, hot box, and warm box. The major catalytic systems are the no-bake and cold box systems (U.S. EPA, 1993).

Oil-Bake

The traditional method used to produce cores is the oil-bake, or core-oil system. The oil-bake system uses oil and cereal binders mixed with sand. The core is shaped in a core box and then baked in an oven to harden it. Oils used can be natural, such as linseed oil, or synthetic resins, such as phenolic resins. The oil-bake system was used almost exclusively before 1950, but has now been largely replaced by other chemical binding systems (U.S. EPA, 1981).

Shell Core

The shell core system uses sand mixed with synthetic resins and a catalyst. The resins are typically phenolic or furan resins, or mixtures of the two. Often the shell core sand is purchased as dry coated sand. The catalyst is a weak aqueous acid such as ammonium chloride. The sand mixture is shaped in a heated metal core box. Starting from the outside edge of the core box and moving through the sand towards the center of the core box, the heat begins to cure the sand mix into a hard mass. When the outside 1/8 to 3/16 inches of sand has been cured, the core box is inverted. The uncured sand pours out of the core box leaving a hard sand core shell behind. The shell core is then removed from the core box, allowed to cure for an addition few minutes and is then ready for placement in the mold (LaRue, 1989). The system has the advantage of using less sand and binders than other systems; however, shell sand may be more expensive than sand used in other sand processes.

Shell Mold

The shell mold system is similar to the shell core system, but is used to construct molds instead of cores. In this process, metal pattern halves are preheated, coated with a silicone emulsion release agent, and then covered by the resin-coated sand mixture. The heat from the patterns cures the sand mix and the mold is removed after the desired thickness of sand is obtained. The silicone emulsion acts as a mold release allowing the shell mold to be removed from the pattern after curing (LaRue, 1989).

Hot Box Core

The hot box process uses a phenolic or furan resin and a weak acid catalyst that are mixed with sand to coat the surface of the grains. The major difference between this system and the shell core system is that the core box is heated to about 450 to 550 °F until the entire core has become solidified (Twarog, 1993). The system has the advantage of very fast curing times and a sand mix consistency allowing the core boxes to be filled and packed quickly. Therefore, the system is ideal for automation and the mass production of cores. The disadvantage is that more sand and binder is used in this system than in the shell core system.

Warm Box Core

The warm box system is essentially the same as the hot box system, but uses a different catalyst. The catalysts used allow the resin binders to cure at a lower temperature (300 to 400 °F). As with the hot box, the resins used are phenolic and furan resins. Either copper salts or sulfonic acids are used as a catalyst. The advantage over hot box is reduced energy costs for heating (Twarog, 1993).

Cold Box

The cold box process is relatively new to the foundry industry. The system uses a catalytic gas to cure the binders at room temperature. A number of different systems are available including phenolic urethane binder with carbon dioxide gas as the catalyst. Other systems involve different binders (e.g., sodium silicate) and gases, such as sulfur dioxide and dimethylethylamine (DMEA), many of which are flammable or irritants. Compared to other chemical systems, the cold box systems have a short curing time (lower than ten seconds) and therefore are well suited to mass production techniques (AFS, 1981). In addition, the absence of costly oven heating can result in substantial energy savings.

No-Bake

The no-bake or air set binder systems allow curing at room temperature without the use of reactive gases. The no-bake system uses either acid catalysts or esters to cure the binder. The acid catalysts are typically benzene, toluene, sulfonic or phosphoric acids. Binders are either phenolic resins, furan resins, sodium silicate solution or alkyd urethane. The system has the advantage of substantial savings in energy costs (Twarog, 1993).

Advantages and Disadvantages

Cores are necessarily constructed using chemical binders. Molds, however, may be constructed with chemical binders or green sand. The advantages to using chemically bonded molds over green sand molds may include: a longer storage life for the molds, a potentially lower metal pouring temperature, and molds having better dimensional stability and surface finish. Disadvantages include the added costs of chemical binders, the energy costs for curing the binders, added difficulties to reclaim used sand, and environmental and worker safety concerns for air emissions associated with binder chemicals during curing and metal pouring.

Wastes Generated

Solid wastes generated include broken cores and sand that has set up prematurely or inadequately. Waste resins and binders can be generated from spills, residuals in containers, and outdated materials. In addition to fugitive dust from the handling of sand, mold and core making using chemical binding systems may generate gaseous emissions such as carbon monoxide, VOCs and a number of gasses listed as hazardous air pollutants (HAPs) under the Clean Air Act. Emissions occur primarily during heating or curing of the molds and cores, removal of the cores from core boxes, cooling, and pouring of metal into molds (Twarog, 1993). The specific pollutants generated depends on the type of binding system being used. Section III.B Table 4 lists typical air emissions that may be expected from each major type of chemical binding system. Wastewater containing metals, suspended solids, and phenols may be generated if molds are cooled with water.

Permanent Mold Casting

In permanent mold casting, metal molds are used repeatedly. Although the molds deteriorate over time, they can be used to make thousands of castings before being replaced. The process is similar to die casting (see Section III.A.6 on Die Casting) with the exception being that gravity is used to fill the mold rather than external pressure. Permanent molds are designed to be opened, usually on a hinge, so that the castings can be removed. Permanent molds can be used for casting both ferrous and nonferrous metals as long as the mold metal has a higher melting point than the casting metal. Cores from permanent molds can be sand, plaster, collapsible metal or, soluble salts.

When cores are not reusable, the process is often referred to as semipermanent mold casting (AFS, 1981).

Since the process is relatively simple after the mold has been fabricated, and since large numbers of castings are usually produced, permanent mold casting is typically an automated process. The sequence of operations includes an initial cleaning of the mold followed by preheating and the spraying or brushing on of a mold coating. The coating serves the purpose of insulating the molten metal from the relatively cool, heat conducting mold metal. This allows the mold to be filled completely before the metal begins to solidify. The coatings also help produce good surface finish, act as a lubricant to facilitate casting removal, and allow any air in the mold to escape via space between the mold and coating. After coating, cores are then inserted and the mold is closed. The metal is poured and allowed to solidify before opening and ejecting the casting (LaRue, 1989).

Materials

Mold metals are typically made of cast iron. The molds can be very simple or can have a number of sophisticated features, such as ejector pins to remove castings, water cooling channels and sliding core pins. Coatings are typically mixtures of sodium silicate and either vermiculite, talc, clay or bentonite (AFS, 1981).

Advantages and Disadvantages

Permanent molds have the obvious advantage of not requiring the making of a new mold (and the associated time and expenses) for every casting. The elimination of the mold making process results in a more simple overall casting process, a cleaner work environment, and far less waste generation. Because molten metal cools and solidifies much faster in a permanent mold than in a sand mold, a more dense casting with better mechanical properties is obtained. The process can also produce castings with a high level of dimensional accuracy and good surface finish (AFS, 1981). One disadvantage is the high cost of tooling, which includes the initial cost of casting and machining the permanent mold. In addition, the shapes and sizes of castings are limited due to the impossibility of removing certain shapes from the molds (USITC, 1984).

Wastes Generated

Compared to sand casting operations, relatively little waste is generated in the permanent mold process. Some foundries force cool the hot permanent molds with water sprayed or flushed over the mold. The waste cooling water may pick up contaminants from the mold such as metals and mold coatings. Fugitive dust and waste sand or plaster are generated if cores are fabricated of sand or plaster, respectively. Waste coating material may also be generated during cleaning of the mold.

R0075802

Plaster Mold Casting

The conventional plaster molding process is similar to the sand molding processes. In cope and drag flasks, a plaster slurry mix is poured over the pattern halves. When the plaster has set, the patterns are removed and the mold halves are baked to remove any water (USITC, 1984). Since even small amounts of water will, when quickly heated during pouring, expand to steam and adversely affect the casting, drying is a critical step in plaster mold casting. Oven temperatures may be as high as 800°F for as long as 16 to 36 hours. As in the sand mold processes, the cores are inserted, and the dried mold halves are attached prior to pouring the molten metal. The plaster molds are destroyed during the shakeout process. Plaster or sand cores may be used in the process.

The conventional plaster molding process described here is the most common of a number of plaster mold casting processes in use. Other processes include the foamed plaster casting process, the Antioch casting process and the match plate pattern casting process (AFS, 1981).

Materials
The plasters used in plaster mold casting are very strong, hard gypsum (calcium sulfate) cements mixed with either fibrous talcs, finely ground silica, pumice stone, clay or graphite. Plaster mixtures may also be comprised of up to 50 percent sand (AFS, 1981).

Advantages and Disadvantages
The plaster mold process can produce castings with excellent surface detail, complex and intricate configurations, and high dimensional accuracy. Plaster mold castings are also light, typically under 20 pounds (USITC, 1994). The process is limited to nonferrous metals because ferrous metals will react with the sulfur in the gypsum, creating defects on the casting surface (AFS, 1981). Plaster mold casting is more expensive than sand casting, and has a longer process time from mold construction to metal pouring. The process is only used, therefore, when the desired results cannot be obtained through sand casting or when the finer detail and surface finish will result in substantial savings in machining costs.

Wastes Generated
Waste mold plaster and fugitive dust can be generated using this process. Waste sand can also be generated, depending on the type of cores used.

Investment/Lost Wax Casting

Investment casting processes use a pattern or replica that is consumed, or lost, from the mold material when heated. The mold-making process results in a

R0075803

one-piece destroyable mold. The most common type of investment casting, the lost wax process, uses patterns fabricated from wax. Plastic patterns, however, are also fairly common in investment casting.

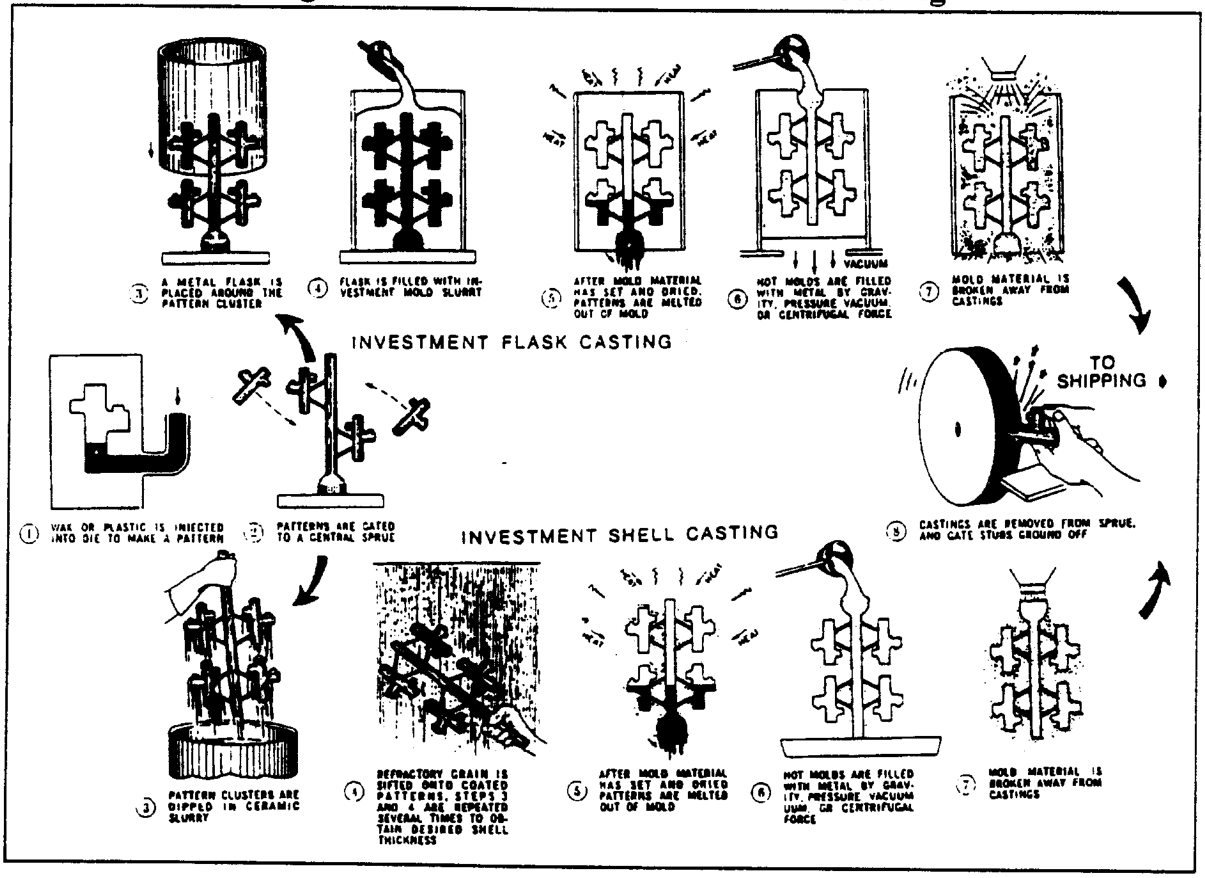
The process begins with the production of a wax or plastic replica of the part. Replicas are usually mass produced by injecting the wax or plastic into a die (metal mold) in a liquid or semi-liquid state. Replicas are attached to a gating system (sprue and runners) constructed of the same material to form a tree assembly (see Figure 6). The assembly is coated with a specially formulated heat resistant refractory slurry mixture which is allowed to harden around the wax or plastic assembly forming the mold (USITC, 1984).

In the investment *flask* casting method, the assembly is placed in a flask and then covered with a refractory slurry which is allowed to harden (see Figure 6). In the more common investment *shell* casting method, the assembly is dipped in a refractory slurry and sand is sifted onto the coated pattern assembly and allowed to harden. This process is repeated until the desired shell thickness is reached (LaRue, 1989). In both methods, the assembly is then melted out of the mold. Some investment casting foundries are able to recover the melted wax and reuse a portion in the pattern making process. The resulting mold assemblies are then heated to remove any residual pattern material and to further cure the binder system. The mold is then ready for the pouring of molten metal into the central sprue which will travel through the individual sprues and runners filling the mold.

Although normally not necessary, cores can be used in investment casting for complex interior shapes. The cores are inserted during the pattern making step. The cores are placed in the pattern die and pattern wax or plastic is injected around the core. After the pattern is removed from the die, the cores are removed. Cores used in investment casting are typically collapsible metal assemblies or soluble salt materials which can be leached out with water or a dilute hydrochloric acid solution.

In addition to the investment flask and shell mold casting methods described above, a number of methods have been developed which use reusable master patterns. These processes were developed to eliminate production of expendable patterns, one of the most costly and time-consuming steps in the casting process. One process, called the Shaw Process, uses a refractory slurry containing ethyl silicate. The slurry cures initially to a flexible gel which can be removed from the pattern in two halves. The flexible mold halves can then be further cured at high temperatures until a hard mold is formed ready for assembly and pouring (AFS, 1981).

Figure 6: Investment Flask and Shell Casting



Source: American Foundrymen's Society, 1981.

Materials

The refractory slurries used in both investment flask and shell casting are comprised of binders and refractory materials. Refractory materials include silica, aluminum silicates, zircon, and alumina. Binders include silica sols (very small silica particles suspended in water), hydrolyzed ethyl silicate, sodium and potassium silicate, and gypsum type plasters. Ethyl silicate is typically hydrolyzed at the foundry by adding alcohol, water, and hydrochloric acid to the ethyl silicate as a catalyst (AFS, 1981).

Pattern materials are most commonly wax or polystyrene. Wax materials can be synthetic, natural, or a combination. Many different formulations are available with varying strengths, hardness, melting points, setting times, and compatibilities, depending on the specific casting requirements.

R0075805

Advantages and Disadvantages

The investment casting process produces castings with a higher degree of dimensional accuracy than any other casting process. The process can also produce castings with a high level of detail and complexity and excellent surface finish. Investment casting is used to create both ferrous and nonferrous precision pieces such as dental crowns, fillings and dentures, jewelry, and scientific instruments. The costs of investment casting are generally higher than for other casting processes due in part to the high initial costs of pattern die-making (USITC, 1984). In addition, the relatively large number of steps in the process is less amenable to automation than many other casting methods.

Wastes Generated

Waste refractory material, waxes, and plastic are the largest volume wastes generated. Air emissions are primarily particulates. Wastewater with suspended and dissolved solids and low pH may also be generated if soluble salt cores are used.

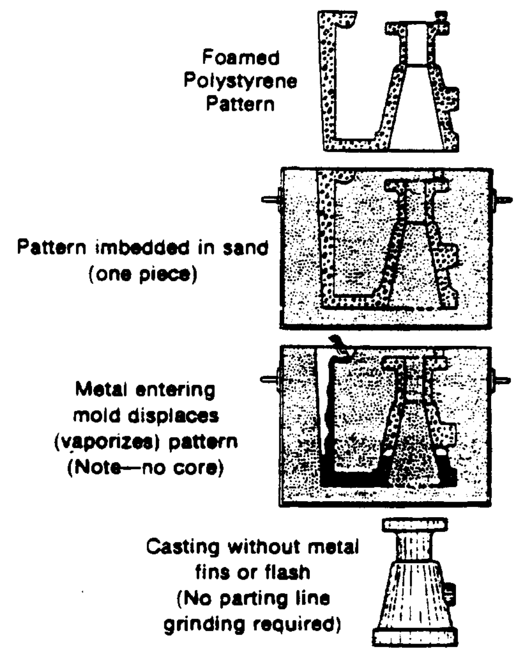
Lost Foam Casting

The lost foam casting process, also known as Expanded Polystyrene (EPS) casting, and cavityless casting, is a relatively new process that is gaining increased use. The process is similar to investment casting in that an expendable polystyrene pattern is used to make a one-piece expendable mold. As in investment casting, gating systems are attached to the patterns, and the assembly is coated with a specially formulated gas permeable refractory slurry. When the refractory slurry has hardened, the assembly is positioned in a flask, and unbonded sand is poured around the mold and compacted into any internal cavities. Molten metal is then poured into the polystyrene pattern which vaporizes and is replaced by the metal (see Figure 7). When the metal has solidified, the flask is emptied onto a steel grate for shakeout. The loose sand falls through the grate and can be reused without treatment. The refractory material is broken away from the casting in the usual manner (AFS, 1981).

Materials

Refractory slurries for lost foam casting must produce a coating strong enough to prevent the loose sand around the coated assembly from collapsing into the cavity as the pattern vaporizes. Coatings must also be permeable to allow the polystyrene vapors to escape from the mold cavity, through the coating, into the sand and out of the flask. Flasks for this process have side vents which allow the vapors to escape (AFS, 1981).

Figure 7: Lost Foam Casting Cross Sections



Source: American Foundrymen's Society, 1981.

Polystyrene patterns can be fabricated from polystyrene boards or by molding polystyrene beads. Patterns from boards are fabricated using normal pattern forming tools (see Section III.A.1). The boards are available in various sizes and thicknesses, and can be glued together to increase thickness if needed. Molded polystyrene patterns begin as small beads of expandable polystyrene product. The beads are pre-expanded to the required density using a vacuum, steam, or hot air processes. In general, the aim is to reduce the bead density as much as possible in order to minimize the volume of vapors to be vented during casting. If vapors are generated faster than can be vented, casting defects will result. The expanded polystyrene beads are blown into a cast aluminum mold. Steam is used to heat the beads causing them to expand further, fill void areas, and bond together. The mold and pattern are allowed to cool, and the pattern is ejected (AFS, 1981).

Advantages and Disadvantages

The lost foam process can be used for precision castings of ferrous and nonferrous metals of any size. In addition to being capable of producing highly accurate, complex castings with thin walls, good surface finish, and no parting lines, there are numerous practical advantages to the process. For example, there are far fewer steps involved in lost foam casting compared to sand casting. Core making and setting is not necessary, nor is the mixing of

R0075807

large amounts of sand and binders. Shakeout and sand handling is a matter of pouring out the sand which is mostly reusable without any treatment since binders are not used. Some portion of sand may need to be removed to avoid the buildup of styrene in the sand. The flasks used are less expensive and easier to use since there are no cope and drag halves to be fastened together. The reduced labor and material costs make lost foam casting an economical alternative to many traditional casting methods. Although the potential exists for other metals to be cast, currently only aluminum and gray and ductile iron are cast using this method (AFS, 1981). In addition there are some limitations in using the technique to cast low carbon alloys (SFSA, 1997).

Wastes Generated

The large quantities of polystyrene vapors produced during lost foam casting can be flammable and may contain hazardous air pollutants (HAPs). Other possible air emissions are particulates related to the use of sand. Waste sand and refractory materials containing styrene may also be generated.

III.A.3. Furnace Charge Preparation and Metal Melting

Foundries typically use recycled scrap metals as their primary source of metal. and use metal ingot as a secondary source when scrap is not available. The first step in metal melting is preparation of the scrap materials. Preparation. which also may be done by the foundry's metal supplier, consists of cutting the materials to the proper size for the furnace and cleaning and degreasing the materials. Cleaning and degreasing can be accomplished with solvents or by a precombustion step to burn off any organic contaminants (Kotzin, 1992). Prepared scrap metal is weighed and additional metal, alloys, and flux may be added prior to adding the metal to the furnace. Adding metal to a furnace is called "charging." (Alloys may also be added at various stages of the melt or as the ladle is filled.)

Flux is a material added to the furnace charge or to the molten metal to remove impurities. Flux unites with impurities to form dross or slag, which rises to the surface of the molten metal where it is removed before pouring (LaRue, 1989). The slag material on the molten metal surface helps to prevent oxidation of the metal. Flux is often chloride or fluoride salts that have an affinity to bind with certain contaminants. The use of salt fluxes may result in emissions of acid gasses.

Five types of furnaces are commonly used to melt metal in foundries: cupola, electric arc, reverberatory, induction and crucible (see Figure 8). Some foundries operate more than one type of furnace and may even transfer molten metal between furnace types in order to make best use of the best features of each.

Cupola Furnaces

The cupola furnace is primarily used to melt gray, malleable, or ductile iron. The furnace is a hollow vertical cylinder on legs and lined with refractory material. Hinged doors at the bottom allow the furnace to be emptied when not in use. When charging the furnace, the doors are closed and a bed of sand is placed at the bottom of the furnace, covering the doors. Alternating layers of coke for fuel and scrap metal, alloys and flux are placed over the sand. Although air, or oxygen enriched air, is forced through the layers with a blower, cupolas require a reducing atmosphere to maintain the coke bed. Heat from the burning coke melts the scrap metal and flux, which drip to the bottom sand layer. In addition, the burning of coke under reducing conditions raises the carbon content of the metal charge to the casting specifications. A hole level with the top of the sand allows molten metal to be drained off, or "tapped." A higher hole allows slag to be drawn off. Additional charges can be added to the furnace as needed (LaRue, 1989).

Electric Arc Furnaces

Electric arc furnaces are used for melting cast iron or steel. The furnace consists of a saucer-shaped hearth of refractory material for collecting the molten metal with refractory material lining the sides and top of the furnace. Two or three carbon electrodes penetrate the furnace from the top or sides. The scrap metal charge is placed on the hearth and melted by the heat from an electric arc formed between the electrodes. When the electric arc comes into contact with the metal, it is a direct-arc furnace and when the electric arc does not actually touch the metal it is an indirect-arc furnace. Molten metal is typically drawn off through a spout by tipping the furnace. Alloying metal can be added, and slag can be removed, through doors in the walls of the furnace (LaRue, 1989). Electric arc furnaces have the advantage of not requiring incoming scrap to be clean. One disadvantage is that they do not allow precise metallurgical adjustments to the molten metal.

Reverberatory Furnaces

Reverberatory furnaces are primarily used to melt large quantities of nonferrous metals. Metal is placed on a saucer-shaped hearth lined with refractory material on all sides. Hot air and combustion gasses from oil or gas burners are blown over the metal and exhausted out of the furnace. The heat melts the metal and more charge is added until the level of molten metal is high enough to run out of a spout in the hearth and into a well from which it can be ladled out (LaRue, 1989).

Induction Furnaces

Induction furnaces are used to melt both ferrous and non-ferrous metals. There are several types of induction furnaces, but all create a strong magnetic field by passing an electric current through a coil wrapped around the furnace. The magnetic field in turn creates a voltage across and subsequently an electric current through the metal to be melted. The electrical resistance of the metal produces heat which melts the metal. Induction furnaces are very efficient and are made in a wide range of sizes (LaRue, 1989). Induction furnaces require cleaner scrap than electric arc furnaces, however, they do allow precise metallurgical adjustments.

Crucible Furnaces

Crucible furnaces are primarily used to melt smaller amounts of nonferrous metals than other furnace types. The crucible or refractory container is heated in a furnace fired with natural gas or liquid propane. The metal in the crucible melts, and can be ladled from the crucible or poured directly by tipping the crucible (LaRue, 1989).

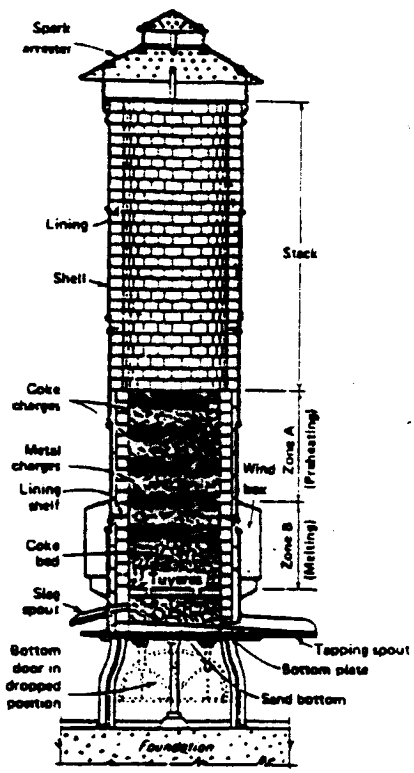
Wastes Generated

Cupola, reverberatory and electric arc furnaces may emit particulate matter, carbon monoxide, hydrocarbons, sulfur dioxide, nitrogen oxides, small quantities of chloride and fluoride compounds, and metallic fumes from the condensation of volatilized metal and metal oxides. Induction furnaces and crucible furnaces emit relatively small amounts of particulates, hydrocarbons, and carbon monoxide emissions. The highest concentration of furnace emissions occur when furnaces are opened for charging, alloying, slag removal, and tapping (Kotzin, 1992). Particulate emissions can be especially high during alloying and the introduction of additives. For example, if magnesium is added to molten metal to produce ductile iron, a strong reaction ensues, with the potential to release magnesium oxides and metallic fumes (NADCA, 1996).

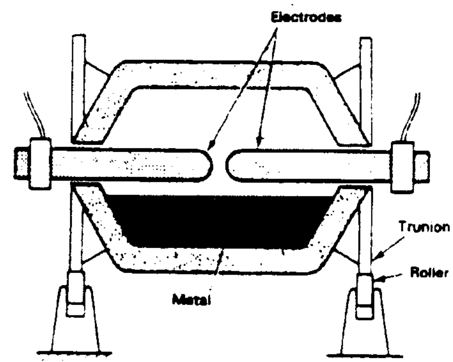
Furnace emissions are often controlled with wet scrubbers. Wet scrubber wastewater can be generated in large quantities (up to 3,000 gallons per minute) in facilities using large cupola furnaces. This water may contain metals and phenols, and is typically highly alkaline or acidic and is neutralized before being discharged to the POTW (AFS Air Quality Committee, 1992). Non-contact cooling water with little or no contamination may also be generated.

Scrap preparation using thermal treatment will emit smoke, organic compounds and carbon monoxide. Other wastes may include waste solvents if solvents are used to prepare metal for charging. Slag is also generated during metal melting operations. Hazardous slag can be generated if the charge materials contain enough toxic metals such as lead and chromium or if calcium carbide is used in the metal to remove sulfur compounds (see Section III.B.1) (U.S. EPA, 1992).

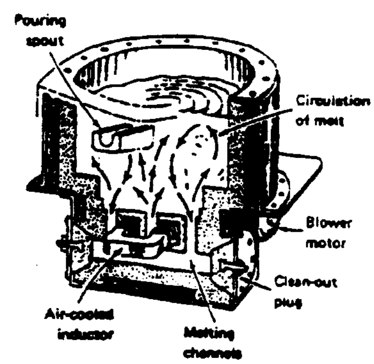
Figure 8: Sectional Views of Melting Furnaces



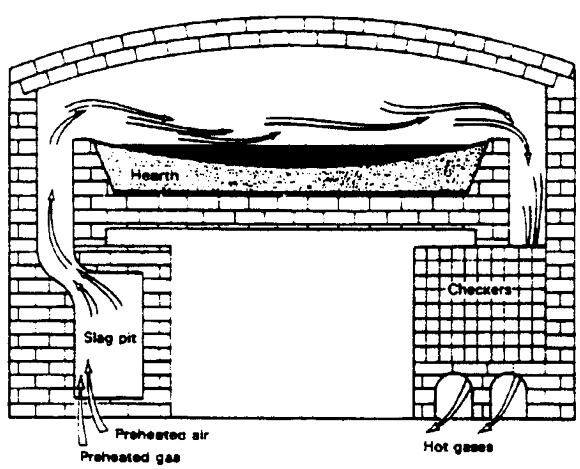
Cupola



Electric Indirect-Arc



Induction



Reverberatory

Source: American Foundrymen's Society, 1989.

R0075811

III.A.4. Shakeout, Cooling and Sand Handling

For those foundries using sand molding and core making techniques, castings need to be cooled and separated from the sand mold. After molten metal has been ladled into the mold and begins to solidify, it is transported to a cooling area where the casting solidifies before being separated from the mold. Larger, more mechanized foundries use automatic conveyor systems to transfer the casting and mold through a cooling tunnel on the way to the shakeout area. Less mechanized foundries allow the castings to cool on the shop floor. In the shakeout area, molds are typically placed on vibrating grids or conveyors to shake the sand loose from the casting. In some foundries, the mold may be separated from the casting manually (EPA, 1986).

Sand casting techniques can generate substantial volumes of waste sand. Many foundries reuse a large portion of this sand and only remove a small portion as waste. Waste sand removed from the foundry is primarily made up of fine grains that build up as the sand is reused over and over. Most foundries, therefore, have a large multi-step sand handling operation for capturing and conditioning the reusable sand. Larger foundries often have conveyorized sand-handling systems working continuously. Smaller, less mechanized foundries often use heavy equipment (e.g., front-end loaders) in a batch process (U.S. EPA, 1992). Increasingly, foundry waste sand is being sent off-site for use as a construction material (see Section V).

Sand handling operations receive sand directly from the shakeout step or from an intermediate sand storage area. A typical first step in sand handling is lump knockout. Sand lumps occur when the binders used in sand cores only partially degrade after exposure to the heat of molten metal. The lumps, or core butts, may be crushed and recycled into molding sand during this step. They can also be disposed as waste material. A magnetic separation operation is often used in ferrous foundries to remove pieces of metal from the sand. Other steps involve screening to remove fines that build up over time, and cooling by aeration. In addition, some foundries treat mold and core sand thermally to remove binders and organic impurities (U.S. EPA, 1992).

Wastes Generated
Shakeout, cooling, and sand handling operations generate waste sand and fines possibly containing metals. In addition, particulate emissions are generated during these operations. If thermal treatment units are used to reclaim chemically bonded sands, emissions such as carbon monoxide, organic compounds, and other gasses can be expected.

R0075812

III.A.5. Quenching, Finishing, Cleaning and Coating

Rapid cooling of hot castings by quenching in a water bath is practiced by some foundries and die casters to cool and solidify the casting rapidly (to speed the process) and to achieve certain metallurgical properties. The water bath may be plain water or may contain chemical additives to prevent oxidation.

Some amount of finishing and cleaning is required for all castings; however, the degree and specific types of operations will depend largely on the casting specifications and the casting process used. Finishing and cleaning operations can be a significant portion of the overall cost to produce a casting. Foundries, therefore, often search for casting techniques and mold designs that will reduce the finishing needed.

Finishing operations begin once the casting is shaken out and cooled. Hammers, band saws, abrasive cutting wheels, flame cut-off devices, and air-carbon arc devices may be used to remove the risers, runners, and sprues of the gating system. Metal fins at the parting lines (lines on a casting corresponding to the interface between the cope and drag of a mold) are removed with chipping hammers and grinders. Residual refractory material and oxides are typically removed by sand blasting or steel shot blasting, which can also be used to give the casting a uniform and more attractive surface appearance (U.S. EPA, 1992).

The cleaning of castings precedes any coating operations to ensure that the coating will adhere to the metal. Chemical cleaning and coating operations are often contracted out to off-site firms, but are sometimes carried out at the foundries. Scale, rust, oxides, oil, grease, and dirt can be chemically removed from the surface using organic solvents (typically chlorinated solvents, although naphtha, methanol, and toluene are also used), emulsifiers, pressurized water, abrasives, alkaline agents (caustic soda, soda ash, alkaline silicates, and phosphates), or acid pickling. The pickling process involves the cleaning of the metal surface with inorganic acids such as hydrochloric acid, sulfuric acid, or nitric acid. Castings generally pass from the pickling bath through a series of rinses. Molten salt baths are also used to clean complex interior passages in castings (U.S. EPA, 1992).

Castings are often given a coating to inhibit oxidation, resist deterioration, or improve appearance. Common coating operations include: painting, electroplating, electroless nickel plating, hard facing, hot dipping, thermal spraying, diffusion, conversion, porcelain enameling, and organic or fused dry-resin coating (U.S. EPA, 1992).

Wastes Generated
Casting quench water may contain phenols, oil and grease, suspended solids, and metals (e.g., copper, lead, zinc). Metal-bearing sludges may be generated when quench baths are cleaned out (EPA, 1995).

Finishing operations may generate particulate air emissions. Wastewater may contain cutting oils, ethylene glycol, and metals. Solid wastes include metal chips and spent cutting oils (EPA, 1995).

Cleaning and coating may generate air emissions of VOCs from painting, coating and solvent cleaning; acid mists and metal ion mists from anodizing, plating, polishing, hot dip coating, etching, and chemical conversion coating. Wastewater may contain solvents, metals, metal salts, cyanides, and high or low pH. Solid wastes include cyanide and metal-bearing sludges, spent solvents and paints, and spent plating baths (EPA, 1995).

III.A.6. Die Casting

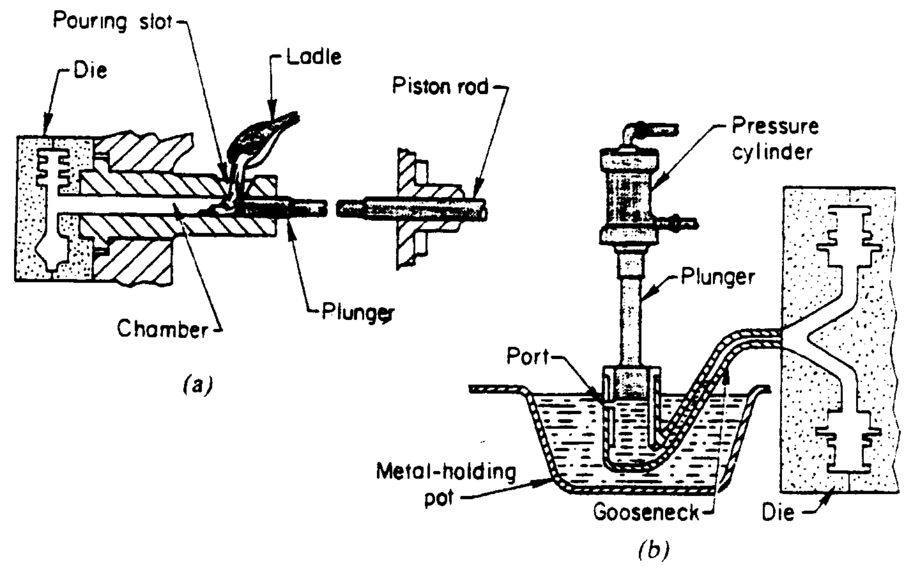
The term "die casting" usually implies "pressure die casting." The process utilizes a permanent die (metal mold) in which molten metal is forced under high pressure. Dies are usually made from two blocks of steel, each containing part of the cavity, which are locked together while the casting is being made. Retractable and removable cores are used to form internal surfaces. The metal is held under pressure until it cools and solidifies. The die halves are then opened and the casting is removed, usually by means of an automatic ejection system. Dies are preheated and lubricated before being used, and are either air- or water-cooled to maintain the desired operating temperature (Loper, 1985). Metal is typically melted on site from prealloyed ingot, or by blending the alloying constituents (or occasionally metal scrap). Some aluminum die casters, however, purchase molten aluminum and store it on site in a holding furnace (NADCA, 1996). Two basic types of die casting machines are used: hot chamber and cold-chamber (see Figure 9).

Die casting machines
Hot-chamber die casting machines are comprised of a molten metal reservoir, the die, and a metal-transferring device which automatically withdraws molten metal from the reservoir and forces it under pressure into the die. A steel piston and cylinder system is often used to create the necessary pressure within the die. Pressures can range from a few hundred to over 5,000 psi. Certain metals, such as aluminum alloys, zinc alloys, and pure zinc cannot be used in hot-chamber die casting because they rapidly attack the iron in the piston and cylinder. These metals, therefore, require a different type of casting machine, called a gooseneck. A gooseneck machine utilizes a cast-iron channel to transfer the molten metal from the reservoir to the die (see Figure 9(b)). After the gooseneck is brought into contact with the die.

compressed air is applied to the molten metal. Pressures are typically in the range of 350 to 500 psi (Loper, 1985).

Cold chamber machines have molten metal reservoirs separate from the casting machine. Just enough metal for one casting is ladled by hand or mechanically into a small chamber, from which it is forced into the die under high pressure (see Figure 9(a)). Pressure is produced through a hydraulic system connected to a piston, and is typically in the range of a few thousand psi to 10,000 psi. In cold chamber machines, the metal is just above the melting point and is in a slush-like state. Since the metal is in contact with the piston and cylinder for only a short period of time, the process is applicable to aluminum alloys, magnesium alloys, zinc alloys, and even high melting-point alloys such as brasses and bronzes (Loper, 1985).

Figure 9: Cold (a), and Hot Chamber (b), Die Casting Machines



Source: American Foundrymen's Society, 1981.

Die Lubrication

Proper lubrication of dies and plungers is essential for successful die casting. Die lubrication affects the casting quality, density, and surface finish, the ease of cavity fill, and the ease of casting ejection. Proper lubrication can also speed the casting rate, reduce maintenance, and reduce build up of material on the die face (Street, 1977).

Die lubrication can be manual or automatic. In manual systems, the die casting machine operator uses a hand held spray gun to apply lubricant to the

R0075815

die surface just before the die is closed. Automatic systems use either fixed or reciprocating spray systems to apply lubricant (Allsop, 1983).

There are many types and formulations of lubricants on the market. No one lubricant meets the requirements for all die casters. The specific lubricant formulation used depends on a number of factors, including: the metal being cast, the temperatures of casting, the lubricant application method, the surface finish requirements, the complexity of the casting, and the type of ejection system. Although specific formulations are proprietary, in general, lubricants are a mixture of a lubricant and a carrier material. Formulations may also include additives to inhibit corrosion, increase stability during storage, and resist bacterial degradation (Kaye, 1982).

Lubricants are mostly carrier material which evaporates upon contact with the hot die surface, depositing a thin uniform coating of die lubricant on the die face. Typical ratios of carrier to lubricant are about 40 to 1 (Kaye, 1982).

Both water-based lubricants and solvent-based lubricants are in use today. Solvents, however, are largely being phased out due to health and fire concerns associated with the large amounts of solvent vapors released. Water-based lubricants are now used almost exclusively in the U.S. Lubricating materials are typically mineral oils and waxes in water emulsions. Silicone oils and synthetic waxes are finding increased use. In addition, research is under way to develop a permanent release coating for die surfaces which will eliminate the need for repeated lubricant application (Kaye, 1982).

Advantages and Disadvantages

Die casting is not applicable to steel and high melting point alloys. Pressure dies are very expensive to design and produce, and the die casting machines themselves are major capital investments (LaRue, 1989). Therefore, to compete with other casting methods, it must be more economical to produce a component by virtue of higher production rates, or the finished components must be superior to those produced using other methods -- often, it is a combination of both factors (USITC, 1984).

Once the reusable die has been prepared, the die casting process can sustain very high production rates. Castings can be made at rates of more than 400 per hour. There is a limit, however, to the number of castings produced in a single die depending on the die design, the alloys being casted, and the dimensional tolerances required. The useable life span of a die can range from under 1,000 to over 5,000,000 castings or "shots." (Allsop, 1983) Therefore, the design of the die itself is critical not only for producing high quality castings but also in ensuring the economic viability of the production process. Die design is a very complex exercise. In addition to the design of the component geometry and constituent materials, numerous factors related to the die itself must be considered, including: the type of alloys, the temperature gradients within the die, the pressure and velocity of the molten metal when it enters the die, the technique for ejecting the casting from the die, and the lubrication system used (Street, 1977). Computer-aided design and modeling of die designs is now commonplace and has played an important role in advancing the technology.

One major advantage of die casting over other casting methods is that the produced castings can have very complex shapes. The ability to cast complex shapes often makes it possible to manufacture a product from a single casting instead of from an assembly of cast components. This can greatly reduce casting costs as well as costs associated with fabrication and machining. Furthermore, die casting produces castings having a high degree of dimensional accuracy and surface definition compared to other casting methods, which may also reduce or eliminate costly machining steps. Finally, castings with relatively thin wall sections can be produced using the die casting method. This can result in substantial savings in material costs and reductions in component weight (Allsop, 1983).

Wastes Generated

Wastes generated during metal melting will be similar to those of metal melting in foundries, depending on the particular furnace used. Relatively little waste is generated in the actual die casting process compared to other metal casting processes. However, some gaseous and fume emissions occur during metal injection. Metal oxide fumes are released as some of the metal vaporizes and condenses. Gaseous emissions can originate from: the molten metal itself; the evolution of chemicals from the lubricant as it is sprayed onto the hot metal die; and as the molten metal contacts the lubricant (NADCA, 1996).

III.B. Raw Materials Inputs and Pollution Outputs

Raw material inputs and pollutant outputs differ for foundries and die casters. The major difference lies in the use of permanent molds by die casting facilities which eliminates any need for large mold making operations and the handling, treatment and disposal of sand and other refractory materials. For this reason, the material inputs and pollutant outputs of permanent mold casting foundries will likely be more similar to those of die casting facilities. Table 4 summarizes the material inputs and pollution outputs discussed in this section.

III.B.1. Foundries

The main raw material inputs for foundries are sand and other core and mold refractory materials (depending of the particular processes used), metals in the form of scrap and ingot, alloys, and fuel for metal melting. Other raw material inputs include binders, fluxing agents, and pattern making materials.

Air Emissions

Air emissions at foundries primarily arise from metal melting, mold and core making, shakeout and sand handling, and the cleaning and finishing of cast parts (Kotzin, 1992).

<u>Furnaces and Metal Melting</u>
Furnace air emissions consist of the products of combustion from the fuel and particulate matter in the form of dusts, metallics, and metal oxide fumes. Carbon monoxide and organic vapors may also arise if oily scrap is charged to the furnace or preheat system (AP-42, 1993). Particulates will vary according to the type of furnace, fuel (if used), metal melted, melting temperature, and a number of operating practices. Air emissions from furnaces and molten metal can often be reduced by applying a number of good operating practices (see Section V.A). Particulates can include fly ash, carbon, metallic dusts, and fumes from the volatilization and condensation of molten metal oxides. In steel foundries, these particulates may contain varying amounts of zinc, lead, nickel, cadmium, and chromium (Kotzin, 1992). Carbon-steel dust can be high in zinc as a result of the use of galvanized scrap, while stainless steel dust is high in nickel and chromium. Painted scrap can result in particulates high in lead. Particulates associated with nonferrous metal production may contain copper, aluminum, lead, tin, and zinc. The particulate sizes of the oxide fumes are often very small (submicron) and, therefore, require high efficiency control devises (Licht, 1992).

Furnace air emissions are typically captured in ventilation systems comprised of hoods and duct work. Hoods and ducts are usually placed over and/or near the tapping spouts, and metal charging, slag removal, and pouring areas. Hoods can be permanently fixed at pouring stations or attached to the pouring ladle or crane through flexible duct work. Depending on the type of furnace and metals melted, these ventilation systems may be ducted to coolers to cool the hot combustion gases, followed by baghouses, electrostatic precipitators and/or wet scrubbers to collect particulates. Afterburners may also be used to control carbon monoxide and oil vapors (Licht, 1992).

Mold and Core Making

The major air pollutants generated during mold and core making are particulates from the handling of sand and other refractory materials, and VOCs from the core and mold curing and drying operations. VOCs, particulates, carbon monoxide, and other organic compounds are also emitted when the mold and core come into contact with the molten metal and while the filled molds are cooled (AP-42, 1993).

The use of organic chemical binding systems (e.g., cold box, hot box, no bake, etc.) may generate sulfur dioxide, ammonia, hydrogen sulfide, hydrogen cyanide, nitrogen oxides and large number of different organic compounds. Emissions occur primarily during heating and curing, removal of the cores from core boxes, cooling, and pouring the metal into molds and may include a number of gases listed as hazardous air pollutants (HAPs) under the Clean Air Act. Potential HAPs emitted when using chemical binding systems include: formaldehyde, methylene diphenyl diisocyanate (MDI), phenol, triethylamine, methanol, benzene, toluene, cresol/cresylic acid, napthalene, polycyclic-organics, and cyanide compounds (Twarog, 1993).

Some core-making processes use strongly acidic or basic substances for scrubbing the off gasses from the core making process. In the free radical cure process, acrylic-epoxy binders are cured using an organic hydroperoxide and SO_2 gas. Gasses are typically scrubbed to remove sulfur dioxide before release through the stack to the atmosphere. A wet scrubbing unit absorbs the SO_2 gas. A 5 to 10 percent solution of sodium hydroxide at a pH of 8 to 14 neutralizes the SO_2 and prevents the by-product (sodium sulfite) from precipitating out of solution (U.S. EPA, 1992).

Amine scrubbers may be used for sulfur dioxide control by foundries. In amine scrubbing the gas containing sulfur dioxide is first passed through a catalyst bed, where the sulfur compounds are converted to hydrogen sulfide. The gas stream then enters a packed or trayed tower (scrubber) where it is contacted with a solution of water and an organic amine. The amine solution is alkaline and the weakly acidic hydrogen sulfide in the gas stream dissolves in it. The amine solution with hydrogen sulfide is then sent to a stripping tower, where it is boiled and the acid gases stripped out. The amine solution is cooled and returned to the scrubbing tower for reuse. Acid gases are cooled and treated through neutralization. A number of amines are used including diethanolamine (DEA), monoethanolamine (MEA), and methyldiethanolamine (MDEA). Air emissions from the amine scrubbers may include some H_2S and other sulfur compounds. (Scott, 1992).

Shakeout, Finishing, and Sand Handling

Shakeout and sand handling operations generate dust and metallic particulates. Finishing and cleaning operations will generate metallic particulates from deburring, grinding, sanding and brushing, and volatile organic compounds from the application of rust inhibitors or organic coatings such as paint. Control systems involve hoods and ducts at key dust generating points followed by baghouses, electrostatic precipitators, or wet scrubbers (AFS Air Quality Committee, 1992).

Wastewater

Wastewater mainly consists of noncontact cooling water and wet scrubber effluent (Leidel, 1995). Noncontact cooling water can typically be discharged to the POTW or to surface waters under an NPDES permit. Wet scrubber wastewater in facilities using large cupola furnaces can be generated in large quantities (up to 3,000 gallons per minute). This water is typically highly alkaline or acidic and is neutralized before being discharged to the POTW (AFS Air Quality Committee, 1992). If amine scrubbers are used, amine scrubbing solution can be released to the plant effluent system through leaks and spills. Some foundries using cupola furnaces also generate wastewater containing metals from cooling slag with water. Wastewater may also be generated in certain finishing operations such as quenching and deburring. Such wastewater can be high in oil and suspended solids (NADCA, 1996).

Residual Wastes

Residual wastes originate from many different points within foundries. Waste sand is by far the largest volume waste for the industry. Other residual wastes may include dust from dust collection systems, slag, spent investment casting refractory material, off-spec products, resins, spent solvents and cleaners, paints, and other miscellaneous wastes.

Furnaces and Metal Melting

The percentage of metal from each charge that is converted to dust or fumes and collected by baghouses, electrostatic precipitators, or wet scrubbers can vary significantly from facility to facility depending on the type of furnace used and the type of metal cast. In steel foundries, this dust contains varying amounts of zinc, lead, nickel, cadmium, and chromium. Carbon-steel dust tends to be high in zinc as a result of the use of galvanized scrap, while stainless steel dust is high in nickel and chromium. Dust high in lead may result from the use of scrap painted with leaded paint. Dust associated with nonferrous metal production may contain copper, aluminum, lead, tin, and zinc. Steel dust may be encapsulated and disposed of in a permitted landfill, while nonferrous dust is often sent to a recycler for metal recovery.

Slag is a glassy mass with a complex chemical structure. It can constitute about 25 percent of a foundry's solid waste stream (Kotzin, 1995). Slag is composed of metal oxides from the melting process, melted refractories, sand, coke ash (if coke is used), and other materials. Large quantities of slag are generated in particular from iron foundries that melt in cupola furnaces. Fluxes are used to facilitate removal of contaminants from the molten metal into the slag so that it can be removed from the molten metal surface. Hazardous slag may be produced in melting operations if the charge materials contain toxic metals such as lead, cadmium, or chromium. To produce ductile iron by reducing the sulfur content of iron, some foundries use calcium carbide desulfurization and the slag generated by this process may be classified as a reactive waste (U.S. EPA, 1992).

Mold and Core Making

Those core-making processes that use strongly acidic or basic substances for scrubbing the off gasses from the core making process may generate sludges or liquors. These sludges or liquors are typically pH controlled prior to discharge to the sewer system as nonhazardous waste. If not properly treated, the waste may be classified as hazardous corrosive waste and thus subjected to numerous federal, state and local mandates (U.S. EPA, 1992).

Shakeout and Sand Handling

Foundries using sand molds and cores generate large volumes of waste sands. Waste foundry sand can account for 65 to 90 percent of the total waste generated by foundries. In many foundries, casting sands are recycled internally until they can no longer be used. Some foundries reclaim waste sands so that they can be recycled to the process or recycled off-site for another use (see Section V.A.1). Sand that can no longer be used by iron or steel foundries, is often landfilled as nonhazardous waste. Casting sands used in the production of brass or bronze castings may exhibit toxicity characteristic for lead or cadmium. The hazardous sand may be reclaimed in a thermal treatment unit which may be subject to RCRA requirements for hazardous waste incinerators (see Section VI.B) (U.S. EPA, 1992). Approximately two percent of all foundry spent sand is hazardous (Kotzin, 1995).

Investment casting shells can be used only once and are disposed in landfills as a nonhazardous waste unless condensates from heavy metal alloy constituents are present in the shells.

Most foundries generate miscellaneous residual waste that varies greatly in composition, but makes up only a small percentage of the total waste. This waste includes welding materials, waste oil from heavy equipment and hydraulics, empty binder drums, and scrubber lime (U.S. EPA, 1992).

III.B.2. Die Casters

The main raw material inputs for die casters include: metal in the form of ingot, molten metal, metal scrap, alloys, and fuel for metal melting. Other raw material inputs include: fluxing agents, die lubricants, refractory materials, hydraulic fluid, and finishing and cleaning materials.

Air Emissions

Furnace air emissions consist of the products of combustion from the fuel and particulate matter in the form of dusts, metallics, and metal oxide fumes. Carbon monoxide and oil vapors may also arise if oily scrap is charged to the furnace or preheat system. Metallic particulates arise mainly from the volatilization and condensation of molten metal oxides. These will vary according to the type of furnace, fuel, metal, melting temperature, and a number of operating practices. The particulate sizes of the oxide fumes are often very small (submicron) and may contain copper, aluminum, lead, tin, and zinc (Licht, 1992).

Fluxing and dross removal operations to remove impurities from the molten metal can also be the source of air emissions. Die casters can use a number of different fluxing agents to remove different impurities, including: sulfur hexafluoride, solvent fluxes, aluminum fluoride, or chlorine. Metallic particulates, the fluxing agents themselves, and products of chemical reactions with impurities can be emitted from the molten metal surface or from the subsequently removed dross as it cools. For example, if chlorine is used, it may react with aluminum and water in the atmosphere to form aluminum oxide fumes and hydrochloric acid. Although not always necessary, particulate emissions control equipment, such as fabric bag filters, are sometimes used to control furnace emissions at die casting facilities (NADCA, 1996).

Die lubrication and plunger tip lubrication can also be a significant source of air releases from die casting facilities. Both oil- and water-based die lubricants are used. Oil-based lubricants typically contain naphtha and result in much higher emissions of volatile organic compounds than water-based lubricants. The air emissions will depend on the specific formulation of the lubricant product and may contain hazardous air pollutants (NADCA, 1996).

Other air emissions arise from finishing and cleaning operations which generate metallic particulates from deburring, grinding, sanding and brushing, and volatile organic compounds from the application of rust inhibitors or paint. Casting quench tanks for the cooling of zinc castings can contain volatile organic compounds and water treatment chemicals resulting in potential emissions of volatile organic compounds and hazardous air pollutants (NADCA, 1996).

Wastewater

Both process wastewater and waste noncontact cooling water may be generated at die casting facilities. Noncontact cooling water will likey have elevated temperature and very little or no chemical contamination. Process wastewater from die casting facilities can be contaminated with spent die lubricants, hydraulic fluid and coolants. Contaminants in such wastewater are typically oil and phenols. As with foundries, die casters may also generate wastewater in certain finishing operations such as in-process cleaning, quenching and deburring. Such wastewater can be high in oil and suspended solids. Typical wastewater treatment at die casting facilities consists of oil/water separation and/or filtration before discharge to a POTW. Facilities generating large volumes of wastewater may also utilize biological treatment (NADCA, 1996).

Residual Wastes

Residual waste streams from die casting facilities are relatively small compared to most sand casting foundries. Typical residual wastes include: slag or dross generated from molten metal surfaces; refractory materials from furnaces and ladles; metallic fines, spent shot (plunger) tips, tools, heating coils, hydraulic fluid, floor absorbent, abrasive cutting belts and wheels, quench sludge, and steel shot. Most residual wastes from die casting facilities are sent off-site for disposal as a non-hazardous waste. Waste dross is usually sent to secondary smelters for metal recovery. Waste oils, lubricants and hydraulic fluids may be sent off-site for recycling or energy recovery (NADCA, 1996).

Table 4: Summary of Material Inputs and Potential Pollutant Outputs for the Metal Casting Industry

Industrial Process	Material Inputs	Air Emissions	Wastewater	Residual Wastes
Pattern Making	Wood, plastic, metal, wax, polystyrene	VOCs from glues, epoxies, and paints.	Little or no wastewater generated	Scrap pattern materials
Mold and Core Preparation and Pouring				
Green Sand	Green sand and chemically-bonded sand cores	Particulates, metal oxide fumes, carbon monoxide, organic compounds, hydrogen sulfide, sulfur dioxide, and nitrous oxide. Also, benzene, phenols, and other hazardous air pollutants (HAPs) if chemically bonded cores are used.	Wastewater containing metals, elevated temperature, phenols and other organics from wet dust collection systems and mold cooling water	Waste green sand and core sand potentially containing metals
Chemical Binding Systems	Sand and chemical binders	Particulates, metallic oxide fumes, carbon monoxide, ammonia, hydrogen sulfide, hydrogen cyanide, sulfur dioxide, nitrogen oxides, and other HAPs	Scrubber wastewater with amines or high or low pH; and wastewater containing metals, elevated temperature, phenols and other organics from wet dust collection systems and mold cooling water	Waste mold and core sand potentially containing metals and residual chemical binders
Permanent Mold	Steel mold, permanent, sand, plaster, or salt cores	Particulates, metallic oxide fumes	Waste cooling water with elevated temperature and wastewater with low pH and high in dissolved salts if soluble salt cores are used	Waste core sand or plaster potentially containing metals
Plaster Mold	Plaster mold material	Particulates, metallic oxide fumes	Little or no wastewater generated	Spent plaster
Investment/Lost Wax	Refractory slurry, and wax or plastic	Particulates, metallic oxide fumes	Wastewater with low pH and high in dissolved salts if soluble salt cores are used	Waste refractory material, waxes and plastics
Lost Foam	Refractory slurry, polystyrene	Particulates, metallic oxide fumes, polystyrene vapors and HAPs	Little or no wastewater generated	Waste sand and refractory material potentially containing metals and styrene

R0075824

Industrial Process	Material Inputs	Air Emissions	Wastewater	Residual Wastes
Furnace Charge Preparation and Metal Melting				
Charging and Melting	Metal scrap, ingot and returned castings	Products of combustion, oil vapors, particulates, metallic oxide fumes	Scrubber wastewater with high pH, slag cooling water with metals, and non-contact cooling water	Spent refractory material potentially containing metals and alloys
Fluxing and Slag and Dross Removal	Fluxing agents	Particulates, metallic oxide fumes, solvents, hydrochloric acid	Wastewater containing metals if slag quench is utilized	Dross and slag potentially containing metals
Pouring	Ladles and other refractory materials	Particulates, metallic oxide fumes	Little or no wastewater generated	Spent ladles and refractory materials potentially containing metals
Quenching, Finishing, Cleaning and Coating				
Painting and rust inhibitor application	Paint and rust inhibitor	VOCs	Little or no wastewater generated	Spent containers and applicators
Cleaning , quenching, grinding, cutting	Unfinished castings, water, steel shot, solvents	VOCs, dust and metallic particulates	Waste cleaning and cooling water with elevated temperature, solvents, oil and grease, and suspended solids	Spent solvents, steel shot, metallic particulates, cutting wheels, metallic filings, dust from collection systems, and wastewater treatment sludge
Shakeout, Cooling and Sand Handling	Water and caustic for wet scrubbers	Dust and metallic particulates; VOC and organic compounds from thermal sand treatment systems	Wet scrubber wastewater with high or low pH or amines, permanent mold contact cooling water with elevated temperature, metals and mold coating	Waste foundry sand and dust from collection systems, metal
Die Casting[1]	Metal, fuel, lubricants, fluxing agents, hydraulic fluid	VOCs from die and plunger tip lubrication	Waste cooling water with elevated temperature and wastewater contaminated with oil, and phenols	Waste hydraulic fluid, lubricants, floor absorbent, and plunger tips

[1] Furnaces, metal melting, finishing, cleaning, and coating operations also apply to die casting.

R0075825

III.C. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of Toxic Release Inventory (TRI) chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1993-1996 and are meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1994 and 1995 are estimates of quantities already managed, the quantities listed by facilities for 1996 and 1997 are projections only. The PPA requires these projections to encourage facilities to consider future source reduction, not to establish any mandatory limits. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Foundries

Table 5 shows that the TRI reporting foundries managed about 272 million pounds of production related wastes (total quantity of TRI chemicals in the waste from routine production operations in column B) in 1995. From the yearly data presented in column B, the total quantity of production related TRI wastes increased between 1994 and 1995. This is likely in part because the number of chemicals on the TRI list nearly doubled between those years. Production related wastes were projected to decrease in 1996 and 1997. The effects of production increases and decreases on the amount of wastes generated are not evaluated here.

Values in Column C are intended to reveal the percent of production-related waste (about 40 percent) either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. Column C shows a decrease in the amount of wastes either transferred off-site or released to the environment from 43 percent in 1994 to 40 percent in 1995. In other words, about 60 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E, and F, respectively. Most of these on-site managed wastes were recycled on-site, typically in a metals recovery process. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production related wastes (32 percent in 1994 and 1995), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or is transferred off-site for disposal.

Table 5: Source Reduction and Recycling Activity for Foundries (SIC 332, 3365, 3366, and 3369) as Reported within TRI

A	B	C	On-Site			Off-Site			J
			D	E	F	G	H	I	
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Released and Transferred[b]	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	% Released and Disposed[c] Off-site
1994	232	43%	58%	0%	1%	18%	0%	0%	32%
1995	272	40%	58%	0%	2%	16%	0%	1%	32%
1996	264	---	54%	0%	2%	20%	0%	1%	24%
1997	261	---	53%	0%	2%	21%	0%	1%	24%

Source: *1995 Toxics Release Inventory Database.*

[a] Within this industry sector, non-production related waste < 1% of production related wastes for 1995.

[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes.

[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

Die Casters

Table 6 shows that the TRI reporting foundries managed about 63 million pounds of production related wastes (total quantity of TRI chemicals in the waste from routine production operations) in 1995 (column B). Column C reveals that of this production-related waste, about 21 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 79% of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E, and F, respectively. Most of these on-site managed wastes were recycled on-site, typically in a metals recovery process. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production related wastes (2 percent in 1994), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

R0075827

Table 6: Source Reduction and Recycling Activity for Die Casting Facilities (SIC 3363 and 3364) as Reported within TRI

A	B	C	On-Site			Off-Site			J
			D	E	F	G	H	I	
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Released and Transferred[b]	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	% Released and Disposed[c] Off-site
1994	60	23%	69%	0%	3%	27%	0%	0%	2%
1995	63	21%	75%	0%	3%	21%	0%	0%	2%
1996	64	---	75%	0%	3%	21%	0%	0%	1%
1997	64	---	76%	0%	2%	21%	0%	0%	1%

Source: *1995 Toxics Release Inventory Database.*

[a] Within this industry sector, non-production related waste < 1% of production related wastes for 1995.

[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes.

[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

R0075828

Page 50 intentionally left blank.

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20 through 39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1995) TRI reporting year (which includes over 600 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries. TRI data provide the type, amount and media receptor of each chemical released or transferred.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1995 Toxic Release Inventory Public Data Release, reported onsite releases of toxic chemicals to the environment decreased by 5 percent (85.4 million pounds) between 1994 and 1995 (not including chemicals added and removed from the TRI chemical list during this period). Reported releases dropped by 46 percent between 1988 and 1995. Reported transfers of TRI chemicals to off-site locations increased by 0.4 percent (11.6 million pounds) between 1994 and 1995. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

Certain limitations exist regarding TRI data. Release and transfer reporting are limited to the approximately 600 chemicals on the TRI list. Therefore, a large portion of the emissions from industrial facilities are not captured by TRI. Within some sectors, (e.g. dry cleaning, printing and transportation equipment cleaning) the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. For these sectors, release information from other sources has been included. In addition, many facilities report more than one SIC code reflecting the multiple operations carried out onsite. Therefore, reported releases and transfers may or may not all be associated with the industrial operations described in this notebook.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, vents, ducts, or pipes. Fugitive emissions include equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Releases due to runoff, including storm water runoff, are also reportable to TRI.

Releases to Land -- occur within the boundaries of the reporting facility. Releases to land include disposal of toxic chemicals in landfills, land treatment/application farming, surface impoundments, and other land disposal methods (such as spills, leaks, or waste piles).

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal. Wastes containing TRI chemicals are injected into either Class I wells or Class V wells. Class I wells are used to inject liquid hazardous wastes or dispose of industrial and municipal wastewater beneath the lowermost underground source of drinking water. Class V wells are generally used to inject non-hazardous fluid into or above an underground source of drinking water. TRI reporting does not currently distinguish between these two types of wells, although there are important differences in environmental impact between these two methods of injection.

TRANSFERS-- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. Chemicals reported to TRI as transferred are sent to off-site facilities for the purpose of recycling, energy recovery, treatment, or disposal. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, the reported quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewater transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment or removal of a chemical from the wastewater depend on the nature of the chemical, as well as the treatment methods present at the POTW. Not all TRI chemicals can be treated or removed by a POTW. Some chemicals, such as metals, may be removed, but are not destroyed and may be disposed of in landfills or discharged to receiving waters.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovery by a variety of recycling methods, including solvent recovery, metals recovery, and acid regeneration. Once these chemicals have been

R0075832

recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site to be treated through a variety of methods, including neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Metal Casting Industry

This section summarizes TRI data of ferrous and nonferrous foundries reporting SIC codes 332, 3365, 3366, and 3369, and ferrous and nonferrous die casting facilities reporting SIC codes 3363 and 3364 as the primary SIC code for the facility. Of the 2,813 metal casting establishments reported by the *1992 Census of Manufacturers*, 654 reported to TRI in 1995.

Ferrous and nonferrous foundries made up 85 percent (554 facilities) of metal casting facilities reporting to TRI and accounted for about 89 percent of the total metal casting TRI releases and transfers for metal casting facilities in 1995. Die casters made up 15 percent (100 facilities) of metal casting facilities and reported the remaining 11 percent of the total releases and transfers. Because the TRI information differs for foundries and die casters, the releases and transfers for these two industry segments are presented separately below.

IV.A.1. Toxic Release Inventory for Ferrous and Nonferrous Foundries

According to the 1995 TRI data, the reporting ferrous and nonferrous foundries released and transferred a total of approximately 109 million pounds of pollutants during calendar year 1995. These releases and transfers are dominated by large volumes of metallic wastes. Evidence of the diversity of processes at foundries reporting to TRI is found in the fact that the most frequently reported chemical (copper) is reported by only 45 percent of the facilities and over half of the TRI chemicals were reported by fewer than ten facilities. The variability in facilities' pollutant profiles may be attributable to the large number of different types of foundry processes and products. For example, foundries casting only ferrous parts will have different pollutant profiles than those foundries casting both ferrous and nonferrous products.

Releases

Releases to the air, water, and land accounted for 33 percent (36 million pounds) of foundries' total reportable chemicals. Of these releases, 70 percent go to onsite land disposal, and about 75 percent are fugitive or point source air emissions (See Table 7). Metallic wastes accounted for over 95 percent of the industry's releases. Manganese, zinc, chromium, and lead account for over 95 percent of the on-site land disposal. The industry's air releases are associated with volatilization, fume or aerosol formation in the furnaces and byproduct processing. Lighter weight organics, such as methanol, acids and metal contaminants found in scrap metal are the principal types of TRI chemicals released to the air. In addition to air releases of chemicals reported to TRI, foundries are often a source of particulates, carbon monoxide, nitrogen oxides and sulfur compounds due to sand handling operations, curing of chemical binders, and combustion of fossil fuels. Methanol, trichloroethylene and other solvent releases account for most of the fugitive releases (approximately 61 percent).

Transfers

Off-site transfers of TRI chemicals account for 69 percent of foundries' total TRI-reportable chemicals (74 million pounds). Almost 57 percent of the industry's total TRI wastes (42 million pounds) are metallic wastes that were transferred off-site for recycling, typically for recovery of the metal content. Metallic wastes account for approximately 95 percent of the industry's transfers. About 61 percent of off-site transfers reported by foundries are sent off-site for recycling. Copper, manganese, zinc, chromium, nickel, and lead are the six metals transferred in the greatest amounts and number of facilities (See Table 8). TRI chemicals sent off-site for disposal (primarily manganese, zinc, chromium, and copper) account for 31 percent of transfers. Less than three percent of the remaining transfers from foundries go to treatment off-site, discharge to POTWs, and energy recovery.

After metals, the next largest volume of chemicals transferred are acids including: sulfuric acid, nitric acid, phosphoric acid, and hydrochloric acid. Spent acids can be generated in wet scrubber systems. In addition, acids are often used to clean and finish the surfaces of the metal castings before plating or coating. The spent acids are often sent off-site for recycling or for treatment. Solvents and other light weight organic compounds are frequently reported but account for a relatively small amount of total transfers. Solvents are used frequently for cleaning equipment and cast parts. The primary solvents and light weight organics include: phenol, xylene, 1,2,4-trimethylbenzene, 1,1,1-trichloroethane, trichloroethylene, methanol, and toluene. Transferred solvents are mostly sent off-site for disposal or recycling. Phenols and phenoisocyanates are frequently reported but amount to less than one percent of the total TRI pounds transferred. Phenols are often found in chemical binding systems and may be present in waste sand containing chemical binders (AFS and CISA, 1992).

Table 7: 1995 TRI Releases for Foundries, by Number of Facilities Reporting
(Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
COPPER	249	78577	100548	4554	0	349835	533514	2143
NICKEL	182	23309	31804	1471	0	122406	178990	983
CHROMIUM	182	47389	33191	1653	0	162923	245156	1347
MANGANESE	179	163447	84164	3258	0	4891621	5142490	28729
PHENOL	89	219560	421803	4490	0	53891	699744	51996
LEAD	76	9671	24366	230	0	352489	386756	5089
DIISOCYANATES	65	12035	13152	260	0	9022	34469	530
MANGANESE COMPOUNDS	50	37530	63037	3020	0	2496212	2599799	
CHROMIUM COMPOUNDS	45	41903	70489	1529	0	779154	893075	19846
COPPER COMPOUNDS	36	14953	9020	517	0	65500	89990	2500
ZINC (FUME OR DUST)	35	71228	144470	2104	0	1696554	1914356	54696
NICKEL COMPOUNDS	32	12241	7188	512	0	724	20665	646
METHANOL	32	1952231	451245	7	0	0	2403483	75109
ZINC COMPOUNDS	31	40379	121541	2956	0	12733217	12898093	416068
ALUMINUM (FUME OR DUST)	31	40491	186471	259	0	792270	1019491	32887
TRIETHYLAMINE	30	235144	1143297	5	0	5	1378451	45948
PHOSPHORIC ACID	26	157071	578	10	0	86093	243752	9375
XYLENE (MIXED ISOMERS)	24	568145	284447	4	0	0	852596	35525
COBALT	24	1450	1832	501	0	5	3788	158
NAPHTHALENE	22	201461	104137	263	0	9481	315342	14334
MOLYBDENUM TRIOXIDE	22	2260	1755	275	0	2547	6837	311
1,2,4-TRIMETHYLBENZENE	18	188854	54393	1	0	32850	276098	15339
LEAD COMPOUNDS	16	5638	13160	579	0	221774	241151	15072
FORMALDEHYDE	16	75414	78441	245	0	11436	165536	10346
TOLUENE	13	334212	179171	20	0	14	513417	39494
BARIUM	13	34486	3691	135	0	141150	179462	13805
ALUMINUM OXIDE (FIBROUS FORMS)	11	82060	18828	250	0	592750	693888	63081
CERTAIN GLYCOL ETHERS	10	119511	85824	0	0	0	205335	20534
SULFURIC ACID	10	25739	510	5	0	0	26254	2625
NITRIC ACID	10	2685	7640	0	0	0	10325	1033
ETHYLENE GLYCOL	9	48835	14045	3	0	68000	130883	14543
HYDROCHLORIC ACID (1995 AND AFTER "ACID AEROSOLS" ONLY)	9	6	1604	0	0	0	1610	179
N-METHYL 2-PYRROLIDONE	8	86624	3520	5	0	482	90631	11329
AMMONIA	8	92708	325575	3002	0	0	421285	52661
1,1,1-TRICHLOROETHANE	7	182997	61382	0	0	0	244379	34911
BARIUM COMPOUNDS	6	23455	5	201	0	43465	67126	11188

Table 7, cont.: 1995 TRI Releases for Foundries, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
CUMENE HYDROPEROXIDE	6	2000	1300	0	0	3400	6700	1117
HYDROGEN FLUORIDE	6	1250	1130	0	0	0	2380	397
BENZENE	5	3150	239000	7	0	36	242193	48439
CHLORINE	5	8	5	615	0	0	628	126
COBALT COMPOUNDS	4	15	505	0	0	0	520	130
N-BUTYL ALCOHOL	4	33272	250	0	0	0	33522	8381
4,4'-ISOPROPYLIDENEDIPHENOL	4	750	0	0	0	0	750	188
ANTIMONY	4	260	260	0	0	0	520	130
DICHLOROMETHANE	3	110912	0	0	0	0	110912	36971
METHYL ETHYL KETONE	3	39851	7820	0	0	0	47671	15890
TRICHLOROETHYLENE	3	30426	46996	0	0	0	77422	25807
STYRENE	3	33421	75457	0	0	0	108878	36293
TETRACHLOROETHYLENE	3	34450	16000	0	0	0	50450	16817
CADMIUM	3	5	6	0	0	0	11	4
NITRATE COMPOUNDS	2	1700	0	23000	0	0	24700	12350
CUMENE	2	340	150	0	0	0	490	245
ETHYLBENZENE	2	4610	18439	0	0	0	23049	11525
METHYL ISOBUTYL KETONE	2	41284	6367	0	0	0	47651	23826
ARSENIC	2	250	250	0	0	0	500	250
PHOSPHORUS (YELLOW OR WHITE)	2	10	255	750	0	0	1015	508
ANTIMONY COMPOUNDS	1	5	5	0	0	0	10	10
BERYLLIUM COMPOUNDS	1	0	0	0	0	0	0	0
URETHANE	1	0	0	0	0	0	0	0
HEXACHLOROETHANE	1	5	250	0	0	0	255	255
DIETHANOLAMINE	1	0	0	0	0	0	0	0
PROPYLENE	1	0	0	0	0	0	0	0
CRESOL (MIXED ISOMERS)	1	0	44,000	20	0	0	44,020	44,020
POLYCHLORINATED BIPHENYLS	1	0	0	0	0	0	0	0
1,1-DICHLORO-1-FLUOROETHANE	1	49,416	0	0	0	0	49,416	49,416
SELENIUM	1	0	5	0	0	0	5	5
	654	5,621,089	4,604,774	56,716	0	25,719,306	36,001,885	55,048

Table 8: 1995 TRI Transfers for Foundries, by Number and Facilities Reporting
(Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW TRANSFERS	DISPOSAL TRANSFERS	RECYCLING TRANSFERS	TREATMENT TRANSFERS	ENERGY RECOVERY TRANSFERS	TOTAL TRANSFERS	AVG TRANSFER PER FACILITY
COPPER	249	3386	926053	12948705	49688	1	13927833	55935
NICKEL	182	5811	752487	2925158	23193	1	3706650	20366
CHROMIUM	182	3568	947383	2042419	14667	5	3008047	16528
MANGANESE	179	2598	6528832	2834670	59838	0	9425938	52659
PHENOL	89	2397	216754	5272	10282	2671	239976	2696
LEAD	76	1566	78229	828352	22767	1	930915	12249
DIISOCYANATES	65	5	110292	55	40449	2510	153561	2362
MANGANESE COMPOUNDS	50	4553	5800216	6143043	152468	0	12100280	242006
CHROMIUM COMPOUNDS	45	17857	4274721	5249563	1475	0	9543616	212080
COPPER COMPOUNDS	36	1375	101566	1288917	31743	0	1423601	39544
ZINC (FUME OR DUST)	35	861	592866	1420309	85916	0	2099952	59999
NICKEL COMPOUNDS	32	2093	101546	1463377	8969	0	1575985	49250
METHANOL	32	2	19260	0	608	2616	22486	703
ZINC COMPOUNDS	31	7308	3479603	4339541	581458	0	8407910	271223
ALUMINUM (FUME OR DUST)	31	7419	1347594	1205369	1500	0	2561882	82641
TRIETHYLAMINE	30	5	250	423423	228606	0	652284	21743
PHOSPHORIC ACID	26	255	228515	49474	8576	0	286820	11032
XYLENE (MIXED ISOMERS)	24	0	3391	12170	250	163869	179680	7487
COBALT	24	1574	21956	618986	7719	0	650235	27093
NAPHTHALENE	22	4	21270	6920	1490	8621	38305	1741
MOLYBDENUM TRIOXIDE	22	0	13042	4965	1086	0	19093	868
1,2,4-TRIMETHYLBENZENE	18	1	21671	6463	260	7922	36317	2018
LEAD COMPOUNDS	16	86	351495	120552	29284	0	501417	31339
FORMALDEHYDE	16	3845	44078	430	3530	0	51883	3243
TOLUENE	13	2	1300	0	0	7906	9208	708
BARIUM	13	294	121356	70525	6830	0	199255	15327
ALUMINUM OXIDE (FIBROUS FORMS)	11	0	651926	17405	0	0	669331	60848
CERTAIN GLYCOL ETHERS	10	0	6550	13000	255	0	19805	1981
SULFURIC ACID	10	600	15162	0	12850	0	28612	2861
NITRIC ACID	10	250	0	22772	35331	0	58353	5835
ETHYLENE GLYCOL	9	38810	53800	17368	0	0	109978	12220
HYDROCHLORIC ACID (1995 AND AFTER "ACID AEROSOLS" ONLY)	9	5	0	0	76000	0	76005	8445
N-METHYL-2-PYRROLIDONE	8	2435	26470	13000	4902	1933	48740	6093
AMMONIA	8	13195	0	40250	0	0	53445	6681
1,1,1-TRICHLOROETHANE	7	0	0	600	250	250	1100	157

Table 8, cont.: 1995 TRI Transfers for Foundries, by Number and Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW TRANSFERS	DISPOSAL TRANSFERS	RECYCLING TRANSFERS	TREATMENT TRANSFERS	ENERGY RECOVERY TRANSFERS	TOTAL TRANSFERS	AVG TRANSFER PER FACILITY
BARIUM COMPOUNDS	6	0	170228	245735	250	0	416213	69369
CUMENE HYDROPEROXIDE	6	0	4900	0	250	0	5150	858
HYDROGEN FLUORIDE	6	250	0	47746	79000	0	126996	21166
BENZENE	5	2	250	0	0	0	252	50
CHLORINE	5	0	0	0	0	0	0	0
COBALT COMPOUNDS	4	0	5869	394655	0	0	400524	100131
N BUTYL ALCOHOL	4	0	0	0	0	0	0	0
4,4'-ISOPROPYLIDENEDIPHENOL	4	0	78170	0	0	0	78170	19543
ANTIMONY	4	255	0	758	250	0	1263	316
DICHLOROMETHANE	3	0	28	0	0	0	28	9
METHYL ETHYL KETONE	3	0	0	6458	250	10822	17530	5843
TRICHLOROETHYLENE	3	0	0	1350	0	2000	3350	1117
STYRENE	3	0	0	0	0	355	355	118
TETRACHLOROETHYLENE	3	0	0	250	0	0	250	83
CADMIUM	3	0	0	0	10	0	10	3
NITRATE COMPOUNDS	2	3700	0	0	0	0	3700	1850
CUMENE	2	0	400	0	250	0	650	325
ETHYLBENZENE	2	0	0	0	0	750	750	375
METHYL ISOBUTYL KETONE	2	0	0	0	53	0	53	27
ARSENIC	2	0	0	250	0	0	250	125
PHOSPHORUS (YELLOW OR WHITE)	2	5	19532	15043	0	0	34580	17290
ANTIMONY COMPOUNDS	1	0	0	0	0	0	0	0
BERYLLIUM COMPOUNDS	1	0	400	0	0	0	400	400
URETHANE	1	0	3000	0	0	0	3000	3000
HEXACHLOROETHANE	1	0	0	0	0	0	0	0
DIETHANOLAMINE	1	1300	0	0	2400	0	3700	3700
PROPYLENE	1	0	0	0	0	0	0	0
CRESOL (MIXED ISOMERS)	1	6	.	.	.	.	6	6
POLYCHLORINATED BIPHENYLS	1	0	.	.	.	.	0	0
1,1-DICHLORO-1-FLUOROETHANE	1	0	.	.	.	.	0	0
SELENIUM	1	0	5	.	.	.	5	5
	554	127,678	27,142,416	44,845,298	1,584,953	212,233	73,915,683	113,021

IV.A.2. Toxic Release Inventory for Die Casting Facilities

According to the 1995 TRI data, the reporting die casting facilities released and transferred a total of approximately 13 million pounds of TRI chemicals during calendar year 1995. As with foundries, the releases and transfers for die casters are dominated by large volumes of metallic wastes. Evidence of the diversity of processes at die casting facilities reporting to TRI is found in the fact that all but three of the TRI reported chemicals (copper, nickel, and aluminum) are reported by fewer than ten percent of the facilities. The variability in facilities' pollutant profiles may be attributed primarily to the different types of metals cast.

Releases

Releases make up only four percent of die casters' total TRI-reportable chemicals (518,000 pounds). Almost all of these releases (99 percent) are released to the air through point source and fugitive emissions (see Table 9). Metallic wastes (primarily aluminum, zinc, and copper) account for over 67 percent of the releases. The remainder of the industry's releases are primarily solvents and other volatile organic compounds including, trichloroethylene, tetrachloroethylene, glycol ethers, hexochloroethane, and toluene, which account for 32 percent of the releases. In addition to air releases of chemicals reported to TRI, die casting facilities can be a source of particulates, carbon monoxide, nitrogen oxides and sulfur compounds due to the combustion of fossil fuels for metal melting, from the molten metal itself, and from die cleaning and lubricating operations.

Transfers

Off-site transfers of TRI chemicals account for 96 percent of die casters' total TRI-reportable chemicals (13 million pounds). Almost all off-site transfers (97 percent) reported by die casting facilities are sent off-site for recycling. Copper, aluminum, zinc, and nickel make up 98 percent of all transfers and are reported by the largest number of facilities (see Table 10). Chemicals sent off-site for disposal (primarily aluminum and copper) account for less than three percent of transfers. After metals, the next class of chemicals transferred are solvents. These chemicals account for only about one percent of total transfers.

Table 9: 1995 TRI Releases for Die Casting Facilities, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
COPPER	79	7,319	17,283	1,006	0	250	25,858	327
NICKEL	24	835	3,028	0	0	0	3,863	161
ALUMINUM (FUME OR DUST)	21	17,663	257,448	22	0	0	275,133	13,102
ZINC (FUME OR DUST)	10	6,747	19,842	0	0	0	26,589	2,659
LEAD	9	34	59	0	0	0	93	10
MANGANESE	9	552	824	0	0	0	1,376	153
ZINC COMPOUNDS	7	992	6,610	321	0	2,959	10,882	1,555
CHROMIUM	6	39	1,069	5	0	0	1,113	186
COPPER COMPOUNDS	3	84	1,853	0	0	0	1,937	646
MANGANESE COMPOUNDS	3	0	0	250	0	0	250	83
TRICHLOROETHYLENE	3	12,689	101,545	0	0	0	114,234	38,078
NITRIC ACID	3	250	1,000	0	0	0	1,250	417
CHLORINE	3	255	1,705	0	0	0	1,960	653
CERTAIN GLYCOL ETHERS	2	4,800	5,600	0	0	0	10,400	5,200
ETHYLENE GLYCOL	2	0	0	0	0	0	0	0
HYDROCHLORIC ACID (1995 AND AFTER "ACID AEROSOLS" ONLY)	2	500	0	0	0	0	500	250
SULFURIC ACID	2	250	750	0	0	0	1,000	500
LEAD COMPOUNDS	1	0	111	0	0	0	111	111
NICKEL COMPOUNDS	1	12	240	0	0	0	252	252
HEXACHLOROETHANE	1	1,146	10,316	0	0	0	11,462	11,462
STYRENE	1	1,450	0	0	0	0	1,450	1,450
PROPYLENE	1	0	0	0	0	0	0	0
TRIETHYLAMINE	1	250	5	0	0	0	255	255
TETRACHLOROETHYLENE	1	5,800	23,200		0	0	29,000	29,000
BERYLLIUM	1	0	0	0	0	5	5	5
	100	61,667	452,488	1,604	0	3,214	518,973	5,189

Table 10: 1995 TRI Transfers for Die Casting Facilities, by Number and Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW TRANSFERS	DISPOSAL TRANSFERS	RECYCLING TRANSFERS	TREATMENT TRANSFERS	ENERGY RECOVERY TRANSFERS	TOTAL TRANSFERS	AVG TRANSFER PER FACILITY
COPPER	79	363	34,284	4,683,629	851	.	4,719,127	59,736
NICKEL	24	45	2,623	166,911	35	.	169,614	7,067
ALUMINUM (FUME OR DUST)	21	265	233,319	4,852,664	5	.	5,086,253	242,203
ZINC (FUME OR DUST)	10	11	20,810	258,685	5	.	279,511	27,951
LEAD	9	20	515	10,443	10	.	10,988	1,221
MANGANESE	9	10	776	5,997	.	.	6,783	754
ZINC COMPOUNDS	7	303	5,259	488,477	6,955	.	500,994	71,571
CHROMIUM	6	15	760	750	15	.	1,540	257
COPPER COMPOUNDS	3	1	502	64,928	.	.	65,431	21,810
MANGANESE COMPOUNDS	3	5	16,400	.	4,752	.	21,157	7,052
TRICHLOROETHYLENE	3	0	1,836	66,330	800	.	68,966	22,989
NITRIC ACID	3	98	.	.	24,324	.	24,422	8,141
CHLORINE	3	0	.	.	.	.	0	0
CERTAIN GLYCOL ETHERS	2	0	.	50,000	.	.	50,000	25,000
ETHYLENE GLYCOL	2	4	70	.	.	.	74	37
HYDROCHLORIC ACID (1995 AND AFTER "ACID AEROSOLS" ONLY)	2	0	.	.	.	.	0	0
SULFURIC ACID	2	0	.	.	.	.	0	0
LEAD COMPOUNDS	1	0	360	1,500,000	.	.	1,500,360	1,500,360
NICKEL COMPOUNDS	1	0	54	7,767	.	.	7,821	7,821
HEXACHLOROETHANE	1	0	.	.	.	.	0	0
STYRENE	1	0	.	.	.	.	0	0
PROPYLENE	1	0	.	.	.	.	0	0
TRIETHYLAMINE	1	0	.	.	.	.	0	0
TETRACHLOROETHYLENE	1	.	.	2,009	.	.	2,009	2,009
BERYLLIUM	1	0	.	750	.	.	750	750
	100	1,140	317,568	12,159,340	37,752	0	12,515,800	125,158

R0075842

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for the metal casting industry are listed below in Tables 11 and 12. Facilities that have reported only the primary SIC codes covered under this notebook appear on Table 11. Table 12 contains additional facilities that have reported the SIC codes covered within this notebook, or SIC codes covered within this notebook report and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list may include facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Table 11: Top 10 TRI Releasing Metal Casting Facilities[1]

Rank	Foundries (SIC 332, 3365, 3366, 3369)		Die Casters (SIC 3363, 3364)	
	Facility	**Total TRI Releases in Pounds**	**Facility**	**Total TRI Releases in Pounds**
1	GM Powertrain Defiance - Defiance, OH	14,730,020	Water Gremlin Co. - White Bear Lake, MN	97,111
2	GMC Powertrain - Saginaw, MI	2,709,764	BTR Precision Die Casting - Russelville, KY	93,903
3	American Steel Foundries - Granite City, IL	1,245,343	QX Inc. - Hamel, MN	67,772
4	Griffin Wheel Co. - Keokuk, IA	1,065,104	AAP St. Marys Corp. - Saint Marys, OH	55,582
5	Griffin Wheel Co. - Groveport, OH	1,042,040	Impact Industries Inc. - Sandwich, IL	45,175
6	Griffin Wheel Co. - Bessemer, AL	742,135	Tool-Die Eng. Co. - Solon, OH	29,005
7	U.S. Pipe & Foundry Co. - Birmingham, AL	738,200	Chrysler Corp. - Kokomo, IN	20,652
8	American Steel Foundries - East Chicago, IN	625,191	Metalloy Corp. - Freemont, IN	13,350
9	Griffin Wheel Co. - Kansas City, KS	607,266	Tool Products, Inc. - New Hope, MN	12,194
10	CMI - Cast Parts, Inc. - Cadillac, MI	604,100	Travis Pattern & Foundry, Inc. - Spokane, WA	11,614

Source: *US Toxics Release Inventory Database, 1995.*

[1] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075843

Table 12: Top 10 TRI Releasing Facilities Reporting Metal Casting SIC Codes[2]

Rank	Foundries (SIC 332, 3365, 3366, 3369)			Die Casters (SIC 3363, 3364)		
	Facility	SIC Codes Reported in TRI	Total TRI Releases in Pounds	Facility	SIC Codes Reported in TRI	Total TRI Releases in Pounds
1	GM Powertrain Defiance - Defiance, OH	3321	14,730,020	Water Gremlin Co. - White Bear Lake, MN	3364, 3949	97,111
2	GMC Powertrain - Saginaw, MI	3321, 3365	2,709,764	BTR Precision Die Casting - Russelville, KY	3363	93,903
3	Heatcraft Inc. - Grenada, MS	3585, 3351, 3366	1,369,306	Honeywell Inc. Home & Building - Golden Valley, MN	3822, 3363, 3900	87,937
4	American Steel Foundries - Granite City, IL	3325	1,245,343	QX Inc. - Hamel, MN	3363	67,772
5	Griffin Wheel Co. - Keokuk, IA	3325	1,065,104	AAP St. Marys Corp. - Saint Marys, OH	3363	55,582
6	Griffin Wheel Co. - Groveport, OH	3325	1,042,040	Impact Industries Inc. - Sandwich, IL	3363	45,175
7	Geneva Steel - Vineyard, UT	3312, 3317, 3325	901,778	Tool-Die Eng. Co. - Solon, OH	3363	29,005
8	Griffin Wheel Co. - Bessemer, AL	3325	742,135	TAC Manufacturing - Jackson, MI	3086, 3363, 3714	25,684
9	U.S. Pipe & Foundry Co. - Birmingham, AL	3321	738,200	Superior Ind. Intl., Inc. - Johnson City, TN	3714, 3363, 3398	25,250
10	American Steel Foundries - East Chicago, IN	3325	625,191	General Electric Co. - Hendersonville, NC	3646, 3363	20,780

Source: *US Toxics Release Inventory Database, 1995.*

[2] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075844

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1995 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reduction over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult these sources for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the Hazardous Substances Data Bank (HSDB) and the Integrated Risk Information System (IRIS). The discussions of toxicity describe the range of possible adverse health effects that have been found to be associated with exposure to these chemicals. These adverse effects may or may not occur at the levels released to the environment. Individuals interested in a more detailed picture of the chemical concentrations associated with these adverse effects should consult a toxicologist or the toxicity literature for the chemical to obtain more information. The effects listed below must be taken in context of these exposure assumptions that are explained more fully within the full chemical profiles in HSDB. For more information on TOXNET[3], contact the TOXNET help line at 1-800-231-3766.

Manganese and Manganese Compounds (CAS: 7439-96-5; 20-12-2)

Sources. Manganese is found in iron charge materials and is used as an addition agent for alloy steel to obtain desired properties in the final product. In carbon steel, manganese is used to combine with sulfur to improve the ductility of the steel. An alloy steel with manganese is used for applications

[3] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

involving small sections which are subject to severe service conditions, or in larger sections where the weight saving derived from the higher strength of the alloy steels is needed (U.S. EPA, 1995).

Toxicity. There is currently no evidence that human exposure to manganese at levels commonly observed in ambient atmosphere results in adverse health effects.

Chronic manganese poisoning, however, bears some similarity to chronic lead poisoning. Occurring via inhalation of manganese dust or fumes, it primarily involves the central nervous system. Early symptoms include languor, speech disturbances, sleepiness, and cramping and weakness in legs. A stolid mask-like appearance of face, emotional disturbances such as absolute detachment broken by uncontrollable laughter, euphoria, and a spastic gait with a tendency to fall while walking are seen in more advanced cases. Chronic manganese poisoning is reversible if treated early and exposure stopped. Populations at greatest risk of manganese toxicity are the very young and those with iron deficiencies.

Ecologically, although manganese is an essential nutrient for both plants and animals, in excessive concentrations manganese inhibits plant growth.

Carcinogenicity. There is currently no evidence to suggest that manganese is carcinogenic.

Environmental Fate. Manganese is an essential nutrient for plants and animals. As such, manganese accumulates in the top layers of soil or surface water sediments and cycles between the soil and living organisms. It occurs mainly as a solid under environmental conditions, though may also be transported in the atmosphere as a vapor or dust.

Zinc and Zinc Compounds (CAS: 7440-66-6; 20-19-9)

Sources. To protect metal from oxidizing, it is often coated with a material that will protect it from moisture and air. In the galvanizing process, steel is coated with zinc. Galvanized iron and steel is often found in furnace charge materials (USITC, 1984).

Toxicity. Zinc is a trace element; toxicity from ingestion is low. Severe exposure to zinc might give rise to gastritis with vomiting due to swallowing of zinc dusts. Short-term exposure to very high levels of zinc is linked to lethargy, dizziness, nausea, fever, diarrhea, and reversible pancreatic and neurological damage. Long-term zinc poisoning causes irritability, muscular stiffness and pain, loss of appetite, and nausea.

Zinc chloride fumes cause injury to mucous membranes and to the skin. Ingestion of soluble zinc salts may cause nausea, vomiting, and purging.

Carcinogenicity. There is currently no evidence to suggest that zinc is carcinogenic.

Environmental Fate. Significant zinc contamination of soil is only seen in the vicinity of industrial point sources. Zinc is a stable soft metal, though it burns in air. Zinc bioconcentrates in aquatic organisms.

Methanol (CAS: 67-56-1)

Sources. Methanol is used as a cleaning solvent and can be emitted during the production of cores using the hot box and no-bake systems.

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed one mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that methanol is carcinogenic.

Environmental Fate. Methanol is highly volatile and flammable. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microorganisms in soils and surface waters.

Trichloroethylene (CAS:79-01-6)

Sources. Trichloroethylene is used extensively as a cleaning solvent.

Toxicity. Trichloroethylene was once used as an anesthetic, though its use caused several fatalities due to liver failure. Short term inhalation exposure to high levels of trichloroethylene may cause rapid coma followed by eventual death from liver, kidney, or heart failure. Short-term exposure to lower concentrations of trichloroethylene causes eye, skin, and respiratory tract irritation. Ingestion causes a burning sensation in the mouth, nausea, vomiting and abdominal pain. Delayed effects from short-term trichloroethylene poisoning include liver and kidney lesions, reversible nerve degeneration, and psychic disturbances. Long-term exposure can produce headache, dizziness, weight loss, nerve damage, heart damage, nausea, fatigue, insomnia, visual impairment, mood perturbation, sexual problems, dermatitis, and rarely jaundice. Degradation products of trichloroethylene (particularly phosgene) may cause rapid death due to respiratory collapse.

Carcinogenicity. Trichloroethylene is considered by EPA to be a probable human carcinogen via both oral and inhalation exposure, based on limited human evidence and sufficient animal evidence.

Environmental Fate. Trichloroethylene breaks down slowly in water in the presence of sunlight and bioconcentrates moderately in aquatic organisms. The main removal of trichloroethylene from water is via rapid evaporation. Trichloroethylene does not photodegrade in the atmosphere, though it breaks down quickly under smog conditions, forming other pollutants such as phosgene, dichloroacetyl chloride, and formyl chloride. In addition, trichloroethylene vapors may be decomposed to toxic levels of phosgene in the presence of an intense heat source such as an open arc welder. When spilled on land, trichloroethylene rapidly volatilizes from surface soils. Some of the remaining chemical may leach through the soil to groundwater.

Xylenes (Mixed Isomers) (CAS: 1330-20-7)

Sources. Xylenes are used extensively as cleaning solvents and paint solvents and may be formed as a decomposition product of binders.

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylene can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylenes (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that xylenes are carcinogenic.

Environmental Fate. A portion of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur. Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years. Xylenes are volatile organic chemicals. As such, xylene in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

Chromium and Chromium Compounds (CAS: 7440-47-3; 20-06-4)

Sources. Chromium is used as a plating element for metal to prevent corrosion and is sometimes found on charge materials. Chromium is also a constituent of stainless steel.

Toxicity. Although the naturally-occurring form of chromium metal has very low toxicity, chromium from industrial emissions is highly toxic due to strong oxidation characteristics and cell membrane permeability. The majority of the effects detailed below are based on Chromium VI (an isomer that is more toxic than Cr III). Exposure to chromium metal and insoluble chromium salts affects the respiratory system. Inhalation exposure to chromium and chromium salts may cause severe irritation of the upper respiratory tract and scarring of lung tissue. Dermal exposure to chromium and chromium salts can also cause sensitive dermatitis and skin ulcers.

Ecologically, although chromium is present in small quantities in all soils and plants, it is toxic to plants at higher soil concentrations (i.e., 0.2 to 0.4 percent in soil).

Carcinogenicity. Different sources disagree on the carcinogenicity of chromium. Although an increased incidence in lung cancer among workers in the chromate-producing industry has been reported, data are inadequate to confirm that chromium is a human carcinogen. Other sources consider chromium VI to be a known human carcinogen based on inhalation exposure.

Environmental Fate. Chromium is a non-volatile metal with very low solubility in water. If applied to land, most chromium remains in the upper five centimeters of soil. Most chromium in surface waters is present in particulate form as sediment. Airborne chromium particles are relatively unreactive and are removed from the air through wet and dry deposition. The precipitated chromium from the air enters surface water or soil. Chromium bioaccumulates in plants and animals, with an observed bioaccumulation factor of 1,000,000 in snails.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures only about one quarter of the facilities in the metal casting industry. However, it allows for a comparison across years and industry sectors. Reported chemicals are limited to the approximately 600 TRI chemicals. A large portion of the emissions from metal casting facilities, therefore, are not captured by TRI. The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many metal casting sources.

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Table 13 summarizes annual releases (from the industries for which a Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

R0075851

Table 13: Air Pollutant Releases by Industry Sector (tons/year)						
Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
Metal Mining	4,670	39,849	63,541	173,566	17,690	915
Nonmetal Mining	25,922	22,881	40,199	128,661	18,000	4,002
Lumber and Wood Production	122,061	38,042	20,456	64,650	9,401	55,983
Furniture and Fixtures	2,754	1,872	2,502	4,827	1,538	67,604
Pulp and Paper	566,883	358,675	35,030	111,210	493,313	127,809
Printing	8,755	3,542	405	1,198	1,684	103,018
Inorganic Chemicals	153,294	106,522	6,703	34,664	194,153	65,427
Organic Chemicals	112,410	187,400	14,596	16,053	176,115	180,350
Petroleum Refining	734,630	355,852	27,497	36,141	619,775	313,982
Rubber and Misc. Plastics	2,200	9,955	2,618	5,182	21,720	132,945
Stone, Clay and Concrete	105,059	340,639	192,962	662,233	308,534	34,337
Iron and Steel	1,386,461	153,607	83,938	87,939	232,347	83,882
Nonferrous Metals	214,243	31,136	10,403	24,654	253,538	11,058
Fabricated Metals	4,925	11,104	1,019	2,790	3,169	86,472
Electronics and Computers	356	1,501	224	385	741	4,866
Motor Vehicles, Bodies, Parts and Accessories	15,109	27,355	1,048	3,699	20,378	96,338
Dry Cleaning	102	184	3	27	155	7,441
Ground Transportation	128,625	550,551	2,569	5,489	8,417	104,824
Metal Casting	**116,538**	**11,911**	**10,995**	**20,973**	**6,513**	**19,031**
Pharmaceuticals	6,586	19,088	1,576	4,425	21,311	37,214
Plastic Resins and Manmade Fibers	16,388	41,771	2,218	7,546	67,546	74,138
Textiles	8,177	34,523	2,028	9,479	43,050	27,768
Power Generation	366,208	5,986,757	140,760	464,542	13,827,511	57,384
Shipbuilding and Repair	105	862	638	943	3,051	3,967
Source: U.S. EPA Office of Air and Radiation, AIRS Database, 1997.						

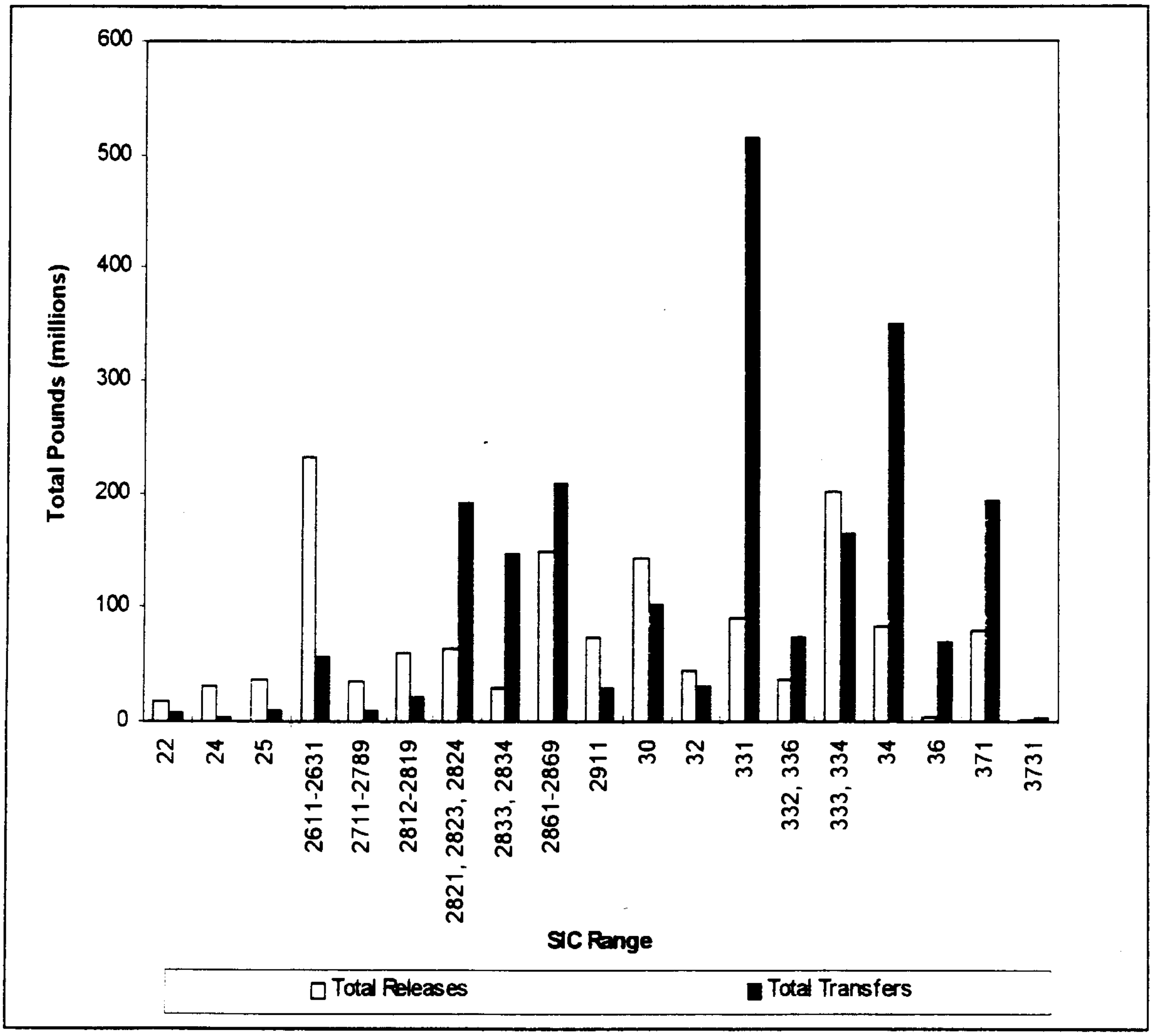
R0075852

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of TRI releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Figure 10 is a graphical representation of a summary of the 1995 TRI data for the metal casting industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the vertical axis. The graph is based on the data shown in Table 14 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the metal casting industry, the 1995 TRI data presented here covers 654 facilities. These facilities listed SIC 332 (Iron and Steel Foundries) and 336 (Nonferrous Foundries) as primary SIC codes.

Figure 10: Summary of TRI Releases and Transfers by Industry



Source: US EPA 1995 Toxics Release Inventory Database.

SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
22	Textiles	2833, 2834	Pharmaceuticals	333, 334	Nonferrous Metals
24	Lumber and Wood Products	2861-2869	Organic Chem. Mfg.	34	Fabricated Metals
25	Furniture and Fixtures	2911	Petroleum Refining	36	Electronic Equip. and Comp.
2611-2631	Pulp and Paper	30	Rubber and Misc. Plastics	371	Motor Vehicles, Bodies, Parts, and Accessories
2711-2789	Printing	32	Stone, Clay, and Concrete	3731	Shipbuilding
2812-2819	Inorganic Chemical Manufacturing	331	Iron and Steel		
2821, 2823, 2824	Plastic Resins and Manmade Fibers	**332, 336**	**Metal Casting**		

R0075854

Table 14: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	TRI Releases		TRI Transfers		Total Releases +Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
			Total Releases (million lbs.)	Ave. Releases per Facility (pounds)	Total Transfers (million lbs.)	Ave. Trans. per Facility (pounds)		
Textiles	22	339	17.8	53,000	7.0	21,000	24.8	74,000
Lumber and Wood Products	24	397	30.0	76,000	4.1	10,000	34.1	86,000
Furniture and Fixtures	25	336	37.6	112,000	9.9	29,000	47.5	141,000
Pulp and Paper	2611-2631	305	232.6	763,000	56.5	185,000	289.1	948,000
Printing	2711-2789	262	33.9	129,000	10.4	40,000	44.3	169,000
Inorganic Chem. Mfg.	2812-2819	413	60.7	468,000	21.7	191,000	438.5	659,000
Plastic Resins and Manmade Fibers	2821,2823, 2824	410	64.1	156,000	192.4	469,000	256.5	625,000
Pharmaceuticals	2833, 2834	200	29.9	150,000	147.2	736,000	177.1	886,000
Organic Chemical Mfg.	2861-2869	402	148.3	598,000	208.6	631,000	946.8	1,229,000
Petroleum Refining	2911	180	73.8	410,000	29.2	162,000	103.0	572,000
Rubber and Misc. Plastics	30	1,947	143.1	73,000	102.6	53,000	245.7	126,000
Stone, Clay, and Concrete	32	623	43.9	70,000	31.8	51,000	75.7	121,000
Iron and Steel	331	423	90.7	214,000	513.9	1,215,000	604.6	1,429,000
Metal Casting	**332, 336**	**654**	**36.0**	**55,000**	**73.9**	**113,000**	**109.9**	**168,000**
Nonferrous Metals	333, 334	282	201.7	715,000	164	582,000	365.7	1,297,000
Fabricated Metals	34	2,676	83.5	31,000	350.5	131,000	434.0	162,000
Electronic Equip. and Comp.	36	407	4.3	11,000	68.8	169,000	73.1	180,000
Motor Vehicles, Bodies, Parts, and Accessories	371	754	79.3	105,000	194	257,000	273.3	362,000
Shipbuilding	3731	43	2.4	56,000	4.1	95,000	6.5	151,000

Source: *US EPA Toxics Release Inventory Database, 1995.*

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be implemented feasibly. In the waste management hierarchy, if source reduction is not feasible the next alternative is recycling of wastes, followed by energy recovery, and waste treatment as a last alternative.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the metal casting industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be used effectively. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Most of the pollution prevention activities in the metal casting industry have concentrated on reducing waste sand, waste electric arc furnace (EAF) dust and desulfurization slag, and increasing the overall energy efficiency of the processes. This section describes some of the pollution prevention opportunities for foundries within each of these areas.

V.A. Waste Sand and Chemical Binder Reduction and Reuse

Disposal of waste foundry sand in off-site landfills has become less appealing to foundry operators in recent years. Landfill disposal fees have increased considerably, especially in areas that suffer from shortages of landfill capacity.

Landfill disposal can be a long-term CERCLA liability as well (see Section VI.A. for a discussion of CERCLA). Currently, about 2 percent of foundry waste sands generated is considered hazardous waste under RCRA requiring expensive special treatment, handling and disposal in hazardous waste landfills. Therefore, there are strong financial incentives for applying pollution prevention techniques that reduce waste foundry sand generation. In fact, for years many foundries have been implementing programs to reduce the amounts of waste sand they generate. Also, the industry is conducting a significant amount of research in this area (AFS, 1996).

V.A.1. Casting Techniques Reducing Waste Foundry Sand Generation

The preferable approach to reducing disposal of waste sands is through source reduction rather than waste management and pollution control or treatment techniques. Foundry operators aiming to reduce waste sand may want to examine the feasibility and economic incentives of new casting methods for all or part of their production. A number of the casting techniques described in Section III.A such as investment casting, permanent mold casting, die casting, and lost foam casting generate less sand waste than other techniques.

Adopting different casting methods, however, may not always be feasible depending on the physical characteristics of the parts to be cast (e.g., type of metal, casting size and configuration, tolerances and surface finish required, etc.), the capabilities of the alternative methods, and the economic feasibility. When considering the economic feasibility of implementing these alternative methods, the savings in waste sand handling and disposal and raw material costs should be examined.

In addition to the more common methods listed above and described in Section III.A, there are a number of lesser known and/or new casting methods that also have the potential to reduce the volume of foundry waste sand generated. One promising method, vacuum molding, is described below. For additional information on new, alternative casting techniques, see the references in Section IX.

Vacuum Molding

Vacuum molding, or the V-Process, uses a strong vacuum applied to free-flowing, dry, unbonded sand around patterns in air tight flasks. The vacuum inside the mold results in a net pressure outside pushing in, holding the sand rigidly in the shape of the pattern even after the pattern is removed. The process uses a specially designed plastic film to seal the open ends of the sand mold and the mold cavity. After the pattern is removed, the mold halves are placed together and the metal is poured. The plastic film inside the mold cavity melts and diffuses into the sand as it contacts the molten metal. When the metal has cooled, the vacuum is removed, allowing the sand to fall away from the casting. Shakeout equipment is not needed and virtually no waste sand is generated. The V-Process can be used on almost all metal types, for all sizes and shapes. Although the process has not gained widespread use, it can be economical, uses very little energy and can produce castings with high dimensional accuracy and consistency (La Rue, 1989).

V.A.2. Reclamation and Reuse of Waste Foundry Sand and Metal

Although less preferable than source reduction, the more immediate shift in industry practices is towards waste reclamation and reuse. A number of techniques are being used to reclaim waste sand and return it to the mold and core making processes. In addition, markets for off-site reuse of waste foundry sand have also been found. (Unless otherwise noted, this section is based on the 1992 EPA Office of Research and Development report, *Guides to Pollution Prevention, The Metal Casting and Heat Treating Industry*.)

Waste Segregation

A substantial amount of sand contamination comes from mixing the various foundry waste streams with waste sand. The overall amount of sand being discarded can be reduced by implementing the following waste segregation steps:

- Replumbing the dust collector ducting on the casting metal gate cutoff saws to collect metal chips for easier recycling
- Installing a new baghouse on the sand system to separate the sand system dust from the furnace dust
- Installing a new screening system or magnetic separator on the main molding sand system surge hopper to continuously clean metal from the sand system
- Separate nonferrous foundry shot blast dust (often a hazardous waste stream) from other nonhazardous foundry and sand waste streams.
- Installing a magnetic separation system on the shotblast system to allow the metal dust to be recycled
- Changing the core sand knockout procedure to keep this sand from being mixed in with system sand prior to disposal

Screen and Separate Metal from Sand

Most foundries screen used sand before reusing it. Some employ several different screen types and vibrating mechanisms to break down large masses of sand mixed with metal chips. Coarse screens are used to remove large chunks of metal and core butts. The larger metal pieces collected in the screen are usually remelted in the furnace or sold to a secondary smelter. Increasingly fine screens remove additional metal particles and help classify the sand by size before it is molded. Some foundries remelt these smaller metal particles; other foundries sell this portion to metal reclaimers. The metal recovered during the screening process is often mixed with coarser sand components or has sand adhering to it. Therefore, remelting these pieces in the furnace generates large amounts of slag, especially when the smaller particles are remelted.

Reclaim Sand by Dry Scrubbing/Attrition

Reclaiming sand by dry scrubbing is widely used, and a large variety of equipment is available with capacities adaptable to most binder systems and foundry operations. Dry scrubbing may be divided into pneumatic or mechanical systems.

In pneumatic scrubbing, grains of sand are agitated in streams of air normally confined in vertical steel tubes called cells. The grains of sand are propelled upward; they impact each other and/or are thrust against a steel target to remove some of the binder. In some systems, grains are impacted against a steel target. Banks of tubes may be used depending on the capacity and degree of cleanliness desired. Retention time can be regulated, and fines are removed through dust collectors. In mechanical scrubbing, a variety of available equipment offers foundries a number of options. An impeller may be used to accelerate the sand grains at a controlled velocity in a horizontal or vertical plane against a metal plate. The sand grains impact each other and metal targets, thereby removing some of the binder. The speed of rotation has some control over impact energy. The binder and fines are removed by exhaust systems, and screen analysis is controlled by air gates or air wash separators. Additional equipment options include:

- A variety of drum types with internal baffles, impactors, and disintegrators that reduce lumps to grains and remove binder
- Vibrating screens with a series of decks for reducing lumps to grains, with recirculating features and removal of dust and fines

- Shot-blast cleaning equipment that may be incorporated into other specially designed units to form a complete casting cleaning/sand reclamation unit

- Vibro-energy systems that use synchronous and diametric vibration, where frictional and compressive forces separate binder from sand grains.

> Southern Aluminum is a high-production automotive foundry in Bay Minette, Alabama. The company recently installed a rotating drum attrition/scrubber sand reclaimer unit to remove lumps and tramp aluminum from its spent green sand and core butts so that it could be used by an asphalt company. Spent sand is fed into one end of the rotating drum where the lumps are reduced and binder is scrubbed off the grains. The sand then enters a screening and classifying section, binder and fines are removed by a dust collector, and clean tramp metal is removed. The company is removing far more aluminum from the sand than expected (about 6,000 pounds per day) resulting in substantial cost savings. The equipment paid for itself before it finished treating three-months worth of spent sand stockpiled at the facility (Philbin, 1996).

Reclaim Sand with Thermal Systems

Most foundries recycle core and mold sands; however, these materials eventually lose their basic characteristics, and the portions no longer suitable for use are disposed of in a landfill. In the reclamation of chemically bonded sands, the system employed must be able to break the bond between the resin and sand and remove the fines that are generated. The systems employed most commonly are scrubbing/attrition and thermal (rotary reclamation) systems for resin-bonded sands.

Reclamation of green sand for reuse in a green sand system is practiced on a limited basis in the United States. However, reclamation of core sand and chemically bonded molding sand is widespread. Wet reclamation systems employed in the 1950s for handling green sands are no longer used. Specific thermal reclamation case studies are summarized in AFS (1989) and Modern Casting August (1996). A typical system to reclaim chemically bonded sand for reuse in core room and molding operations consists of a lump reduction and metal removal system, a particle classifier, a sand cooler, a dust collection system, and a thermal scrubber (two-bed reactor). A number of thermal sand reclamation techniques are described below. Note that EPA may classify some types of thermal sand reclamation as incineration. As of June 1996, EPA was taking comments on the regulatory status of thermal recovery units. Contact Mary Cunningham at (703) 308-8453.

Thermal Calcining/Thermal Dry Scrubbing. These systems are useful for reclamation of organic and clay-bonded systems. Sand grain surfaces are not smooth; they have numerous crevices and indentations. The application of heat with sufficient oxygen calcines the binders or burns off organic binders. Separate mechanical attrition units may be required to remove calcined inorganic binders. Heat offers a simple method of reducing the encrusted grains of molding sand to pure grains. Both horizontal and vertical rotary kiln and fluidized bed systems are available. Foundries should examine the regulatory requirements of using thermal systems to treat waste sand. The use of these systems may need to be permitted as waste incineration.

Carondelet Foundry Company in Pevely, Missouri installed a fluidized bed thermal sand reclamation unit and a mechanical reclaimer in 1994 to treat its phenolic urethane no-bake and phenolic urethane Isocure sand. The steel jobbing shop was sending on average 150 tons per day of waste sand off-site for landfill disposal at a cost of about $29 per cubic yard. In addition, new sand was costing approximately $22 per ton. The thermal system processes 125 tons per day and the mechanical system processes the remaining 25 tons. Only 5 percent of the foundry's sand is not reclaimed. The reclamations system is estimated to save the foundry over $1 million per year and payed for itself in under a year. In addition, the foundry feels that the reclaimed sand is better than new sand and results in better castings (Philbin, 1996).

Rotary Drum. This system has been used since the 1950s for reclaiming shell and chemically bonded sands. The direct-fired rotary drum is a refractory-lined steel drum that is mounted on casters. The feed end is elevated to allow the sand to flow freely through the unit. The burners can be at either end of the unit with direct flame impingement on the cascading sand; flow can be either with the flow of solids or counter to it.

In indirect-fired units, the drum is mounted on casters in the horizontal position and is surrounded by refractory insulation. Burners line the side of the drum, with the flames in direct contact with the metal drum. The feed end is elevated to allow the sand to flow freely through the unit, and in some cases flights (paddles connected by chains) are welded to the inside to assist material flow.

Multiple-Hearth Vertical Shaft Furnace. This furnace consists of circular refractory hearths placed one above the other and enclosed in a refractory-lined steel shell. A vertical rotating shaft through the center of the furnace is equipped with air-cooled alloy arms containing rabble blades (plows) that stir the sand and move it in a spiral path across each hearth.

Sand is repeatedly moved outward from the center of a given hearth to the periphery, where it drops through holes to the next hearth. This action gives excellent contact between sand grains and the heated gases. Material is fed into the top of the furnace. It makes its way to the bottom in a zigzag fashion, while the hot gases rise counter-currently, burning the organic material and calcining clay, if one or both are present. Discharge of reclaimed sand can be directly from the bottom hearth into a tube cooler, or other cooling methods may be used. The units are best suited to large tonnages (five tons or more).

New approaches and equipment designed for sand reclamation units are continuing to evolve, and foundries must evaluate each system carefully with regard to the suitability for a particular foundry operation.

In 1988, R.H. Sheppard Company, Inc. in Hanover, Pennsylvania installed a thermal sand reclamation system to recover its 2,200 tons per year of waste green sand. Between the sand purchase price and disposal costs, the foundry was spending over $180,000 per year. Even considering the $428,500 capital investment and regular operation and maintenance costs, over the 20 year useful life of the equipment, the company estimates it will save about $2 million. This does not include the intangible savings of reduced liability of waste sand disposal (Pennsylvania DEP, 1996).

Use Sand as a Construction Material

Depending on its physical and chemical characteristics, non-hazardous waste foundry sand can be used as construction material assuming a market can be found and federal, state, and local regulations relating to handling, storage, and disposal allow it. Many foundries currently recycle foundry waste sand for construction purposes. Industry research, however, indicates that only a small portion of the potential market for waste sand is being utilized. Some potential construction uses for waste sand include: feed stock for portland cement production; fine aggregate for concrete; fine construction aggregate for fill; and bituminous concrete (asphalt) fine aggregate.

Since late 1993, Viking Pump, Inc., of Cedar Falls, Iowa has been shipping spent sand to a portland cement manufacturer for use as a raw material. This reuse reduces the costs for the cement company because the need for mining virgin sand is reduced. Landfill costs for the foundry have been reduced creating a win-win situation for both companies. When Viking began testing foundry sand for use in cement manufacturing, the sand was loaded with an endloader into grain trucks for hauling to the cement plant. Completing a loading took almost an hour. Once the cement company decided that the waste sand was compatible with its process, Viking invested in a sand silo for storage. The sand is now conveyed to the silo and gravity fed into trucks for transportation, significantly reducing handling time to six minutes. Viking expects to send at least half of the spent foundry sand to the portland cement manufacturer and is continuing to look for alternative uses to achieve its pollution prevention goals (U.S. EPA Enviroene Website, 1996).

Not all foundry sand will be ideal for all construction uses. For example, although many foundry sands actually increase compression strengths of concrete when used as a fine aggregate, green molding sands have been shown to decrease compression strengths. In addition, foundries will probably not be able to find markets for their waste sand in its "as-generated" condition. Some processing is typically required in order to match the customers' product specifications. Waste sand may first need to be dried, crushed, screened and separated from metals.

Waste sand streams from certain foundry processes could render a foundry's entire waste sand stream worthless if mixed together. A material flow diagram detailing the flow of sand and its characteristics (particle size distribution, mineralogical composition, moisture content, and chemical and contaminant concentration) through the production processes will help foundry operators identify those spent sand generation points that must be separated out for either processing and sale to a customer or for disposal in a landfill.

V.B. Metal Melting Furnaces

The metal casting industry is highly energy intensive and therefore has opportunities to prevent pollution through increasing energy efficiency. The majority of the energy is consumed by the furnaces used to melt metal; however, energy used in heat curing of sand molds can also be significant depending on the process used (DOE, 1996). Increases in energy efficiency in metal casting operations may have the dual pollution prevention effect of reducing fossil fuel consumption (and the associated environmental impacts) and reducing the amounts of wastes generated from furnaces and curing ovens (e.g., hazardous desulfurization slag, dust, VOCs, etc.). Since energy costs can be a large portion of a metal caster's overall operating costs, increases in energy efficiency can also result in significant cost savings.

Improve Furnace Efficiency

Currently, many foundry furnaces are less than 35 percent energy efficient. Facilities using reverberatory or crucible furnaces may have opportunities to improve their furnace efficiency and stack emissions by upgrading their combustion system (DOE, 1996). New oxygen burners and computerized gas flow metering systems have helped a number of facilities to comply with Clean Air Act regulations for NO_x and CO emissions while reducing energy costs. Some foundries are utilizing regenerative ceramic burner systems. The systems are comprised of two burners which function alternately as a burner and an exhaust port. When one burner fires, the other collects the exhaust gases, recouping the heat from the waste gases. In the next cycle, this burner then fires, recombusting the gases. The recombustion of the waste gases ensures complete combustion and has been shown to reduce NO_x formation. One firm implementing this system reported a 33 percent reduction in energy use and a better melting rate, improving production capacity (Binczewski, 1993).

Install Induction Furnaces

Induction furnaces may offer advantages over electric arc or cupola furnaces for some applications. Induction furnaces are about 75 to 80 percent energy efficient and emit about 75 percent less dust and fumes because of the absence of combustion gases or excessive metal temperatures. When clean scrap material is used, the need for emission control equipment may be minimized. Of course, production operations and process economics must be considered carefully when planning new or retrofit melting equipment (U.S. EPA, 1992).

Minimize Metal Melting

Depending on the casting, between reject castings and gating systems, over half of the metal poured into molds may not become a useful part of the casting. This metal needs to be separated from the castings and remelted, usually at a significant cost. Any increases in yield (reductions in the amount of scrap) will result in energy cost savings from eliminating the need for melting the excess metal. In addition, costs of separating scrap from the castings and waste sand, and the time and expense in machining of gating systems may be reduced. Gating system design that increases yield and reduces the need for machining can reduce a foundry's costs. Optimally designed systems will not use any more metal than is necessary while ensuring that the metal flows into the mold cavity properly to minimize casting defects. A number of computer software products are available to optimize casting design. These products simulate mold filling and casting solidification for various designs and can reduce costs by improving quality and reducing scrap.

A number of casting methods use a central sprue gated to a number of individual casting patterns. Such assemblies termed "trees" or pattern clusters, can generate less excess metal than single pattern mold designs. This technique is most commonly used in the investment and lost foam casting methods. A variation of the investment casting method termed, hollow sprue casting, or counter gravity casting, employs a vacuum to fill the mold with molten metal. A mold or mold cluster assembly fabricated using the investment casting technique is placed in a closed mold chamber with only the open end protruding from the bottom. The mold and mold chamber are lowered to the surface of a ladle or crucible of molten metal until the mold opening is below the surface. A vacuum is then applied to the mold chamber and mold, forcing the molten metal to rise and fill the mold and gating system. The vacuum is maintained until the casting and gates have solidified and is released before the sprue has solidified. The sprue metal then drains back into the molten metal for reuse. If the gating system is designed properly, over 90 percent of the metal becomes part of the useful casting.

Use Alternative Fuels for Melting

Some melt furnaces can utilize natural gas or fuel-oil as a fuel source. Particulate emissions from fuel oils tend to be much greater than emissions from natural gas combustion. If fuel oil must be used, particulate emissions can be reduced by using a lower grade of fuel oil. Petroleum distillates (Numbers 1 and 2 fuel oil) will result in lower particulate emissions than heavier grade fuels (Nos. 4,5,6). Sulfur dioxide emissions can be reduced by choosing a fuel with a low sulfur content. Emissions of nitrogen oxides result from the oxidation of nitrogen bound in the fuel. Selection of a low nitrogen fuel oil will reduce NOx emissions (NADCA, 1996).

Air emissions from the operation of furnaces can be further reduced by using natural gas as a fuel source. Natural gas is considered a clean fuel which, when combusted, emits relatively small amounts of SOx and particulate matter. The primary emission resulting from the combustion of natural gas is nitrogen oxides. NOx emissions can be reduced by applying alternative firing techniques, including the recirculation of flue-gas, staged combustion, and the installation of low NOx burners (NADCA, 1996).

Proper maintenance of furnaces will also help to reduce air emissions. Inefficient fuel/air mixing may generate excess particulate emissions.

V.C. Furnace Dust Management

Dust generation, especially in the Electric Arc Furnace (EAF), and its disposal, has been recognized as a serious problem, but one with potential for pollution prevention through material recovery and source reduction. EAF dust can have high concentrations of lead and cadmium. Some EAF dust can be shipped off-site for zinc reclamation. Most of the EAF dust recovery options are only economically viable for dust with a zinc content of at least 15 - 20 percent (U.S. EPA, 1995).

In-process recycling of EAF dust may involve pelletizing and then reusing the pellets in the furnace, however, recycling of EAF dust on-site has not proven to be technically or economically competitive for all foundries. Improvements in technologies have made off-site recovery a cost effective alternative to thermal treatment or secure landfill disposal.

Maintain Optimal Operating Parameters

Dust emissions from furnaces can often be minimized through a number of good operating practices. Such practices include: avoiding excessive superheating of the metal; maintaining a sufficient flux or slag cover over the metal to keep the molten metal separated from the atmosphere; preheating the metal charged; avoiding the addition of metals at maximum furnace temperatures; and avoiding the heating of the metal too fast.

Recycle EAF Dust to the Original Process

EAFs generate 1 to 2 percent of their charge into dust or fumes. If the zinc and lead levels of the metal dust are low, return of the dust to the furnace for recovery of base metals (iron, chromium, or nickel) may be feasible. This method may be employed with dusts generated by the production of stainless or alloy steels. However, this method is usually impractical for handling dust associated with carbon steel production because galvanized metal scrap is often used and the recovered dust tends to be high in zinc (U.S. EPA, 1992).

Many methods have been proposed for flue-dust recycling, including direct zinc recovery. Zinc content can be increased to the required 15 to 20 percent by returning the dust to the furnace from which it is generated. If the dust is injected into the furnace after the charge of scrap metal is melted, temperatures are high enough for most of the heavy metals to fume off. This technique results in an increased zinc concentration in the dust collected by the scrubbers, electrostatic precipitation systems, or baghouses (U.S. EPA, 1992).

Recycle Dust Outside the Original Process

Silica-based baghouse dust from sand systems and cupola furnaces may be used as a raw material by cement companies. The dust is preblended with other components and transferred to a kiln operation. It is envisioned that baghouse dusts may constitute 5 to 10 percent of the raw material used by cement manufacturers in the future. The use of higher levels may be limited by adverse effects of the baghouse dust on the setting characteristics of the cement (U.S. EPA, 1992).

Waste EAF dust can be reused outside the original process by reclaiming the zinc, lead, and cadmium concentrated in emission control residuals. The feasibility of such reclamation depends on the cost of dust treatment and disposal, the concentration of metals within the residual, the cost of recovering the metals, and the market price for the metals. While this approach is useful in the nonferrous foundry industry (i.e., brass foundries), its application within gray iron foundries is extremely limited. Some foundries market furnace dust as input to brick manufacturing and other consumer product applications, but product liability limits this option. Recovery methods include: pyrometallurgical, rotary kiln, electrothermic shaft furnace, and zinc oxide enrichment (U.S. EPA, 1992).

Pyrometallurgical methods for metals recovery are based on the reduction and volatilization of zinc, lead, cadmium, and other components of EAF dust. Lead is removed preferentially through roasting in an oxidizing environment, while zinc, cadmium and other metals are removed through roasting under reducing conditions. The rotary (or Waelz) kiln method can simultaneously reduce ferrous iron oxide to solid iron and lead and zinc oxide to their metallic forms, using a reducing atmosphere such as carbon monoxide and hydrogen. However, rotary kilns must be fairly large and must process large volumes of dust to be economically and thermally efficient. The electrothermic shaft furnace can extract metallic zinc from a feed containing at least 40 percent of the metal. Typically, agglomerated EAF dust is mixed with other feed to attain this percentage. To recycle dust by direct reduction of oxides, iron oxide is reduced to iron and water using pure hydrogen at a temperature range of 1000 to 1100°C. The reduction of zinc oxide produces zinc vapors and steam at 1000 to 1100°C that are removed from the furnace and subjected to an oxidation step. The zinc reacts with water to produce zinc oxide, and hydrogen is removed and recycled. The zinc oxide produced is separated in a baghouse. The hydrogen containing the steam is further treated for steam condensation, and then the hydrogen is ready for recycling into the furnace (U.S. EPA, 1992).

Alter Raw Materials

The predominant source of lead, zinc, and cadmium in ferrous foundry baghouse dust or scrubber sludge is galvanized scrap metal used as a charge material. To reduce the level of these contaminants, their source must be identified and charge material containing lower concentrations of the contaminants must be acquired. A charge modification program at a large foundry can successfully reduce the lead and cadmium levels in dust collector waste to below EP-toxicity values. Foundries need to work closely with steel scrap suppliers to develop reliable sources of high-grade scrap.

V.D. Slag and Dross Management

Minimize Hazardous Desulfurizing Slag

In the production of ductile iron, it is often necessary to add a desulfurizing agent in the melt to produce the desired casting microstructure. One desulfurization agent used commonly is solid calcium carbide (CaC_2). Calcium carbide is thought to decompose to calcium and graphite. The calcium carbide desulfurization slag is generally removed from the molten iron in the ladle and placed into a hopper. For adequate sulfur removal, CaC_2 must be added in slight excess. Since an excess of CaC_2 is employed to ensure removal of the sulfur, the resulting slag contains both CaS and CaC_2 and must be handled as a reactive waste. The slag might also be hazardous due to high concentrations of heavy metals (U.S. EPA, 1992).

Treatment of this material consists normally of converting the carbide to acetylene and calcium hydroxide by reacting with water. Problems with this method include handling a potentially explosive waste material; generating a waste stream that contains sulfides (due to calcium sulfide in the slag) and many other toxic compounds; and liberating arsine, phosphine, and other toxic materials in the off gas (U.S. EPA, 1992).

One way to reduce the need for calcium carbide is to reduce the amount of high sulfur scrap used as furnace charge materials. While this method is effective, the ability to obtain a steady supply of high-grade scrap varies considerably and may be uneconomical (U.S. EPA, 1992).

To eliminate entirely the use of calcium carbide, several major foundries have investigated the use of alternative desulfurization agents. One proprietary process employs calcium oxide, calcium fluoride, and two other materials. The process can be more economical than carbide desulfurization and results in a satisfactory iron quality (U.S. EPA, 1992).

Often, the amount of sulfur removal for a product is based not on the requirements of that product but on what is achievable in practice. When total sulfur removal is required, it is not uncommon that 20 to 30 percent excess carbide is employed resulting in the generation of larger amounts of slag. If the iron were desulfurized only to the extent actually needed, much of this waste could be reduced or eliminated (U.S. EPA, 1992).

Recycle Hazardous Desulfurizing Slag

Because calcium carbide slag is often removed from the metal by skimming, it is not uncommon to find large amounts of iron mixed in with the slag. Depending on the means of removal, this metal will either be in the form of large blocks or small granules. To reduce metal losses, some foundries crush the slag and remove pieces of metal by hand or with a magnet for remelting. Other foundries have investigated recharging the entire mass to the remelting furnace. Inside the furnace, calcium hydroxide forms in the slag as the recycled calcium carbide either removes additional sulfur or is oxidized directly. While this method has been successful, more research is necessary. For example, it is not known to what extent the calcium sulfide stays with the slag or how much sulfur is carried in the flue gas and the scrubber system. Initial tests indicate that the sulfur does not concentrate in the metal, so that product quality is not affected (U.S. EPA, 1992).

Slag from stainless steel melting operations (where Ni, Mo, and Cr metals are used as alloy additions) is hazardous as a result of high chromium concentrations. Such slag can be recycled as a feed to cupola furnaces (gray iron production line). The cupola furnace slag scavenges trace metals from the induction furnace slag. The resulting cupola slag may be rendered a nonhazardous waste (U.S. EPA, 1992).

Minimize Air Emissions During Dross and Slag Removal

Emissions resulting from the removal of dross and slag can be reduced by decreasing the time in which the dross is exposed to the air. This is true for dross and slag removal processes throughout the facility (e.g., melting, laundering, die casting). Dross and slag pots should be covered as soon as possible to eliminate emissions to the atmosphere. Alternative dross and slag handling techniques can also be practical to reduce emissions. Dross and slag pots can be positioned under or near exhaust hoods in order to divert the emissions to a filter or other emission control device (NADCA, 1996).

R0075869

V.E. Wastewater

Reduce Phenols in Die Casting Wastewater Streams

The major pollutants in the wastewater streams from die casting operations are oils and phenols, with the phenols being the regulated pollutant in most wastewater discharge situations. Common sources of phenols in die casting are the various oils used in the process, such as phosphate ester-based hydraulic oil, die lube, way lube, die cast coolant, etc. Cast salts, degreasers, and heat transfer oils may also contain phenols as an impurity (NADCA, 1996).

An effective method for source control of phenols would be to check each individual raw material used in die casting for phenols, and use or substitute with materials which have little or no phenols. For example, petroleum oils which often contain phenols as contaminants may be substituted with synthetic oils or water-based materials that contain no phenols. Although the alternative materials can be more costly than petroleum-based oils, the annual incremental cost increase may not be significant depending on the volume of material used. In addition, anticipated reductions in environmental control costs may outweigh potential raw material cost increases (NADCA, 1996).

Another effective method of reducing or eliminating phenols in wastewater consists of segregating the various waste streams at the point of generation by collecting the materials in catch pans and handling them separately. For example, die lube overspray can be collected in a metal pan installed below the die, screened to remove debris, filtered (if necessary) to remove fine particulate matter, treated (if necessary) for bacteria contamination, and recycled for reuse in the plant. Plunger lubricants and other drippings may also be collected in pans and recycled off-site as used oil (NADCA, 1996).

Reduce Wastewater and Sludge Generation

Water used to cool parts can be reduced by implementing cooling water recycling systems. Further wastewater reductions may be accomplished by optimizing deburring operations to minimize the total suspended solids in wastewater. This, in turn, will reduce the sludge generation from subsequent treatment. Sludge dewatering can also be optimized through the use of pH controls and filter aids (such as diatomaceous earth) to produce a drier filter cake prior to land disposal.

R.H. Sheppard Company, Inc. in Hanover, Pennsylvania used large quantities of fresh water for cooling metal parts as they were ground to fine tolerances. The company installed a 16,000 gallon closed loop cooling system with temperature and bacteria controls which improved the grinding process and saves 3.4 million gallons of water per year. From its reduced coolant disposal costs and savings in water costs, R.H. Sheppard Company expects a two- to three-year payback period on its $540,000 investment (Pennsylvania DEP, 1996).

Reduce VOC Emissions from Cooling and Quench Water

The primary cause of air emissions from non-contact cooling water cooling towers and quench baths is the use of additives, such as biocides, which contain volatile organic compounds that are eventually emitted to the atmosphere. The best method for reducing air emissions from cooling towers and quench baths is to use fewer additives or to use additives containing no VOCs or Hazardous Air Pollutants (HAPs) (NADCA, 1996).

V.F. Die Casting Lubrication

The majority of emissions generated during the die casting process come from the application of die lubes. These emissions consist of VOC, particulate matter, and HAPs. VOC emissions from die lube application can be reduced by the use of water-based die lubricants or solid lubricants. Eliminating the volatile components of petroleum-based lubricants will also reduce VOC emissions when wet milling finishing techniques are used. However, it is important to note that lubricants which reduce VOC emissions may not necessarily reduce HAP emissions and, in some cases, HAP emissions may be greater from water-based die lubes. Apparently, some of the solvent replacement additives in water-based lubricants may result in increased HAP emissions. It is important to thoroughly evaluate the potential implications for air emissions before alternative lubricant products are used (NADCA, 1996).

In the same manner as VOC emissions, alternative lubricants can be used to reduce particulate emissions from the application of die lubes. However, lubricant-specific evaluations should be performed to determine the particulate emission reduction potential of individual lubricant changes (NADCA, 1996).

V.G. Miscellaneous Residual Wastes

The generation of solid wastes from shipping and receiving processes can be minimized through the use of reusable packaging materials. Metal casters can seek suppliers that use these materials, and work with customers to initiate their use of reusable shipping materials. Many of the common packaging materials in use today, including shrink wrap, strapping materials, cardboard, totes, and drums, can be recycled off-site using commercial recycling services. (NADCA, 1996)

Dross from melting operations is commonly sold to secondary smelters for recovery of the valuable metals. Die casting shot-tip turnings can be re-sized on-site and re-used in the original process (NADCA, 1996).

Leaking hydraulic fluid from die cast machines can be segregated from other die cast fluids using drip pans and/or containment curbing. Leaking and spent hydraulic fluids may be collected and recycled as used oil. Used oil recycling options include re-refining and burning the material for energy recovery in space heaters, boilers, or industrial furnaces (NADCA, 1996).

Refractory, coils, and servicing tools must be periodically replaced in the melting and conveyance operations due to wear. Although the generation of these materials cannot be eliminated, their generation rates can be minimized by raising the pollution prevention awareness of maintenance personnel and optimizing maintenance and servicing schedules (NADCA, 1996).

The generation of floor absorbent solid waste at die cast machines can be minimized through the use of drip pans and containment berming. Hydraulic fluids, die release agents, way lubricants, and other leaking fluids can be collected in this manner. If floor absorbents are to be used, launderable absorbents should be considered. These absorbents are becoming available increasingly from industrial suppliers and laundry services, and can be reused over and over. The use of launderable absorbents results in reduced landfill disposal for both the absorbents and the recovered fluids (NADCA, 1996).

Page 94 intentionally left blank.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities must obtain a permit either from EPA or from a State agency which EPA has authorized to implement the permitting program if they store hazardous wastes for more than 90 days before treatment or disposal. Facilities may treat hazardous wastes stored in less-than-ninety-day tanks or containers without a permit. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 States and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator must follow to determine whether the material in question is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet LDR treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities that store such waste, including large quantity generators accumulating waste prior to shipment off-site.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that must be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA, Superfund and EPCRA Hotline, *at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.*

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law known commonly as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the

Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as removals. EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance (the list of such substances is in 40 CFR Part 355. Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release equaling or exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, known commonly as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The National Pollutant Discharge Elimination System (NPDES) program (CWA §502) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized 42 States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set the conditions and effluent limitations on the facility discharges.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated the NPDES storm water permit application regulations. These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing, 32 (except 323)-stone, clay, glass, and concrete, 33-primary metals, 3441-fabricated structural metal, and 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national pretreatment program (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities that could reasonably be expected to discharge oil in harmful quantities prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR §112.20) and for PCB transformers and PCB-containing items were revised and finalized in 1995.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA Underground Injection Control (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, volatile organic compounds (VOCs), ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under section 110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and may go into effect as early as late 1997.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title I, section 112(c) of the CAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV of the CAA establishes a sulfur dioxide nitrous oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI of the CAA is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs) and chloroform, were phased out (except for essential uses) in 1996.

EPA's Clean Air Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities (www.epa.gov ttn then select Directory and then CATC).

VI.B. Industry Specific Requirements

Resource Conservation and Recovery Act (RCRA)

Under the authority of RCRA, EPA created a regulatory framework that addresses the management of hazardous waste. The regulations address the generation, transport, storage, treatment, and disposal of hazardous waste.

The metal casting industry generates waste during molding and core making, melting operations, casting operations, and finishing and cleaning operations. The wastes that are produced during these processes which meet the RCRA hazardous waste criteria must be handled accordingly.

Molding and core making operations produce large quantities of spent foundry sand. Although most of the spent sand is non-hazardous, sand that results from the production of brass or bronze may exhibit the toxicity characteristic for lead or cadmium. The hazardous sand may be reclaimed in a thermal treatment unit which may be subject to RCRA requirements for hazardous waste incinerators. EPA is currently taking public comment on the regulatory status of these units. Wastewaters that are produced during molding and core making may exhibit the corrosivity characteristic but are generally discharged to a POTW after being neutralized, in which case they are not subject to RCRA. Sludges resulting from mold and core making may also be corrosive hazardous wastes.

The wastes associated with metal casting melting operations include fugitive dust and slag. Lead and chromium contamination may cause the waste slag to be subject to RCRA as a hazardous waste. Additionally, calcium carbide desulfurization slag generated during metal melting could be a reactive hazardous waste. Spent solvents used in the cleaning and degreasing of scrap metal prior to melting may also be a hazardous waste. The inorganic acids and chlorinated solvents used in the cleaning operations could be subject to RCRA as well, if they are spilled or disposed of prior to use.

Casting facilities that use electric arc furnaces (EAF) for metal melting produce dust and sludge that may be characteristically hazardous. However, the emission control dust and sludge from foundry operations that use EAFs is not within the K061 hazardous waste listing. Also, this dust and sludge is not considered to be a solid waste under RCRA when reclaimed.

Finishing operations produce wastes similar to those resulting from the cleaning and degreasing of scrap metal prior to melting, including spent solvents and alkaline cleaners. Additionally, any sludge from spent pickle liquor recovery generated by metal casting facilities (SIC code 332) would be a listed hazardous waste (K062).

Clean Air Act

The CAA New Source Review (NSR) requirements apply to new facilities, expansions of existing facilities, or process modifications. New sources of the NAAQS "criteria" pollutants in excess of "major" levels defined by EPA are subject to NSR requirements (40 CFR §52.21(b)(1)(i)(a)-(b)). NSRs are typically conducted by the state agency under standards set by EPA and adopted by the state as part of its state implementation plan (SIP). There are two types of NSRs: Prevention of Significant Deterioration (PSD) reviews for those areas that are meeting the NAAQS; and nonattainment (NA) reviews for areas that are violating the NAAQS. Permits are required to construct or operate the new source for PSD and NA areas.

For NA areas, permits require the new source to meet lowest achievable emission rate (LAER) standards and the operator of the new source must procure reductions in emissions of the same pollutants from other sources in the NA area in equal or greater amounts to the new source. These emission offsets may be banked and traded through state agencies.

For PSD areas, permits require the best available control technology (BACT), and the operator or owner of the new source must conduct continuous on-site air quality monitoring for one year prior to the new source addition to determine the effects that the new emissions may have on air quality.

EPA has not established New Source Performance Standards (NSPSs) for the metal casting industrial category.

Under Title V of the CAAA 1990 (40 CFR Parts 70-72) all of the applicable requirements of the Amendments are integrated into one federal renewable operating permit. Facilities defined as major sources under the Act must apply for permits within one year from when EPA approves the state permit programs. Since most state programs were not approved until after November 1994, Title V permits, for the most part, began to be due in late 1995. Due dates for filing complete applications vary from state to state, based on the status of review and approval of the state's Title V program by EPA.

A facility is designated as a major source if it includes sources subject to the NSPS acid rain provisions or NESHAPS, or if it releases a certain amount of any one of the CAAA regulated pollutants (SO_x, NO_x, CO, VOC, PM_{10}, hazardous air pollutants, extremely hazardous substances, ozone depleting substances, and pollutants covered by NSPSs) depending on the region's air quality category. Title V permits may set limits on the amounts of pollutant emissions and require emissions monitoring, recordkeeping, and reporting.

Many large and some medium-sized foundries are likely to be major sources and therefore must apply for a Title V permit. Selected small foundries may also be classified as major sources, depending on their location and operational factors.

Clean Water Act

Foundry and die casting facility wastewater released to surface waters is regulated under the CWA (40 CFR Part 464). National Pollutant Discharge Elimination System (NPDES) permits must be obtained to discharge wastewater into navigable waters (40 Part 122). Effluent limitation guidelines, new source performance standards, pretreatment standards for new sources, and pretreatment standards for existing sources for the Metal Molding and Casting Point Source Category apply to ferrous and non-ferrous foundries and die casters and are listed under 40 CFR Part 464 and are divided into subparts according to the metal cast:

Subpart A	Applies to aluminum casting operations
Subpart B	Applies to copper casting operations
Subpart C	Applies to ferrous casting operations
Subpart D	Applies to zinc casting operations

In addition to the effluent guidelines, facilities that discharge to a POTW may be required to meet National Pretreatment Standards for some contaminants. General pretreatment standards applying to most industries discharging to a POTW are described in 40 CFR Part 403 (Contact Pat Bradley, EPA Office of Water, 202-260-6963). As shown above, pretreatment standards applying specifically to the metal casting point source category are listed in the subparts of 40 CFR Part 464 (Contact: George Jett, EPA Office of Water, 202-260-7151).

Stormwater rules require that metal casting facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. The rules require that certain facilities with storm water discharge from from industrial activity apply for storm water permit applications (see Section VI.A).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) provide the basic legal framework for the federal "Superfund" program to clean up abandoned hazardous waste sites (40 CFR Part 305). The metals and metal compounds used in metal casting, are often found in casting facilities' air emissions, water discharges, or waste shipments for off-site disposal. These include chromium, manganese, aluminum, nickel, copper, zinc, and lead. Metals are frequently found at CERCLA's problem sites. In 1989, when Congress ordered EPA and the Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR) to list the hazardous substances found most commonly at problem sites and that pose the greatest threat to human health, lead, nickel, and aluminum all made the list (Breen and Campbell-Mohn, 1993). A number of sites containing foundry wastes are on the National Priorities (Superfund) List. Compliance with the requirements of RCRA lessens the chances that CERCLA compliance will be an issue in the future.

VI.C. Pending and Proposed Regulatory Requirements

Resource Conservation and Recovery Act (RCRA)

Currently, the practice of adding iron dust or filings to spent foundry sand as a form of stabilization is subject to case-specific interpretation by EPA regarding whether this activity effectively treats the waste. However, EPA has proposed to regulate this activity as impermissible dilution, which is strictly prohibited under the land disposal restrictions program, and intends to examine the issue further.

Thermal processing or reclamation units (TRUs) remove contaminants from spent foundry sand primarily by combusting the organic binder materials in the sand. These units are identified as foundry furnaces under the definition of industrial furnace and are subject to regulation under 40 CFR Part 266, Subpart H when they burn hazardous waste. However, EPA did not consider whether TRUs would be appropriately controlled under these standards. EPA has proposed two approaches to ensure controls for TRUs. The first option is a deferral from regulation under 40 CFR Part 266, Subpart H. This would allow development of the foundry maximum achievable control technology under the Clean Air Act and potentially the application of these controls to TRUs that process hazardous waste sand. The second option is to provide a variance from the RCRA definition of solid waste. Under the variance provisions, EPA may grant a variance from the definition of solid waste for materials that are reclaimed and used as a feedstock within the original production process if the reclamation process is an essential part of the production process. Under this option, TRUs would not be subject to RCRA regulation, but could be regulated under the Clean Air Act or state or local air pollution laws (EPA, RCRA Hotline, 1997).

Clean Air Act

In addition to the CAA requirements discussed above, EPA is currently working on or will be working on additional regulations that will directly affect the metal casting industry. Under Title III, EPA is required to develop national standards for 189 hazardous air pollutants (HAPs) some of which are emitted from foundries. NESHAP standards may limit the air emissions from foundries through Maximum Achievable Control Technology (MACT) based on performance standards that will set limits based upon concentrations of HAPs in the waste stream. NESHAP standards for ferrous foundries are scheduled to be promulgated by EPA in November of 2000 (James Maysilles, U.S. EPA, Office of Air, (919) 541-3265). Non-ferrous foundries and die casting facilities will not be subject to NESHAP standards.

R0075890

EPA is also developing the Compliance Assurance Monitoring Rule. The rule may require monitoring of certain emissions from certain facilities. Facilities are required to pay a fee for filing for a permit and are required to pay an annual fee based on the magnitude of the facility's potential emissions.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small

businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (April 1, 1992 to March 31, 1997) and the other for the most recent twelve-month period (April 1, 1996 to March 31, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across EPA Regions for certain sectors.[4] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data

[4] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times, e.g., a facility with 3 enforcement actions counts as 3.

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and FIFRA/TSCA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Metal Casting Industry Compliance History

Table 15 provides an overview of the reported compliance and enforcement data for the metal casting industry over the past five years (April 1992 to April 1997). These data are also broken out by EPA Regions thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Almost 80 percent of metal casting facility inspections and 63 percent of enforcement actions occurred in Regions III, IV, and V, where most facilities (68 percent) are located.

- Region X had a high ratio of enforcement to inspections (0.40) compared to other Regions.

- Region IX had a significantly higher average time between inspections (70 months), which means that fewer inspections were carried out in relation to the number of facilities in the Region (54 facilities and 40 inspections).

- Region IV had the shortest average time between inspections (9 months), but also had the lowest rate of enforcement actions to inspections of any Region (0.05).

Table 15: Five-Year Enforcement and Compliance Summary for the Metal Casting Industry

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	15	8	44	20	2	3	67%	33%	0.07
II	26	16	128	12	10	19	68%	32%	0.15
III	74	61	458	10	19	29	83%	17%	0.06
IV	77	53	505	9	12	24	88%	12%	0.05
V	307	191	1,026	18	45	68	63%	37%	0.07
VI	44	25	103	26	6	14	43%	57%	0.14
VII	40	33	167	14	6	10	30%	70%	0.06
VIII	9	7	16	34	2	2	100%	0%	0.13
IX	54	15	46	70	4	5	100%	0%	0.11
X	23	15	42	33	7	17	94%	6%	0.40
TOTAL	669	424	2,535	16	113	191	71%	29%	0.08

VII.B. Comparison of Enforcement Activity Between Selected Industries

Tables 16 and 17 allow the compliance history of the metal casting sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Tables 16 and 17 permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering the last five years (April 1992 to April 1997) to that of the past year (April 1996 to April 1997). Some points evident from the data are listed below.

- Over the past year, the industry has had one of the highest proportions of facilities inspected with violations (103 percent) and enforcement actions (10 percent).

- Over the past year, the average enforcement to inspection rate for the metal casting industry has decreased to 0.06 compared to 0.08 over the past five years.

- Of the sectors listed, facilities in the metal casting sector had one of the highest proportions of federal-lead enforcement actions (29 percent).

Tables 18 and 19 provide a more in-depth comparison between the metal casting industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Tables (Tables 16 and 17), the data cover the last five years (Table 18) and the last one year (Table 19) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- The percentage of inspections carried out under each environmental statute has changed little over the past five years compared to the past year. Inspections under CAA account for the majority (about 60 percent) followed by RCRA and CWA.

- The percentage of CAA enforcement actions increased from 44 percent over the past five years to 58 percent over the past year. In addition, the percentage of enforcement actions carried under FIFRA/TSCA/EPCRA/Other decreased from 14 percent to 0 percent while CWA and RCRA remained about the same.

Table 16: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	4,676	1,902	6,071	46	149	309	79%	21%	0.05
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	**669**	**424**	**2,535**	**16**	**113**	**191**	**71%**	**29%**	**0.08**
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Table 17: One-Year Enforcement and Compliance Summary for Selected Industries									
A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	4,676	874	1,173	127	15%	26	3%	34	0.03
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	**669**	**234**	**433**	**240**	**103%**	**24**	**10%**	**26**	**0.06**
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection*

Table 18: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries											
Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	1,902	6,071	309	75%	65%	16%	14%	8%	18%	0%	3%
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	**424**	**2,535**	**191**	**55%**	**44%**	**11%**	**10%**	**32%**	**31%**	**2%**	**14%**
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

Table 19: One-Year Inspection and Enforcement Summary by Statute for Selected Industries											
Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	874	1,173	34	82%	68%	10%	9%	9%	24%	0%	0%
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	**234**	**433**	**26**	**60%**	**58%**	**10%**	**8%**	**30%**	**35%**	**0%**	**0%**
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

VII.C. Review of Major Legal Actions

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

VII.C.1. Review of Major Cases

As indicated in EPA's *Enforcement Accomplishments Report, FY1995 and FY1996* publications, 8 significant enforcement actions were resolved between 1995 and 1996 for the metal casting industry.

EMI Company (Pennsylvania): On May 29, 1996, EPA executed a consent agreement and order settling an administrative action against EMI Company for payment of $20,000 and agreement to perform a Supplemental Environmental Project (SEP). The SEP requires respondent to install and operate (for one (1) year) baghouse emissions control technology for four (4) electric induction furnaces presently not subject to Best Available Control Technology (BAT) control requirements. The total SEP capital costs and operating expenditure costs for one year are estimated to be at least $786,664. Those particulates include some of the regulated materials (copper and manganese) that are the subject of this action. Region III filed the administrative complaint against EMI Company of Erie, Pennsylvania for EPCRA reporting violations.

Leggett and Platt (Grafton, Wisconsin): On Monday, April 1, 1996, a consent decree was entered in the Milwaukee Federal court with Leggett & Platt, concerning their Grafton, WI, facilities (2). A penalty of $450,000 was stipulated in the decree based on four years of reporting failures and exceeding the Federal Pretreatment standards for the Metal Molding and Casting industry. Also, the company agreed in the consent decree not to discharge process wastes to the Grafton POTW. As a result of this stipulation the company started a water recycle system in April, 1995, with several levels of plant water cleanliness. After several months of experimentation the company observed that the recycle system had a two-year payout due to the reduction of the use of plant lubricants. The yearly savings were in excess of $50,000/year. Therefore, there was no economic benefit available for recovery.

Cooper Cameron (Richmond, Texas): This enforcement action arose out of the Region VI Foundry Initiative. EPA conducted an inspection of the Cooper Industries, Inc., Oil Tool Division in Richmond, Texas on September 21-23, 1994. At that facility, the Cooper Oil Tool Division manufactured a variety of low and high carbon steel and stainless steel oil tool castings for valves and other equipment. During the inspection, EPA discovered a waste pile which contained Electric Arc Furnace (EAF) baghouse dust. This material was sampled using the TCLP method and was found to contain chromium (D007) above the 5.0 mg/L regulatory level. Therefore, the EAF baghouse dust is a hazardous waste. Cooper Oil Tool Division was acquired by Cooper Cameron Corporation which was spun off from Cooper Industries, Inc. in 1995. As the corporate successor to the Oil Tool Division, Cooper Cameron became responsible for the cited violations. Region VI simultaneously filed the consent agreement/consent order on September 30, 1996, assessing a civil penalty of $45,000 plus injunctive relief. Additionally, Cooper Cameron has agreed to remediate, under the Texas Natural Resource Conservation Commision (TNRCC) Voluntary Cleanup Program, approximately 30 acres of waste materials stored in piles on their site. It is estimated that this action will reduce the risk of releasing more than 100 tons of chromium contaminated soil. The agreement to remediate the waste pile is a result of concern over environmental justice. The surrounding community is approximately 51% minority while Texas' average is 39%.

HICA Steel Foundry and Upgrade Co. (Shreveport, Louisiana): On November 7, 1995, EPA issued HICA Steel Foundry and Upgrade Company an administrative order (complaint). The order proposed a $472,000 fine and required closure of several unauthorized hazardous waste management units. This action required the removal and proper disposal of 2,600 gallons on corrosive and ignitable hazardous waste and 255 tons of lead and chromium contaminated waste from the facility.

NIBCO, Inc. (Blytheville, Arkansas): A final consent agreement/consent order was signed by both Region VI and NIBCO on September 30, 1996. NIBCO agreed to pay $750,000 in cash to satisfy the approximately $2.5 million in civil penalties assessed by Region VI in this Foundry Initiative enforcement action. The enforcement action against NIBCO originated because the facility was treating sand used in the casting of metal valves (casting sand) with metallic iron dust, without a permit, and disposing of the material in the Nacogdoches municipal landfill. The casting sand absorbs lead during the casting process, making it a hazardous waste. In order to offset the civil penalty, NIBCO agreed to work with Texas Natural Resource Conservation Commision (TNRCC) and the City of Nacogdoches to characterize the foundry sand waste disposed of in the Nacogdoches municipal landfill, and ensure closure and post-closure measures are performed in accordance with all applicable requirements and schedules established by TNRCC.

Lynchburg Foundry Company (Lynchburg, VA): On August 24, 1995, the Region III Administrator signed a consent order which requires Lynchburg Foundry Company to perform tasks set out in the compliance section of the consent agreement, and to pay $330,000 to EPA. Lynchburg, located in Lynchburg, Virginia, operates two facilities: Radford and Archer Creek, both of which manufacture metal automotive parts. Under the terms of the consent agreement and order, Lynchburg must: 1) list all hazardous wastes handled at both facilities within its hazardous waste notification filed with the Virginia Department of Hazardous Waste; 2) amend or supplement its emergency contingency plans for both facilities to reflect the arrangements agreed to by local emergency services; and 3) permanently cease illegally storing or treating D006 and D008 hazardous wastes in waste piles at either facility.

Great Lakes Casting Corporation (Ludington, MI): On November 15, 1994, a consent decree was entered in the U.S. District Court for the Western District of Michigan in the *U.S. v. Great Lakes Casting Corporation* case requiring Great Lakes to pay a civil penalty of $350,000 for illegal hazardous waste disposal under RCRA.

CMI-Cast Parts, Inc. (Cadillac, MI): A consent agreement and final order was signed on December 22, 1994, which settled an administrative complaint against CMI-Cast Parts, Inc. CMI-Cast Parts, Inc. is a Michigan corporation which owns and operates an iron foundry in Cadillac, Michigan. CMI-Cast Parts, Inc. failed to obtain interim status or a proper operating permit to treat, store or dispose of hazardous waste at its Cadillac facility. From September 1990 to January 1994, the facility failed to comply with the hazardous waste management standards. On January 26, 1995, CMI-Cast Parts, Inc., submitted a certified check in the amount of $454,600.00, payable to the Treasurer of the United States of America, for final settlement of the enforcement action.

VII.C.2. Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the Internet at EPA's Enviroene Website: http://es.inel.gov/sep.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those initiated independently by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

VIII.A.1. Federal Activities

Metalcasting Competitiveness Research (MCR) Program

The U.S. Department of Energy (DOE) Metalcasting Competitiveness Research Act (Public Law 101-425) was signed in 1990 and established the U.S. DOE, Office of Industrial Technology Metalcasting Competitiveness Research (MCR) Program. The program provides assistance to the metalcasting industry by fostering R&D in technology areas that were identified as priority in nature by the industry including technology competitiveness and energy efficiency. In this program, industry and the DOE provide cost-share funding to metalcasting research institutions that conduct the R&D. Projects are chosen based on a set of research priorities developed by the Metalcasting Industrial Advisory Board (IAB). The IAB meets once a year to revise these priorities. As of 1996, 24 projects have been funded through the MCR Program, a number of them having direct and indirect benefits to the environment.

Casting Emission Reduction Program

The Casting Emission Reduction Program (CERP) is primarily focused on developing new materials, processes or equipment for metalcasting manufacturing which will achieve a near-zero effect on the environment while producing high quality components for the U.S. military and other users. The program also has the objective of bridging the critical gap between laboratory and full scale casting production. The result will be a platform for proofing and validating the next generation of light weight weapon system components using near net shape metal castings.

The program was initiated by the Department of Defense (DoD) in response to the rapid reduction in domestic foundries capable of producing the critical components of military hardware. These parts range from tank tracks and turrets to the tail structure of the F-16 fighter. The DoD sees an immediate threat to sand casting foundries and their ability to withstand the changes resulting from the Titles III and V Amendments to the 1990 Clean Air Act.

In addition, DoD realizes that the needs of the military for post year 2000 hardware will depend on manufacturing technologies which do not exist today or are unable to make the transition from the lab bench to the shop floor. CERP aims to provide the country with the ability to launch lighter weight castings more quickly and at the same time meet the more demanding environmental regulations of the 1990 Clean Air Act Amendments. Although the program was initiated to address military needs, it is anticipated that it will benefit the entire industry.

The specific activities of CERP will include obtaining a baseline of emissions from foundries across the U.S., developing a pilot foundry at McClellan AFB in California for the testing and prototyping of new casting processes and materials, and developing the real-time emission instrumentation for foundries. The five-year program receives Congressional appropriations under the Research, Development, Test & Defense Wide category. Other technical partners directly supporting the project include the American Foundrymen's Society, the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and the U.S. Council for Automotive Research (USCAR). Contact: Bill Walden, (916) 643-1090.

EPA Region VI Foundry Initiative

EPA's Region VI (Oklahoma, Texas, Louisiana, Arkansas, New Mexico) began a Foundry Initiative in 1993 to improve compliance rates among the 600 foundries in the region. An initial inspection of 27 foundries in the Region indicated that a large percentage had potential RCRA violations. Region VI formed a partnership with the States and the American Foundrymen's Society to develop an initiative for environmental compliance which would be beneficial to foundries. EPA, the States and foundry representatives established a workgroup that provides an open forum for discussion, identifies relevant environmental issues facing foundries and develops educational assistance programs.

Through education and compliance assistance, the program aims to improve communication between the industry and the regulatory agencies and increase voluntary compliance with the regulations. The program provides foundries with information to fix problems before active enforcement occurs. For example, in Oklahoma where the initiative has recently been completed, a six month correction period was offered. Workshops and seminars were held in each state and individual compliance assistance and site visits are being offered. Contact: Joel Dougherty, Ph.D., (214) 665-2281.

VIII.A.2. State Activities

Oklahoma

The Oklahoma Department of Environmental Quality (DEQ) Customer Assistance Program recently completed its Foundry Initiative with EPA Region VI (See above). After Region 6 made plans to inspect 12 facilities in Oklahoma, the Oklahoma (DEQ) suggested an alternate strategy. A multi-media workshop was held in April 1995 that focused on pollution issues facing the foundry industry. From that workshop, an entire state-wide compliance achievement program was developed for metal casting facilities.

The Program consisted of the following trade-offs between industry and the regulators.

1) The industry would perform an environmental self-audit and fix any problems identified.
2) The DEQ and the EPA would allow a six month "correction period."
3) During the correction period any regularly scheduled annual inspections were canceled. This allowed the facility to focus on identifying and correcting areas of non-compliance.
4) At the end of the "correction period" there would be a return to normally scheduled inspections.

Of the 45 qualifying facilities in Oklahoma, 23 participated in the program. Each of the 23 facilities performed a self-audit that covered air quality, water quality, and waste management issues. Each facility also completed the program, which included workshops, self-audits, site visits, and "free" inspections. The types of compliance issues that were corrected as a result of the program were:

1) state minor air permits,
2) solid waste disposal approvals,
3) storm water pollution prevention plans,
4) SARA Title III reporting, and
5) air pollution controls.

An important outcome was the new relationship between the foundries and the agency. This new relationship was based on information sharing for the common goal of compliance. The participating foundries were able to obtain permits and disposal approvals without penalty. Several facilities continue to work with the DEQ to solve more complex compliance issues, such as on-site land disposal of foundry sand. Contact: Dave Dillon, Customer Assistance Program, Oklahoma DEQ, (405) 271-1400.

University of Wisconsin - Milwaukee Center for By-Product Utilization

At the University of Wisconsin - Milwaukee Center for By-Product Utilization researchers are examining the feasibility of using spent foundry sand and slag as feed for concrete manufacturing. The center is testing the compression strengths of concrete mixed with 25 percent and 35 percent (by weight) of different types of used foundry sand. Tests are also being carried out substituting foundry sand in asphaltic concrete. Many of the tests have shown that structural grade concrete and asphaltic concrete can be produced successfully and economically using waste foundry sand.

VIII.B. EPA Voluntary Programs

33/50 Program

The 33/50 Program is a groundbreaking program that has focused on reducing pollution from seventeen high-priority chemicals through voluntary partnerships with industry. The program's name stems from its goals: a 33% reduction in toxic releases by 1992, and a 50% reduction by 1995, against a baseline of 1.5 billion pounds of releases and transfers in 1988. The results have been impressive: 1,300 companies have joined the 33/50 Program (representing over 6,000 facilities) and have reached the national targets a year ahead of schedule. The 33% goal was reached in 1991, and the 50% goal -- a reduction of 745 million pounds of toxic wastes -- was reached in 1994. The 33/50 Program can provide case studies on many of the corporate accomplishments in reducing waste (Contact 33/50 Program Director David Sarokin -- 202-260-6396).

Table 19 lists those companies participating in the 33/50 program that reported four-digit SIC codes within 332 and 336 to TRI. Some of the companies shown also listed facilities that are not producing metal castings. The number of facilities within each company that are participating in the 33/50 program and that report metal casting SIC codes is shown. Where available and quantfiable against 1988 releases and transfers, each company's 33/50 goals for 1995 and the actual total releases and transfers and percent reduction between 1988 and 1994 are presented.

Fourteen of the seventeen target chemicals were reported to TRI by metal casting facilities in 1994. Of all TRI chemicals released and transferred by the metal casting industry, nickel and nickel compounds, and chromium and chromium compounds (both 33/50 target chemicals), were released and transferred second and third most frequently (behind copper), and were in the top ten largest volume released and transferred. Other frequently reported 33/50 target chemicals were lead and lead compounds, xylenes and toluene.

Table 20 shows that 55 companies comprised of 129 facilities reporting SIC 332 and 336 are participating in the 33/50 program. For those companies shown with more than one metal casting facility, all facilities may not be participating in 33/50. The 33/50 goals shown for companies with multiple metal casting facilities, however, are company-wide, potentially aggregating more than one facility and facilities not carrying out metal casting operations. In addition to company-wide goals, individual facilities within a company may have their own 33/50 goals or may be specifically listed as not participating in the 33/50 program. Since the actual percent reductions shown in the last column apply to all of the companies' metal casting facilities and only metal casting facilities, direct comparisons to those company goals incorporating non-metal casting facilities or excluding certain facilities may not be possible. For information on specific facilities participating in 33/50, contact David Sarokin (202-260-6907) at the 33/50 Program Office.

Table 20: Metal Casting Industry Participation in the 33/50 Program

Parent Company (Headquarters Location)	Company-Owned Metal Casting Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988 to 1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	1994 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	Actual % Reduction for Metal Casting Facilities (1988-1994)
A B & I Incorporated Oakland, CA	1	98	455,570	345,419	24
Allied-Signal Inc Morristown, NJ	1	50	500	0	100
American Cast Iron Pipe Co Birmingham, AL	3	25	761,209	188,769	75
Ampco Metal Mfg. Inc. Milwaukee, WI	2	*	2,500	12,552	-402
Amsted Industries Incorporated - Chicago, IL	9	66	1,066,730	2,174,300	-104
Armco Inc - Pittsburgh, PA	3	4	74,810	16,480	78
Auburn Foundry Inc Auburn, IN	1	99	592,150	465	100
Bloomfield Foundry Inc Bloomfield, IA	1	***	500	520	-4
Burnham Corporation Lancaster, PA	1	95	99,149	700	99
Cast-Fab Technologies Inc Cincinnati, OH	1	54	24,196	50	100
Caterpillar Inc - Peoria, IL	2	60	24,650	265,815	-978
Chrysler Corporation Auburn Hills, MI	2	80	37,082	18,281	51
Columbia Steel Casting Co Portland, OR	1	*	0	16,801	-
Cooper Industries Inc Houston, TX	4	75	100,873	224,830	-123
Dalton Foundries Inc Warsaw, IN	2	75	594,000	106,996	82
Dana Corporation Toledo, OH	1	**	0	8,860	-
Deere & Company Moline, IL	1	*	161,942	8,337	95
Duriron Company Inc Dayton, OH	1	36	49,725	0	100
Electric Steel Castings Co Indianapolis, IN	1	***	0	0	-

R0075911

Parent Company (Headquarters Location)	Company-Owned Metal Casting Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988 to 1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	1994 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	Actual % Reduction for Metal Casting Facilities (1988-1994)
Emerson Electric Co Saint Louis, MO	2	50	0	0	-
Federal-mogul Corporation Southfield, MI	1	50	0	3,455	-
Ford Motor Company Dearborn, MI	1	15	94,478	96,803	-2
Funk Finecast Inc Columbus, OH	1	*	14,290	596	96
General Electric Company Fairfield, CT	1	50	0	195	-
General Motors Corporation Detroit, MI	3	*	676,800	387,813	43
Hartzell Manufacturing Inc Saint Paul, MN	1	85	250	0	100
Hitchiner Manufacturing Co Milford, NH	4	50	91,930	699	99
Hubbell Incorporated Orange, CT	1	***	23,641	0	100
Interlake Corporation Lisle, IL	1	37	8,000	0	100
Jefferson City Mfg Co Inc Jefferson City, MO	1	**	29,500	0	100
Naco Inc - Lisle, IL	7	***	250,920	102,532	59
Navistar Intl Transportation Co - Chicago, IL	2	*	40,500	0	100
Newell Co - Freeport, IL	16	23	1,091,853	149,630	86
Ngk Metals Corp. Temple, PA	1	99	280	2,800	-900
Northern Precision Casting Co - Lake Geneva, WI	1	99	18,583	96	99
Pac Foundries Port Hueneme, CA	1	75	16,950	0	100
Pacific Alloy Castings South Gate, CA	1	**	1,500	2,659	-77
Pechiney Corporation Greenwich, CT	4	***	266,950	24,099	91
PHB Inc - Fairview, PA	1	100	22,292	0	100
Precision Castparts Corp Portland, OR	10	29	584,861	197,377	66
Premark International Inc Deerfield, IL	1	***	0	530	-
Progress Casting Group Inc Minneapolis, MN	1	95	17,412	0	100

R0075912

Parent Company (Headquarters Location)	Company-Owned Metal Casting Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988 to 1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	1994 TRI Releases and Transfers of 33/50 Chemicals (pounds)[2]	Actual % Reduction for Metal Casting Facilities (1988-1994)
Rexcorp U S Inc (Del) Sandwich, IL	1	***	0	274	-
SKF USA Inc King of Prussia, PA	1	***	67,662	0	100
Slyman Industries Inc Medina, OH	1	100	3,858	18,912	-390
Smith Everett Investment Co - Milwaukee, WI	1	89	2,907	1,035	64
Spuncast Inc - Watertown, WI	1	***	0	4	-
SPX Corporation Muskegon, MI	1	2	0	0	-
Sure Cast Inc - Burnet , TX	1	*	0	510	-
Tenneco Inc - Houston , TX	2	8	370,489	0	100
Thyssen Holding Corporation - Troy, MI	3	11	262,300	395,814	-51
Walter Industries Inc Tampa, FL	11	***	1,433,194	536,132	63
Watts Industries Inc North Andover, MA	3	15	97,620	12,070	88
York Mold Inc. Manchester, PA	1	*	500	500	0
Young Corporation Seattle, WA	1	***	0	0	-
TOTAL	129	--	9,535,106	5,323,710	44

Source: U.S. EPA 33/50 Program Office, 1996.

1 Company-Wide Reduction Goals aggregate all company-owned facilities which may include facilities not producing metal castings.

2 Releases and Transfers are from metal casting facilities only.

* = Reduction goal not quantifiable against 1988 TRI data.

** = Use reduction goal only.

*** = No numeric reduction goal.

R0075913

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative developed by EPA that focuses on improving environmental performance, encouraging voluntary compliance, and building working relationships with stakeholders. EPA initiated a one year pilot program in 1995 by selecting 12 projects at industrial facilities and federal installations which would demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, pollution prevention, community involvement, and mentor programs. In return for participating, pilot participants received public recognition and were given a period of time to correct any violations discovered during these experimental projects.

EPA is making plans to launch its full-scale Environmental Leadership Program in 1997. The full-scale program will be facility-based with a 6-year participation cycle. Facilities that meet certain requirements will be eligible to participate, such as having a community outreach/employee involvement programs and an environmental management system (EMS) in place for 2 years. (Contact: http://es.inel.gov/elp or Debby Thomas, ELP Deputy Director, at 202-564-5041)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Fax-on-Demand Hotline 202-260-8590, Web: http://www.epa.gov/ProjectXL, or Christopher Knopes at EPA's Office of Policy, Planning and Evaluation 202-260-9298)

Climate Wise Program

Climate Wise is helping US industries turn energy efficiency and pollution prevention into a corporate asset. Supported by the technical assistance, financing information and public recognition that Climate Wise offers, participating companies are developing and launching comprehensive industrial energy efficiency and pollution prevention action plans that save money and protect the environment. The nearly 300 Climate Wise companies expect to save more than $300 million and reduce greenhouse gas emissions by 18 million metric tons of carbon dioxide equivalent by the year 2000. Some of the actions companies are undertaking to achieve these results include: process improvements, boiler and steam system optimization, air compressor system improvements, fuel switching, and waste heat recovery measures including cogeneration. Created as part of the President's Climate Change Action Plan, Climate Wise is jointly operated by the Department of Energy and EPA. Under the Plan many other programs were also launched or upgraded including Green Lights, WasteWi$e and DoE's Motor Challenge Program. Climate Wise provides an umbrella for these programs which encourage company participation by providing information on the range of partnership opportunities available. (Contact: Pamela Herman, EPA, 202-260-4407 or Jan Vernet, DoE, 202-586-4755)

Energy Star Buildings Program

EPA's ENERGY STAR Buildings Program is a voluntary, profit-based program designed to improve the energy-efficiency in commercial and industrial buildings. Expanding the successful Green Lights Program, ENERGY STAR Buildings was launched in 1995. This program relies on a 5-stage strategy designed to maximize energy savings thereby lowering energy bills, improving occupant comfort, and preventing pollution -- all at the same time. If implemented in every commercial and industrial building in the United States, ENERGY STAR Buildings could cut the nation's energy bill by up to $25 billion and prevent up to 35% of carbon dioxide emissions. (This is equivalent to taking 60 million cars of the road). ENERGY STAR Buildings participants include corporations; small and medium sized businesses; local, federal and state governments; non-profit groups; schools; universities; and health care facilities. EPA provides technical and non-technical support including software, workshops, manuals, communication tools, and an information hotline. EPA's Office of Air and Radiation manages the operation of the ENERGY STAR Buildings Program. (Contact: Green Light/Energy Star Hotline at 1-888-STAR-YES or Maria Tikoff Vargas, EPA Program Director at 202-233-9178 or visit the ENERGY STAR Buildings Program website at http://www.epa.gov/appdstar/buildings/)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program saves money for businesses and organizations and creates a cleaner environment by reducing pollutants released into the atmosphere. The program has over 2,345 participants which include major corporations, small and medium sized businesses, federal, state and local governments, non-profit groups, schools, universities, and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. As of March 1997, participants had lowered their electric bills by $289 million annually. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and an information hotline. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Green Light/Energy Star Hotline at 1-888-STARYES or Maria Tikoff Vargar, EPA Program Director, at 202-233-9178)

WasteWiSe Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1997, the program had about 500 companies as members, one third of whom are Fortune 1000 corporations. Members agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports. To member companies, EPA, in turn, provides technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at 1-800-372-9473 or Joanne Oxley, EPA Program Manager, 703-308-0199)

NICE^3

The U.S. Department of Energy is administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 45 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, and demonstrate new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the forest products, chemicals, petroleum refining, steel, aluminum, metal casting and glass manufacturing sectors. (Contact: http//www.oit.doe.gov/access/nice3, Chris Sifri, DOE, 303-275-4723 or Eric Hass, DOE, 303-275-4728)

Design for the Environment (DfE)

DfE is working with several industries to identify cost-effective pollution prevention strategies that reduce risks to workers and the environment. DfE helps businesses compare and evaluate the performance, cost, pollution prevention benefits, and human health and environmental risks associated with existing and alternative technologies. The goal of these projects is to encourage businesses to consider and use cleaner products, processes, and technologies. For more information about the DfE Program, call (202) 260-1678. To obtain copies of DfE materials or for general information about DfE, contact EPA's Pollution Prevention Information Clearinghouse at (202) 260-1023 or visit the DfE Website at http://es.inel.gov/dfe.

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Industry Research Programs

American Metalcasting Consortium (AMC)

The American Metalcasting Consortium (AMC) is a group of six organizations from the metalcasting industry that have joined together to ally the thousands of small and medium sized metalcasters within the market in an effort to re-establish American viability in the metalcasting industry. AMC aims to energize critical facets of the industry which stimulate lead time and cost reductions, quality, and market share/growth. These goals are being implemented through efforts focused on projects in the areas of 1) applied research and development, 2) education, training, and technology transfer, 3) small business, and 4) casting applications development. Many of the projects will result in positive environmental impacts by improving the industry's overall energy efficiency and reducing the quantity of wastes and off-spec castings. The AMC organizations are: The American Foundrymen's Society (AFS); Non-Ferrous Founders' Society (NFFS); North American Die Casting Association (NADCA); and the Steel Founders' Society of America (SFSA).

Cast Metals Coalition (CMC)

In 1995, Chief Executive Officers and Presidents from the foundry, diecasting, and foundry supply industries developed goals for the future of the industry in *Beyond 2000: A Vision for the American Metalcasting Industry*. Representatives from the American Foundrymen's Society, the Steel Founders' Society of America, and the North American Die Casters Association formed the Cast Metals Coalition (CMC). The CMC is working

R0075917

towards developing a technology roadmap for pursuing and achieving these goals. CMC is working with industry and research institutions, including universities and national laboratories to develop this roadmap.

Pennsylvania Foundry Consortia

A consortia of Pennsylvania foundries, the Pennsylvania Foundrymen's Association and Penn State University have been working cooperatively since 1985 on issues associated with solid waste disposal, sand reclamation, and beneficial use of foundry residuals. This group is addressing the impediments to beneficial use of foundry residuals on a comprehensive national level. The goals of the research are to maximize the beneficial reuse of environmentally safe foundry residuals and to streamline the path for their acceptability by other industries. Specific tasks carried out involve establishing a database of technical and environmental information to support reuse applications, developing and administering a comprehensive survey of potential aggregate users, and performing physical and environmental testing to demonstrate the applicability of residual wastes for reuse applications. The program receives funding from a U.S. EPA grant.

VIII.C.2. Trade Associations

American Foundrymen's Society, Inc.
(AFS)
505 State Street
Des Plaines, IL 60016-8399
Phone: (800) 537-4237
Fax: (847) 824-7848

Members: 12,800
Staff: 60
Contact: Gary Mosher,
Vice President, Environmental Health and Safety

The American Foundrymen's Society (AFS) is the primary trade association for the foundry industry. Founded in 1896, the Society has student and local groups throughout the U.S. and internationally. AFS is the technical, trade, and management association of foundrymen, pattern makers, technologists, and educators. The society sponsors foundry training courses through the Cast Metals Institute on all subjects pertaining to the casting industry and sponsors numerous regional and local conferences and meetings. AFS maintains an extensive Technical Information Center, conducts research programs, compiles statistics, and provides marketing information. environmental services, and testing. The monthly trade magazine, *Modern Casting*, covers current technology practices and other factors affecting the production and marketing of metal castings.

North American Die Casting Association
(NADCA)
9701 W. Higgins Rd., Ste. 880
Rosemont, IL 60018
Phone: 847-292-3600
Fax: 847-292-3620

Members: 3,200
Staff: 17
Contact: Dan Twarog

The North American Die Casting Association (NADCA) was founded in 1989 and is made up of producers of die castings and suppliers to industry, product and die designers, metallurgists, and students. There are regional and local groups across the U.S. NADCA develops product standards; compiles trade statistics on metal consumption trends; conducts promotional activities; and provides information on chemistry, mechanics, engineering, and other arts and sciences related to die casting. The association also maintains a library and provides training materials and short, intensive courses in die casting. A trade magazine, *Die Casting Engineer*, is published periodically and contains information on new products and literature, chapter news, and a calendar of events.

Non-Ferrous Founders' Society
455 State St., Suite 100
Des Plaines, IL 60016
Phone: 847-299-0950
Fax: 847-299-3598

Members: 185
Staff: 2
Contact: Jim Mallory or Mark Remlinger, Chair of Environment Committee

The Non-Ferrous Founders' Society (NFFS) is comprised of manufacturers of brass, bronze, aluminum, and other nonferrous castings. Founded in 1943, NFFS conducts research programs and compiles statistics related to the nonferrous castings industry. The Society has committees related to: export government relations; insurance; local management group; management conferences; planning; quality; and technical research. NFFS publishes *The Crucible* bimonthly. This trade magazine contains articles relevant to the day-to-day management of aluminum, brass, bronze, and other nonferrous foundries. NFFS also publishes a biennial *Directory of Nonferrous Foundries* listing member and nonmember foundries producing primarily aluminum, brass, and bronze castings.

Steel Founders' Society of America (SFSA)
Cast Metals Fed. Bldg.
455 State St.
Des Plaines, IL 60016
Phone: 847-299-9160
Fax: 847-299-3105

Members: 75
Staff: 6
Contact: Raymond Monroe

The Steel Founders Society of America (SFSA) is comprised of manufacturers of steel castings. Founded in 1902, the Society conducts research programs and compiles statistics related to the steel casting industry. SFSA periodically publishes *CASTEEL* which contains special articles on specifications and technical aspects of steel castings. SFSA also publishes a biennial *Directory of Steel Foundries* listing steel foundries in the U.S., Canada, and Mexico. Committees include Marketing, Specifications, and Technical Research.

Investment Casting Institute
8350 N. Central Expressway
Suite M 1110
Dallas, TX 75206
Phone: 214-368-8896
Fax: 214-368-8852

Members: 275
Staff: 5
Contact: Henry Bidwell

The Investment Casting Institute is an international trade association comprised of manufacturers of precision castings for industrial use made by the investment (or lost wax) process and suppliers to such manufacturers. The Institute provides training courses and other specialized education programs and publishes the monthly newsletter *Incast*.

Casting Industry Suppliers Association (CISA)
455 State St., Suite 104
Des Plaines, IL 60016
Phone: 708-824-7878
Fax: 708-824-7908

Members: 66
Staff: 1
Contact: Darla Boudjenah

The Casting Industry Suppliers Association (CISA) was founded in 1986 and represents manufacturers of foundry equipment and supplies such as molding machinery, dust control equipment and systems, blast cleaning machines, tumbling equipment, and related products. CISA also aims to foster better trade practices and serve as an industry representative before the government and the public. The Association also compiles industry statistics and disseminates reports of progress in new processes and methods in foundry operation.

The Ferroalloys Association (TFA)
900 2nd St. NE, Suite 201
Washington, DC 20002
Phone: 202-842-0292
Fax: 202-842-4840

Members: 21
Staff: 3
Contact: Edward Kinghorn Jr.

The purpose of The Ferroalloys Association's (TFA) is to promote the general welfare of the producers of chromium, manganese, silicon, vanadium ferroalloys and related basic alloys/metals in the United States and to engage in all lawful activities to that end. Founded in 1971, TFA consistently provides the ferroalloy industry a means to accomplish tasks through a common bond of business interests.

The ferroalloy industry produces high strength metals created by submerged electric arc smelting, induction melting, alumino/silicothermic reduction processes, and vacuum reduction furnaces, as well as by electrolytic processes. More than 50 different alloys and metals in hundreds of compositions and sizes are produced by the ferroalloy industry for use in the manufacturing of stainless steel, iron, and aluminum. The industry also produces vital materials used in the production of chemicals, semi-conductors, solar cells, coatings, and catalysts.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the metal casting industry a list of contacts and publications are provided below.

Contacts[5]

Name	Organization	Telephone	Subject
Jane Engert	EPA/OECA (Office of Enforcement and Compliance Assurance)	202-564-5021	Compliance assistance
James Maysilles	EPA/OAR (Office of Air and Radiation)	919-541-3265	Regulatory requirements (air)
Mary Cunningham	EPA/OSW (Office of Solid Waste)	703-308-8453	Regulatory requirements (RCRA)
Larry Gonzales	EPA/OSW (Office of Solid Waste)	703-308-8468	Regulatory requirements (RCRA) and waste sand treatment
George Jett	EPA/OW (Office of Water), Office of Science and Technology	202-260-7151	Regulatory requirements (water)
Doug Kaempf	DOE (Department of Energy)	202-586-5264	Energy efficiency and technology trends
Bill Walden	Casting Emissions Reduction Program (McClellan AFB, CA)	916-643-1090	Air emissions and casting technologies
Joel Dougherty	EPA/Region VI	214-665-8323	Regulatory requirements pollution prevention
David Byro	EPA/Region III	215-566-5563	Pollution prevention
Dave Dillon	Oklahoma Department of Environmental Quality	405-271-1400	Industrial processes and pollution prevention
Gary Mosher	American Foundrymen's Society Vice President Environmental Health and Safety	800-537-4237	Environment and pollution prevention
Ted Kinghorn Megan Medley	Non-Ferrous Founders' Society	202-842-0219	Regulatory issues
Dan Twarog Tricia Margel	North American Die Casting Association	847-292-3600	Regulatory issues and pollution prevention
Raymond Monroe	Steel Founders Society of America	847-299-9160	Regulatory issues
Bob Voigt	Pennsylvania State University	814-863-7290	Industrial processes

[5] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

R0075922

Section II: Introduction to the Metal Casting Industry

LaRue, James P., Ed.D., *Basic Metal Casting*, American Foundrymen's Society, Des Plaines, IL, 1989.

U.S. Industrial Outlook 1994, U.S. Department of Commerce, International Trade Administration, 1995.

1992 Census of Manufacturers Industry Series: Ferrous and Nonferrous Foundries, Department of Commerce, Bureau of the Census, 1996.

Trends Effecting [sic] *R&D in the Metalcasting Industry*, U.S. Department of Energy, Office of Industrial Technologies, Washington, D.C., March 1996.

Kirgin, Kenneth H., *1990s Provide Stability for Ferrous Foundries, Part 1*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 86 no. 8, August 1995. pp35-37.

Beyond 2000: A Vision for the American Metalcasting Industry, Cast Metals Coalition, September, 1995.

Walden, William C., *Casting Emissions Reduction Program (CERP) Primer*, U.S. Department of Defense, September, 1995.

Rost, John E., *Rebound in Casting Markets Bodes Well for U.S. Foundries*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 82 no. 1, January 1992. pp29-31.

Loper, Carl R. Jr., *Foundry Practice and Equipment*, Mark's Standard Handbook for Mechanical Engineers, 8th ed., McGraw Hill, 1985. pp. 13-2 - 13-9.

Kunsman, C.D., and Carlson, C.C., *NonFerrous Metals*, Mark's Standard Handbook for Mechanical Engineers, 8th ed., McGraw Hill, 1985. pp. 6-59 - 6-89.

Kirgin, Kenneth H., *Slowing Economy Lowers Casting Demand*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 85 no. 6, June 1994. p70.

Kirgin, Kenneth H., *Forecast Remains Bullish for '95*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 85 no. 3, March 1995. p51.

Kirgin, Kenneth H., *Continued Slowdown in '96 Could Lower Casting Shipments 7%*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 85 no. 9, September 1995. p54.

Section III: Industrial Process Description

LaRue, James P., Ed.D., *Basic Metal Casting*, American Foundrymen's Society, Des Plaines, IL. 1981.

Metal Casting and Molding Processes, ed. Kotzin, Ezra L., American Foundrymen's Society, Des Plaines, IL, 1981.

Kotzin, Ezra L., *Steel Foundries: Air Pollution Engineering Manual*, ed. Buonicore, Anthony J. and Davis, Wayne T., Air and Waste Management Association, Van Nostrand Reinhold, New York. 1992. pp. 733-738.

Scott, Bruce, *Sulfur: Air Pollution Engineering Manual*, ed. Buonicore, Anthony J. and Davis, Wayne T., Air and Waste Management Association, Van Nostrand Reinhold, New York, 1992. pp. 476-477.

Licht, Charles A., *Secondary Brass and Bronze Melting Processes: Air Pollution Engineering Manual*, ed. Buonicore, Anthony J. and Davis, Wayne T., Air and Waste Management Association, Van Nostrand Reinhold, New York, 1992. pp. 733-738.

Leidel, Dieter S., *Pollution Prevention and Foundries*, from Industrial Pollution Prevention Handbook, ed. Freeman, Harry M., McGraw-Hill, Inc., New York, 1995. pp. 667-684.

Profile of the Fabricated Metal Products Industry, Sector Notebook Project, U.S. EPA Office of Compliance, Washington D.C., September 1995. (EPA-310-R-95-007)

Pretreatment of Industrial Wastes, Manual of Practice No. FD-3, Water Environment Federation. Alexandria, Virginia, 1994.

American Foundrymen's Society Air Quality Committee, *Iron Foundries: Air Pollution Engineering Manual*, ed. Buonicore, Anthony J. and Davis, Wayne T., Air and Waste Management Association, Van Nostrand Reinhold, New York, 1992. pp. 719-723.

Summary of Factors Affecting Compliance by Ferrous Foundries, Volume I - Text, Final Report, U.S. EPA, Office of General Enforcement, Washington D.C., January 1981. (EPA-340/1-80-020)

Allsop, D. F., and Kennedy, D., *Pressure Diecasting*, Pergamon Press, Oxford, 1983.

Kaye, Alan, and Street, Arthur, *Die Casting Metallurgy*, Butterworth Scientific, London, 1982.

Street, Arthur, *The Diecasting Book*, Portcullis Press Ltd., Surrey, U.K., 1977.

Form R Reporting of Binder Chemicals Used in Foundries, American Foundrymen's Society, Des Plaines, IL, and Casting Industry Suppliers Association, Worthington. OH, 1992.

Competitive Assessment of the U.S. Foundry Industry, U.S. International Trade Commission, Washington, D.C., 1984. (USITC Publication 1582)

Twarog, Daniel L., and University of Alabama, *Waste Management Study of Foundries Major Waste Streams: Phase I*, Hazardous Waste Research and Information Center, Champaign, IL, January 1993. (HWRIC TR-011)

McKinley, Marvin D., et al., *Waste Management Study of Foundries Major Waste Streams: Phase II*, Hazardous Waste Research and Information Center, Champaign, IL, April 1994. (HWRIC TR-016)

AP-42 Sections 7.13: Steel Foundries and 7.10: Gray Iron Foundries, U.S. EPA Office of Air and Radiation, October 1986.

Section IV: Chemical Release and Transfer Profile

1994 Toxics Release Inventory Public Data Release, U.S. EPA Office of Pollution Prevention and Toxics, June 1996. (EPA 745-R-96-002)

Section V: Pollution Prevention Opportunities

Guides to Pollution Prevention, The Metal Casting and Heat Treating Industry, U.S. EPA, Office of Research and Development, Cincinnati, OH, September 1992. (EPA/625/R-92/009)

Foundry Sand Beneficial Reuse Manual, Special Report, ed. Thomas, Susan P., American Foundrymen's Society, Des Plaines, IL, 1996.

Philbin, Matthew L., *Sand Reclamation Equipment Users Answer the Questions*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 86 no. 8, August 1996. pp22-26.

Leidel, Dieter S., *Pollution Prevention and Foundries*, from Industrial Pollution Prevention Handbook, ed. Freeman, Harry M., McGraw-Hill, Inc., New York, 1995. pp. 667-684.

Pollution Prevention Practices for the Die Casting Industry, North American Die Casting Association, Rosemont, IL, 1996.

Personal Correspondence with Ms. Suzanne Simoni, Pennsylvania Department of Environmental Protection, Office of Pollution Prevention and Compliance Assistance, Conshohocken, PA, November 1996.

U.S. EPA EnviroSenSe website, http://www.portfolio/epa/environet/ncpd/auscase_ studies /mason.html, 1996.

Twarog, Daniel L., and University of Alabama, *Waste Management Study of Foundries Major Waste Streams: Phase I*, Hazardous Waste Research and Information Center, Champaign, IL, January 1993. (HWRIC TR-011)

McKinley, Marvin D., et al., *Waste Management Study of Foundries Major Waste Streams: Phase II*, Hazardous Waste Research and Information Center, Champaign, IL, April 1994. (HWRIC TR-016)

Archer, Hugh V., et al., *Foundry Calculates the Value of Pollution Prevention*, Water Environment and Technology, vol. 6, no. 6, June, 1994.

Estes, John M., *Energy Cutting Can Give Foundries Real Savings*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 84, no. 11, November 1994.

Binczewski, George J., *Aluminum Casting and Energy Conservation*, Light Metal Age, vol. 51, no. 11-12, December 1993.

Profile of the Iron and Steel Industry, U.S. EPA Office of Compliance, Washington D.C., 1995.

Section VI: Summary of Applicable Federal Statutes and Regulations

Transactions of the American Foundrymen's Society, Proceedings of the Ninety-Ninth Annual Meeting, April 23-26, 1995, American Foundrymen's Society, Des Plaines, IL, vol.103.

Lessiter, Michael J., *Foundries Prepare for Clean Air Act's Title V Showdown*, Modern Casting, American Foundrymen's Society, Des Plaines, IL, November 1994. pp. 58-59.

Title V Air Operating Permits: What They Mean for Foundries, Modern Casting, American Foundrymen's Society, Des Plaines, IL, vol. 85, no. 1, February 1995. pp. 52-53.

Kwan, Quon Y., and Kaempf, Douglas E., *Environmental Compliance in Metalcasting, Part 1*, Foundry Management and Technology, pg. 42, October 1995.

Kwan, Quon Y., and CEMF, Douglas E., *Environmental Compliance in Metalcasting, Part 2*, Foundry Management and Technology, pg. 39, November 1995.

Breen, Barry, and Campbell-Mohn, Celia, *Sustainable Environmental Law, Chapter 16: Metals*, Environmental Law Institute, West Publishing Co., St. Paul, MN, 1993.

Section VIII: Compliance Activities and Initiatives

American Metalcasting Consortium, http://www.scra.org/amc/, 1996.

U.S. EPA Enviroene website, http://www.portfolio/epa/environet/ncpd/auscase_studies/mason.html, 1996.

Beyond 2000: A Vision for the American Metalcasting Industry, Cast Metals Coalition, September, 1995.

Personal Correspondence with Mr. David Byro, U.S. EPA, Region III, Philadelphia, PA, June 1996.

Personal Correspondence with Joel Dougherty, Ph.D., U.S. EPA, Region 6, Hazardous Waste Enforcement Branch, Dallas, TX, October 1996.

Personal Correspondence with Mr. Bill Walden, U.S. Department of Defense, McClellan AFB, CA, June 1996.

Personal Correspondence with Ms. Kathy Martin, Oklahoma Department of Environmental Quality, Oklahoma City, OK, September 1996.

Personal Correspondence with Ms. Suzanne Simoni, Pennsylvania Department of Environmental Protection, Office of Pollution Prevention and Compliance Assistance, Conshohocken, PA, November 1996.

Personal Correspondence with Mr. Douglas Kaempf, U.S. Department of Energy, Industries of the Future, Washington, D.C., July 1996.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.epa.gov/comply/sector/index.html

or use

www.epa.gov/oeca - then select the button labeled Industry and Gov't Sectors and select the appropriate sector from the menu. The Notebook will be listed.

Direct technical questions to the Feedback function at the bottom of the web page or to Shhonn Taylor at (202) 564-2502

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States Environmental Protection Agency

Enforcement And Compliance Assurance (2221A)

EPA 310-R-95-007
September 1995

EPA

Profile Of The Fabricated Metal Products Industry

EPA Office Of Compliance Sector Notebook Project

SECTOR EPA NOTEBOOKS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-007

EPA Office of Compliance Sector Notebook Project

Profile of the Fabricated Metal Products Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048274-7

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, U.S. EPA. Photograph courtesy of Mid-Atlantic Finishing, Capitol Heights, Maryland.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

FABRICATED METAL PRODUCTS (SIC 34) TABLE OF CONTENTS

FABRICATED METAL PRODUCTS
(SIC 34)
TABLE OF CONTENTS (CONT'D)

FABRICATED METAL PRODUCTS
(SIC 34)
TABLE OF CONTENTS (CONT'D)

Page

FABRICATED METAL PRODUCTS
(SIC 34)
EXHIBIT INDEX

FABRICATED METAL PRODUCTS
(SIC 34)
EXHIBIT INDEX (CONT'D)

R0075939

FABRICATED METAL PRODUCTS (SIC 34) LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation
NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)

FABRICATED METAL PRODUCTS
(SIC 34)
LIST OF ACRONYMS (CONT'D)

NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)
OAR - Office of Air and Radiation
OECA - Office of Enforcement and Compliance Assurance
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
TOC - Total Organic Carbon
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TCRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

FABRICATED METAL PRODUCTS (SIC 34)

I. INTRODUCTION OF THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a

manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE FABRICATED METAL PRODUCTS INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Fabricated Metal Products industry. The types of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The fabricated metal products industry comprises facilities that generally perform two functions: forming metal shapes and performing metal finishing operations, including surface preparation. The Standard Industrial Classification (SIC) code 34 is composed of establishments that fabricate ferrous and nonferrous metal products and those that perform electroplating, plating, polishing, anodizing, coloring, and coating operations on metals. Since the main processes associated with this industry can be divided into three types of operations (i.e., metal fabrication, metal preparation, and metal finishing), this profile is organized by the techniques that fall within these three groups.

II.B. Characterization of the Fabricated Metal Products Industry

To provide a general understanding of this industry, information pertaining to the industry size and distribution, product characterization, and economic health and outlook is presented below. This information should provide a basic understanding of the facilities developing the products, the products themselves, and the economic condition of the industry.

II.B.1. <u>Industry Size and Geographic Distribution</u>

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

The U.S. fabricated metal products industry comprises approximately 34,000 companies. Exhibit 1 lists the largest companies in selected metal fabricating industries. Companies are ranked by sales figures.

Exhibit 1
Metal Fabrication Companies

Company	Sales ($ Millions)	Number of Employees
SIC 3444 -- Sheet Metal Work		
Stolle Corp., Sidnev, OH	480	4,600
Alcan Alum. Corp., Warren, OH	120	1,200
Nytronics, Inc., Pitman, NJ	110	2,000
Hart and Cooley Inc., Holland, MI	100	1,200
Syro Steel Co., Girard, OH	100	400
Consolidated Systems, Inc., Columbia, SC	100	300
SIC 3465 -- Automotive Stampings		
Budd Co., Troy, MI	1,000	9,000
Douglas and Lomason Co., Farmington Hts., MI	391	5,800
Northern Engraving Corp., Sparta, WI	280	3,000
Randall Textron Inc., Cincinnati, OH	210	2,000
SIC 3469 -- Metal Stampings		
Hexcel Corp., Pleasanton, CA	386	2,900
JSJ Corp., Grand Haven, MI	260	2,500
Mirro-Folev Co., Manitowoc, WI	210	2,000
Tempel Steel Co., Niles, IL	210	1,100
SIC 3499 -- Fabricated Metal Products		
Steel Technologies, Louisville, KY	155	500
R.D. Werner Companv, Inc., Greenville, PA	150	1,600
BW/IP Int., Inc., Seal Div., Long Beach, CA	104	400
LeFebure Corp., Cedar Rapids, IA	100	1,100
Dura Mech. Components, Inc., Troy, MI	100	1,000

Source: Fabricators & Manufacturers Association, Intl.

Exhibits 2 and 3 show the distribution of employees and the total shipments for the metal finishing industry. A typical "job shop" (i.e., small, independently owned metal finishing company) employs 15 to 20 people and generates $800,000 to $1 million in annual gross revenues.

Exhibit 2
Number of Employees in Metal Finishing Industry

	1988	1989	1990	1991	1992
SIC 3471	76,300	76,600	73,200	66,600	65,400
SIC 3479	47,000	44,600	44,300	43,400	43,700
Total	123,300	121,200	117,500	110,000	109,100

Source: U.S. Department of Commerce, 1992 Census of Manufacturers.

Exhibit 3
Value of Shipments for Metal Finishing Establishments ($ Millions)

	1988	1989	1990	1991	1992
SIC 3471	4,324	4,452	4,513	4,124	4,726
SIC 3479	4,867	4,756	4,929	4,634	5,161
Total	9,191	9,208	9,442	8,758	9,887

Source: U.S. Department of Commerce, 1992 Census of Manufacturers.

Exhibits 4 and 5 list the largest companies in selected metal finishing industries. Companies are ranked by sales figures.

Exhibit 4
Inorganic Coating Job Shops

Company	Sales ($ Millions)	Number of Employees
Windsor Plastics, Evansville, IN	50	600
Crown City Plating, El Monte, CA	25	425
Pioneer Metal Finishing, Minneapolis, MN	20-30	380
Metal Surfaces, Bell Gardens, CA	15-25	310
Victory Finishing Technologies, Inc., Providence, RI	15-25	245
State Plating, Inc., Elwood, IN	15-20	400

Source: "Large Plating Job Shops," Beverly A. Greaves, Products Finishing, April 1994.

Exhibit 5
Organic Coating Job Shops

Company	Sales ($ Millions)	Number of Employees
Metokote Corp., Lima, OH	25+	800
The Crown Group, Warren, MI	25+	659
Industrial Powder Coatings, Inc., Norwalk, OH	25+	620
PreFinish Metals, Chicago, IL	25+	600
E/M Corp., West Lafayette, IN	15-25	300
Chicago Finished Metals, Bridgeview, IL	25+	250
Linetec Co., Wausau, WI	10-15	200
B.L. Downey Co., Inc., Broadview, IL	10-15	175

Source: "Large Coating Job Shops," Beverly A. Greaves, Products Finishing, December 1994.

Between 1982 and 1987, the total number of independent metal finishers employing less than 20 employees declined slightly, while those employing more than 20 employees increased by a corresponding amount. Exhibit 6 shows the number and percent of metal finishers of various sizes.

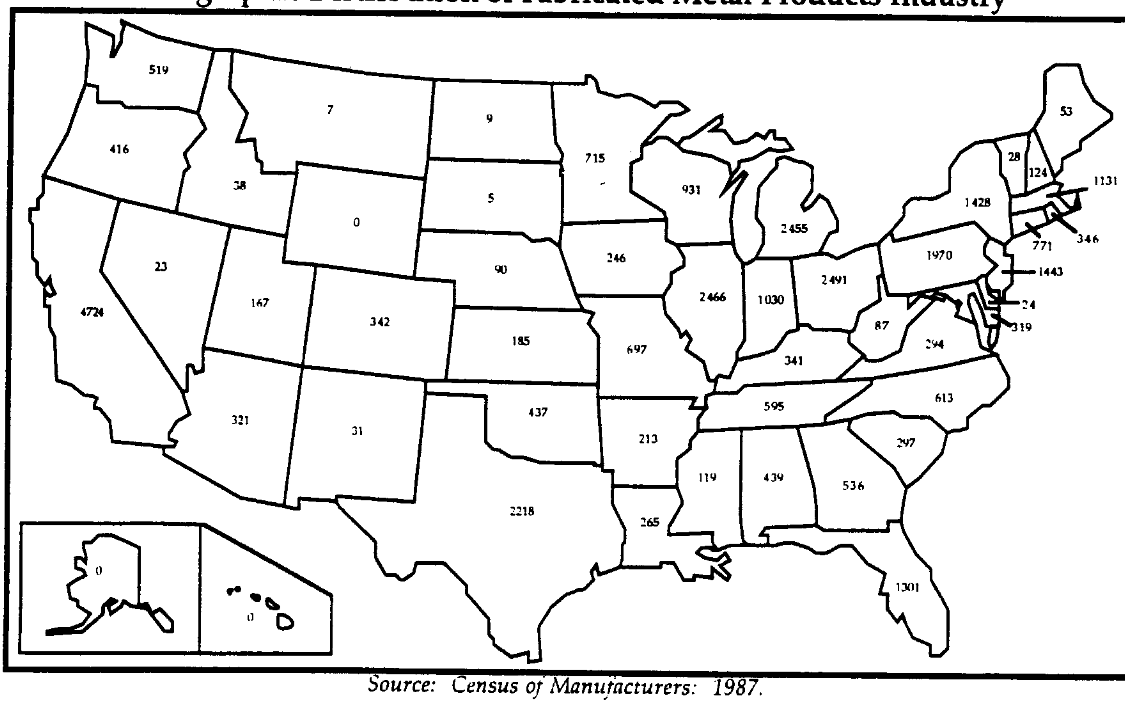
Exhibit 6
Metal Finishing Establishments, by Size

	1987		1992	
Establishments With and Average of :	**Number of Companies**	**Percent Total**	**Number of Companies**	**Percent Total**
1 to 9 Employees	2481	47.1	2553	48.7
10 to 49 Employees	2262	43.0	2186	41.7
50 to 99 Employees	365+	6.9	381	6.8
100 to 249 Employees	137	2.6	356	2.4
250 or more Employees	20	0.4	127	0.4
Total	**5265**	**100.0**	**5603**	**100.0**

Source: Census of Manufacturers: 1992, U. S. Department of Commerce, Bureau of the Census.

Although the metal finishing industry is geographically diverse, the industry is concentrated in what are usually considered the most heavily industrialized regions in the United States (See Exhibit 7). This geographic concentration occurs in part because it is cost-effective for small metal finishing facilities to be located near their customer base.

Exhibit 7
Geographic Distribution of Fabricated Metal Products Industry



Source: Census of Manufacturers: 1987.

California has more establishments that produce metal-related products than any other State. California's establishments

R0075948

constitute 10.2 percent of the total establishments that produce fabricated structural metal (SIC 3441). In addition, California leads in the number of establishments of other related industries: 15.6 percent of the sheet metal work establishments (SIC 3444); 13 percent of the metal doors, sash, and trim establishments (SIC 3442); and 13.7 percent of the architectural metal work establishments (SIC 3446). California also has the majority of plating and polishing (SIC 3471) and metal coating and allied services (SIC 3479) establishments at 17.3 and 16.1 percent, respectively.

Michigan, Illinois, and Ohio have large numbers of various metal-related industries. Michigan has the largest number of companies in the screw machine products (SIC 3451) and automotive stampings (SIC 3465) industries, at 14 and 46.7 percent of the total companies in the United States, respectively. Illinois is home to 14.1 percent of companies that produce bolts, nuts, rivets, and washers (SIC 3452) and Ohio contains 12.6 percent of companies that produce iron and steel forgings (SIC 3462).

Establishments engaged primarily in metal finishing tend to be small, independently owned job shops, also are referred to as independent metal finishers. Establishments that conduct metal finishing operations as part of a larger manufacturing operation are referred to as "captive" metal finishers. Captive metal finishing facilities are approximately three times more numerous than independent metal finishers. Numerous similarities exist between the independent and captive facilities; for the purposes of this profile, they are considered part of one industry. In addition, the two segments have parallel ties with suppliers and customers. Captive operations may be more specialized in their operations, however, because they often work on a limited number of products and/or employ a limited number of processes. Independent metal finishers, on the other hand, tend to be less specialized in their operations because they may have many customers, often with different requirements.

II.B.2. Product Characterization

The Department of Commerce classification codes divide this industry by product and services. SIC code 34 is further divided as follows:

- SIC 341 - Metal Cans and Shipping Containers
- SIC 342 - Cutlery, Handtools, and General Hardware
- SIC 343 - Heating Equipment, Except Electric and Warm Air, and Plumbing Fixtures
- SIC 344 - Fabricated Structural Metal Products
- SIC 345 - Screw Machine Products, and Bolts, Nuts, Screws, Rivets, and Washers
- SIC 346 - Metal Forgings and Stampings
- SIC 347 - Coating, Engraving, and Allied Services
- SIC 348 - Ordnance and Accessories, Except Vehicles and Guided Missiles
- SIC 349 - Miscellaneous Fabricated Metal Products.

II.B.3. Economic Trends

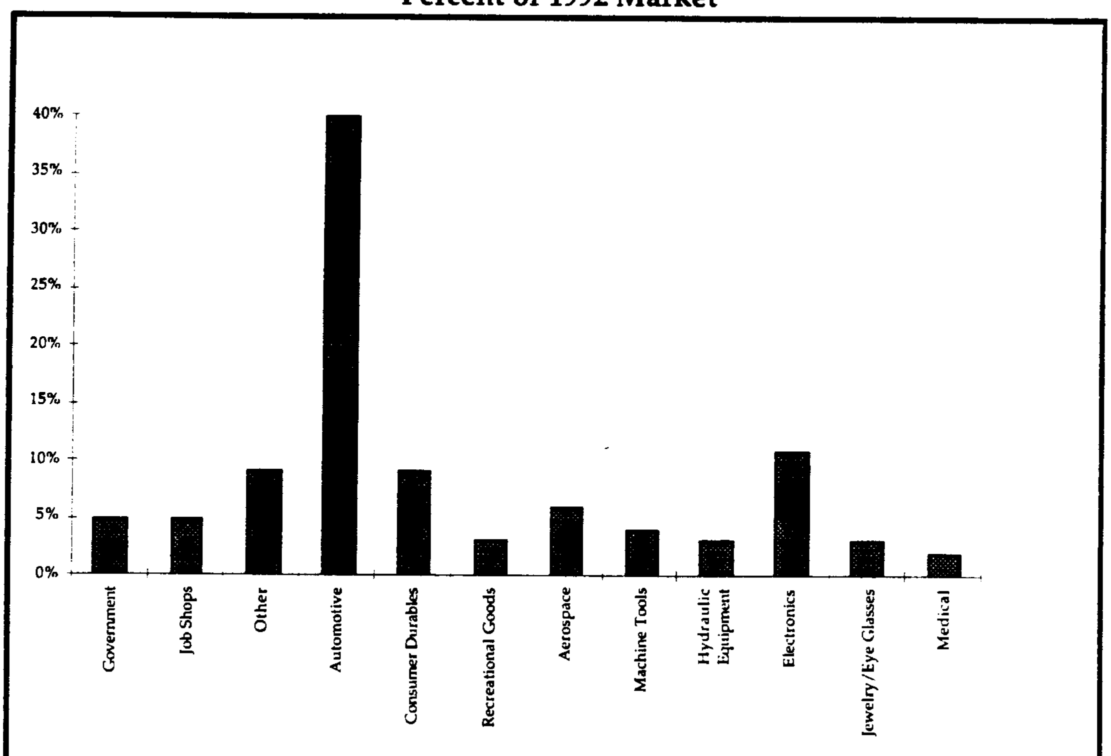
Most industries in SIC 34 are largely dependent upon the demands of other industries. For example, the success of the commercial construction industry is fundamental to the success of the fabricated structural metal industry; 95 percent of the output from the latter is consumed by the former. The general component-producing industries (e.g., screw machine products, industrial fasteners, etc.) display the same demand structure; the demand for such products is directly related to the demand for automobiles and public works construction.

Fabricated structural metal output declined two percent in 1993 due to a decrease in construction of office buildings, commercial structures, manufacturing facilities, and multi-family housing. Ninety-five percent of structural metal output is consumed by the construction industry. Low demand for structural metal is expected to continue, attributable to the recent overbuilding of commercial space and high levels of vacant office space. A slight increase in demand from the public sector (e.g., highway construction) is expected, however, which will positively influence demand for structural metal products. An increased demand for plumbing products is also likely, as the residential construction industry continues to grow.

Total shipments of general components (e.g., screw machine products, industrial fasteners, valves, and pipe fittings) increased by about 3.1 percent in 1993. Strong demand from the automotive sector, combined with increased demand from equipment and machinery manufacturers, were the major factors causing the increased shipments.

The two primary markets for metal finishing services are the automotive and electronics industries. As illustrated in Exhibit 8, consumer durables, aerospace, and the government also are large segments served by metal finishers.

Exhibit 8
Markets Served by Metal Finishers
Percent of 1992 Market



Source: Surface Finishing Market Research Board, Metal Finishing Industry Market Survey 1992-1993.
NOTE: Data includes both job and captive shops.

The sale of metal finishing services is also essentially a derived demand (i.e., sales depend entirely upon the production of other industries). However, sales by the metal finishing industry have not kept up with sales of the industries served.

R0075951

In the last several years, many U.S. fastener (nuts, screws, bolts, rivets) companies have become more competitive in the global market by incorporating new technology into production lines to improve efficiency and quality. In 1993, U.S. exports of industrial fasteners edged up about 0.6 percent; Canada and Mexico were the largest importers. U.S. imports of industrial fasteners also increased 11 percent over the last several years. This is because demand in the U.S. out-paced production. The expansion of the U.S. automotive and residential construction sectors was a major factor in the increase in fastener imports.

Exports of U.S. valve and pipe fittings are also expected to grow. 1993 industry exports increased six percent compared with 1992 figures. Although Canada remains the principal foreign market, exports to Chile and the Philippines almost tripled, and exports to developing countries increased dramatically.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the Fabricated Metal Products industry, including the materials and equipment used and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile: pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

Specifically, this section contains a description of commonly used production processes, the associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Fabricated Metal Products Industry

In view of the high cost of most new equipment and the relatively long lead time necessary to bring new equipment into operation, changes in production methods and products are made only gradually; even new process technologies that fundamentally change the industry are only adopted over long periods of time. In addition, the recent financial performance of the Fabricated Metal Products industry combined with the difficulty of raising funds in the bond market, have left many establishments with a limited ability to raise the capital necessary to purchase new equipment.

For the purposes of this profile, the industrial processes associated with the Fabricated Metal Products industry will be grouped into three categories: fabricated metal products; surface preparation; and metal finishing. Each category is discussed in greater depth in the following subsections.

III.A.1. Fabricated Metal Products

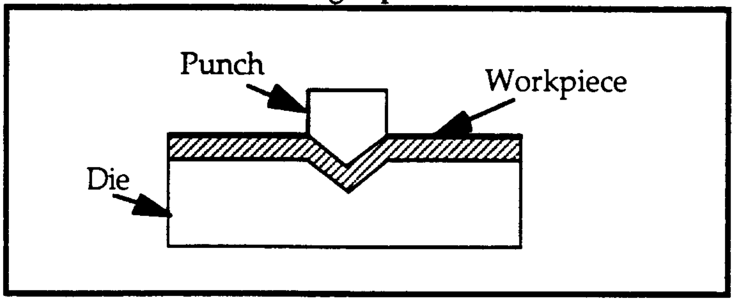
Once molten metal (ferrous or nonferrous) containing the correct metallurgical properties has been produced (see SIC 33, which comprises activities associated with the nonferrous metals industry), it is cast into a form that can enter various shaping processes. Recently, manufacturers have been using continuous casting techniques that allow the molten metal to be formed directly into sheets, eliminating interim forming stages. This section identifies some of the many forming and shaping methods used by the metal fabrication industry. In general, the metal may be heat treated or remain cold. Heat treating is the modification of the physical properties of a workpiece through the application of controlled heating and cooling cycles. Cold metal is formed by applying direct physical pressure to the metal.

Regardless of the forming method used, the metal fabricating process usually employs the use of cutting oils (e.g., ethylene glycol), degreasing and cleaning solvents, acids, alkalis, and heavy metals. The oils are typically used when forming and cutting the metal. The solvents (e.g., trichloroethane, methyl ethyl ketone), alkalines, and acids (e.g., hydrochloric, sulfuric) are used to clean the surface of the metals. The current trend in the industry is to use aqueous non-VOCs to clean the metals, whenever possible. The use of 1,1,1-trichloroethane and methyl ethyl ketone is declining.

Once molten metal is formed into a workable shape, shearing and forming operations are usually performed. Shearing operations cut materials into a desired shape and size, while forming operations bend or conform materials into specific shapes. Cutting or shearing operations include punching, piercing, blanking, cutoff, parting, shearing, and trimming. Basically, these operations produce holes or openings, or produce blanks or parts. The most common hole-making operation is punching. Cutoff, parting, and shearing are similar operations with different applications. The rate of production is highest in hot forging operations and lowest in simple bending and spinning operations.

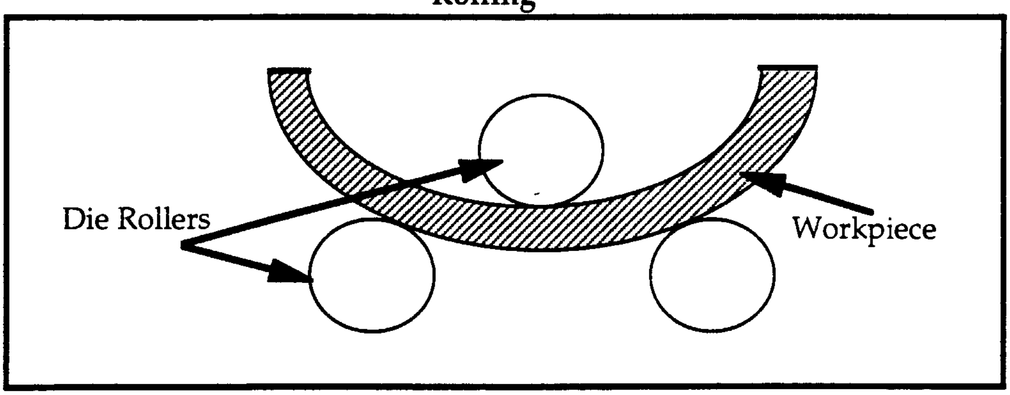
Forming operations, as illustrated in Exhibit 9, shape parts by bending, forming, extruding, drawing, rolling, spinning, coining, and forging the metal into a specific configuration. Bending is the simplest forming operation; the part is simply bent to a specific angle or shape. Other types of forming operations produces both two- and three-dimensional shapes.

Exhibit 9
Forming Operations



Extruding is the process of forming a specific shape from a solid blank by forcing the blank through a die of the desired shape. Extruding can produce complicated and intricate cross-sectional shapes. In rolling the metal passes through a set or series of rollers that bend and form the part into the desired shape (See Exhibit 10). Coining is a process that alters the form of the part by changing its thickness to produce a three-dimensional relief on one or both sides of the part, like a coin.

Exhibit 10
Rolling



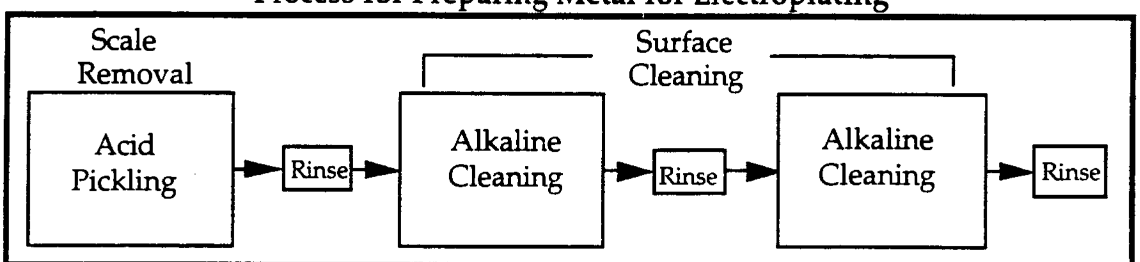
In drawing, a punch forces sheet stock into a die, where the desired shape is formed in the space between the punch and die. In spinning, pressure is applied to the sheet while it spins on a rotating form, forcing the sheet to acquire the shape of the form. Forging operations produce a specific shape by applying external pressure that either strikes or squeezes a heated blank into a die of the desired shape. Forging operations may be conducted on hot or cold metal using either single- or multi-stage dies.

Once shearing and forming activities are complete, the material is machined. Machining refines the shape of a workpiece by removing material from pieces of raw stock with machine tools. The principal processes involved in machining are drilling, milling, turning, shaping/planing, broaching, sawing, and grinding.

III.A.2. Surface Preparation

The surface of the metal may require preparation prior to applying a finish. Surface preparation, cleanliness, and proper chemical conditions are essential to ensuring that finishes perform properly. Without a properly cleaned surface, even the most expensive coatings will fail to adhere or prevent corrosion. Surface preparation techniques range from simple abrasive blasting to acid washes to complex, multi-stage chemical cleaning processes. Exhibit 11 provides a flow chart of a representative process used when preparing metal for electroplating. Various surface preparation methods are discussed below.

Exhibit 11
Process for Preparing Metal for Electroplating



Source: Metals Handbook, Ninth Edition; Volume 5, Surface Cleaning, Finishing, and Coating, 1982, American Society for Metals.

Some cleaning techniques involve the application of organic solvents to degrease the surface of the metal. Other techniques, emulsion cleaning, for example, use common organic solvents (e.g., kerosene, mineral oil, and glycols) dispersed in an aqueous medium with the aid of an emulsifying agent. Emulsion cleaning uses less chemical than solvent degreasing because the concentration of solvent is lower.

Alkaline cleaning may also be utilized for the removal of organic soils. Most alkaline cleaning solutions are comprised of three major types of components: (1) builders, such as alkali hydroxides and carbonates, which make up the largest portion of the cleaner; (2) organic or inorganic additives, which promote better cleaning or act to affect the metal surface in some way; and (3) surfactants.

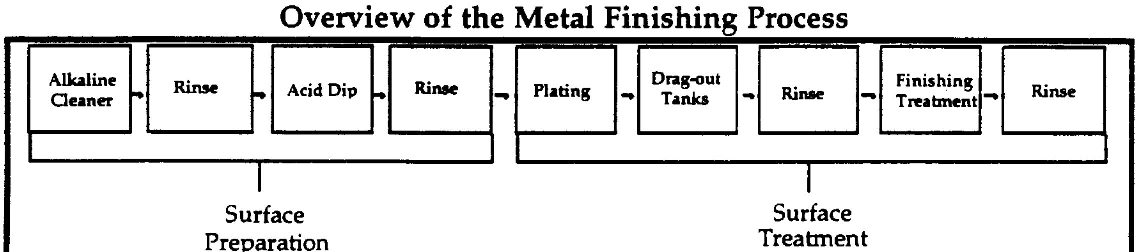
Alkaline cleaning is often assisted by mechanical action, ultrasonics, or by electrical potential (e.g., electrolytic cleaning).

Acid cleaning, or pickling, can also be used to prepare the surface of metal products by chemically removing oxides and scale from the surface of the metal. For instance, most carbon steel is pickled with sulfuric or hydrochloric acid, while stainless steel is pickled with hydrochloric or hydrofluoric acids, although hydrochloric acid may embrittle certain types of steel and is rarely used. The metal generally passes from the pickling bath through a series of rinses. Acid pickling is similar to acid cleaning, but is usually used to remove the scale from semi-finished mill products, whereas acid cleaning is usually used for near-final preparation of metal surfaces before electroplating, painting, and other finishing processes.

III.A.3. Metal Finishing

Surface finishing usually involves a combination of metal deposition operations and numerous finishing operations. A diagram depicting the general metal finishing process, including surface preparation, is provided in Exhibit 12. Wastes typically generated during these operations are associated with the solvents and cleansers applied to the surface and the metal-ion-bearing aqueous solutions used in the plating tanks. Metal-ion-bearing solutions are commonly based on hexavalent chrome, trivalent chrome, copper, gold, silver, cadmium, zinc, and nickel. Many other metals and alloys are also used, although less frequently. The cleaners (e.g., acids) may appear in process wastewater; the solvents may be emitted into the air, released in wastewater, or disposed of in solid form; and other wastes, including paints, metal-bearing sludges, and still bottom wastes, may be generated in solid form. Several of the many metal finishing operations are described below.

Exhibit 12
Overview of the Metal Finishing Process



Source: Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, OERR, June 1995.

Anodizing

Anodizing is an electrolytic process which converts the metal surface to an insoluble oxide coating. Anodized coatings provide corrosion protection, decorative surfaces, a base for painting and other coating processes, and special electrical and mechanical properties. Aluminum is the most frequently anodized material. Common aluminum anodizing processes include: chromic acid anodizing, sulfuric acid anodizing, and boric-sulfuric anodizing. The sulfuric acid process is the most common method.

Following anodizing, parts are typically rinsed, then proceed through a sealing operation that improves the corrosion resistance of the coating. Common sealants include chromic acid, nickel acetate, nickel-cobalt acetate, and hot water.

Chemical Conversion Coating

Chemical conversion coating includes chromating, phosphating, metal coloring, and passivating operations. Chromate conversion coatings are produced on various metals by chemical or electrochemical treatment. Solutions, usually containing hexavalent chromium and other compounds, react with the metal surface to form a layer containing a complex mixture of compounds consisting of chromium, other constituents, and base metal. Phosphate coatings may be formed by the immersion of steel, iron, or zinc-plated steel in a dilute solution of phosphate salts, phosphoric acid, and other reagents to condition the surfaces for further processing. They are used to provide a good base for paints and other organic coatings, to condition the surfaces for cold forming operations by providing a base for drawing compounds and lubricants, and to impart corrosion resistance to the metal surface.

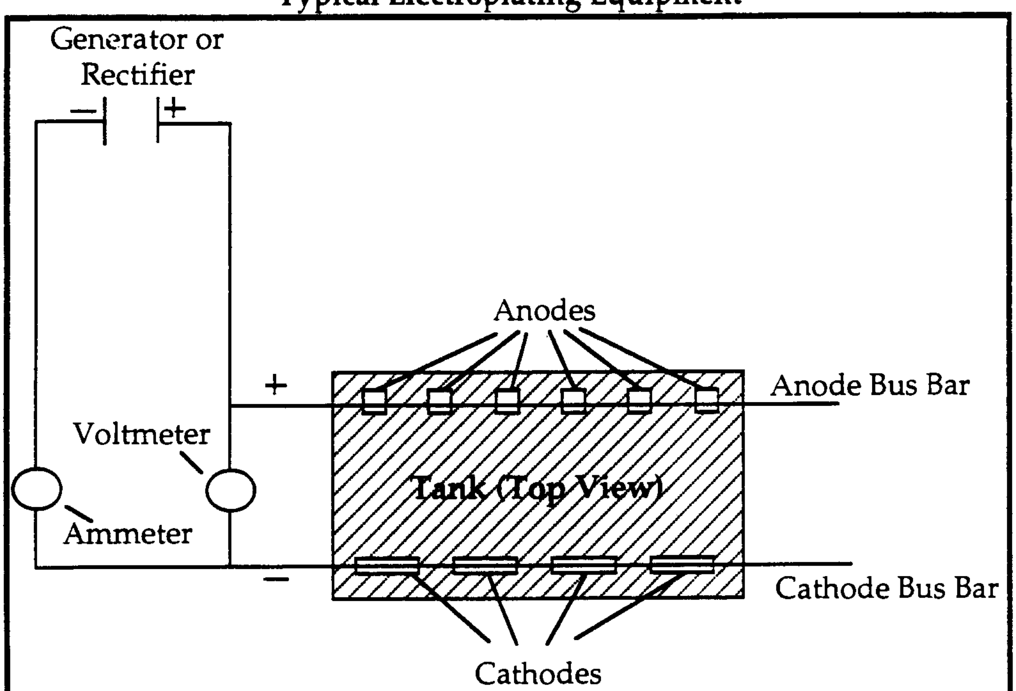
Metal coloring involves chemically converting the metal surface into an oxide or similar metallic compound to produce a decorative finish such as a green or blue patina on copper or steel, respectively. Passivating is the process of forming a protective film on metals by immersion into an acid solution, usually nitric acid or nitric acid with sodium dichromate. Stainless steel products are often passivated to prevent corrosion and extend the life of the product.

Electroplating

Electroplating is the production of a surface coating of one metal upon another by electrodeposition. Electroplating activities involve applying predominantly *inorganic* coatings onto surfaces to provide corrosion resistance, hardness, wear resistance, anti-frictional characteristics, electrical or thermal conductivity, or decoration. Exhibit 13 illustrates the important parts of typical electroplating equipment. The most commonly electroplated metals and alloys include: brass (copper-zinc), cadmium, chromium, copper, gold, nickel, silver, tin, and zinc.

In electroplating, metal ions in either acid, alkaline, or neutral solutions are reduced on the workpieces being plated. The metal ions in the solution are usually replenished by the dissolution of metal from solid metal anodes fabricated of the same metal being plated, or by direct replenishment of the solution with metal salts or oxides. Cyanide, usually in the form of sodium or potassium cyanide, is usually used as a complexing agent for cadmium and precious metals electroplating, and to a lesser degree, for other solutions such as copper and zinc baths.

Exhibit 13
Typical Electroplating Equipment



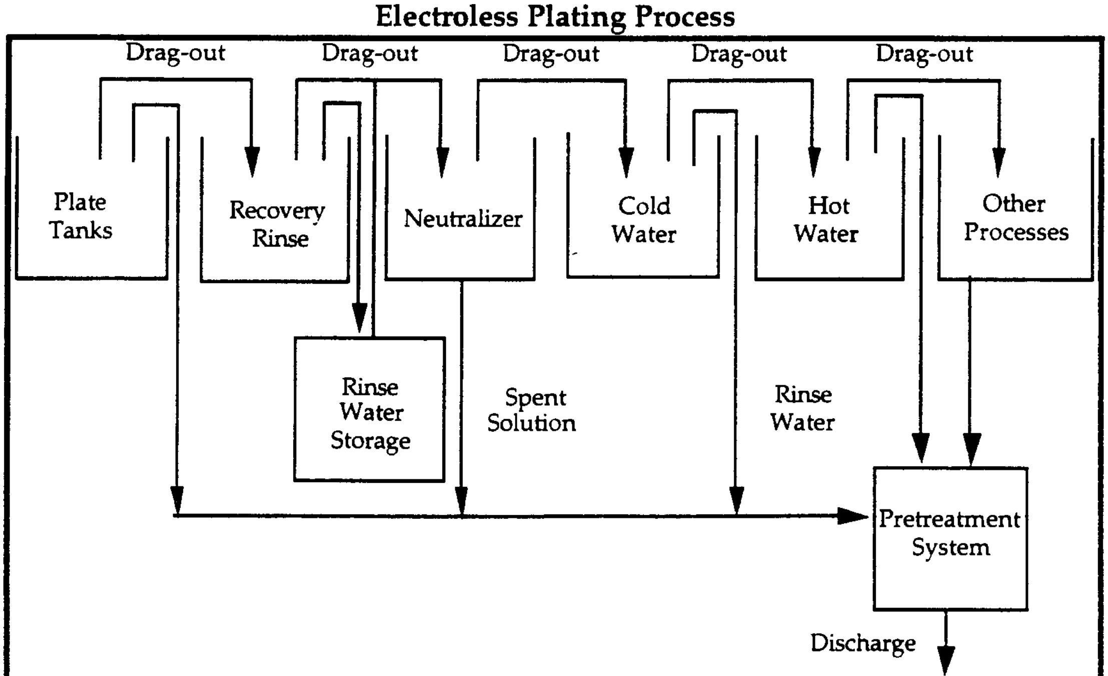
Source: McGraw Hill Encyclopedia of Science and Technology, Volume 6, 1987.

The sequence of steps in an electroplating includes: cleaning, often using alkaline and acid solutions; stripping of old plating or paint; electroplating; and rinsing between and after each of these operations. Sealing and conversion coating may be employed on the metals after electroplating operations.

Electroless Plating

Electroless plating is the chemical deposition of a metal coating onto a plastic object, by immersion of the object in a plating solution. Copper and nickel electroless plating is commonly used for printed circuit boards. The basic ingredients in an electroless plating solution are: a source of metal (usually a salt); a reducer; a complexing agent to hold the metal in solution; and various buffers and other chemicals designed to maintain bath stability and increase bath life. Immersion plating produces a thin metal deposit, commonly zinc or silver, by chemical displacement. Immersion plating baths are usually formulations of metal salts, alkalis, and complexing agents (e.g., lactic, glycolic, malic acid salts). Electroless plating and immersion plating commonly generate more waste than other plating techniques, but individual facilities vary significantly in efficiency. Exhibit 13 illustrates a typical plating process.

Exhibit 14
Electroless Plating Process



Source: *Pollution Prevention and Control Technology for Plating Operations, First Edition, National Center for Manufacturing Sciences and National Association of Metal Finishers, 1994.*

R0075960

Painting

Painting involves the application of predominantly *organic* coatings to a workpiece for protective and/or decorative purposes. It is applied in various forms, including dry powder, solvent-diluted formulations, and water-borne formulations. Various methods of application are used, the most common being spray painting and electrodeposition. Spray painting is a process by which paint is placed into a pressurized cup or pot and is atomized into a spray pattern when it is released from the vessel and forced through an orifice. Electrodeposition is the process of coating a workpiece by either making it anodic or cathodic in a bath that is generally an aqueous emulsion of the coating material. When applying the paint as a dry powder, some form of heating or baking is necessary to ensure that the powder adheres to the metal. These processes may result in solvent waste (and associated still bottom wastes generated during solvent distillation), paint sludge wastes, paint-bearing wastewaters, and paint solvent emissions.

Other Metal Finishing Techniques

Polishing, hot dip coating, and etching are processes that are also used to finish metal. Polishing is an abrading operation used to remove or smooth out surface defects (scratches, pits, or tool marks) that adversely affect the appearance or function of a part. Following polishing operations, area cleaning and washdown can produce metal-bearing wastewaters. Hot dip coating is the coating of a metallic workpiece with another metal to provide a protective film by immersion into a molten bath. Galvanizing (hot dip zinc) is a common form of hot dip coating. Water is used for rinses following precleaning and sometimes for quenching after coating. Wastewaters generated by these operations often contain metals. Etching produces specific designs or surface appearances on parts by controlled dissolution with chemical reagents or etchants. Etching solutions commonly comprise strong acids or bases with spent etchants containing high concentrations of spent metal. The solutions include ferric chloride, nitric acid, ammonium persulfate, chromic acid, cupric chloride, and hydrochloric acid.

III.B. Raw Material Inputs and Pollution Outputs in the Production Line

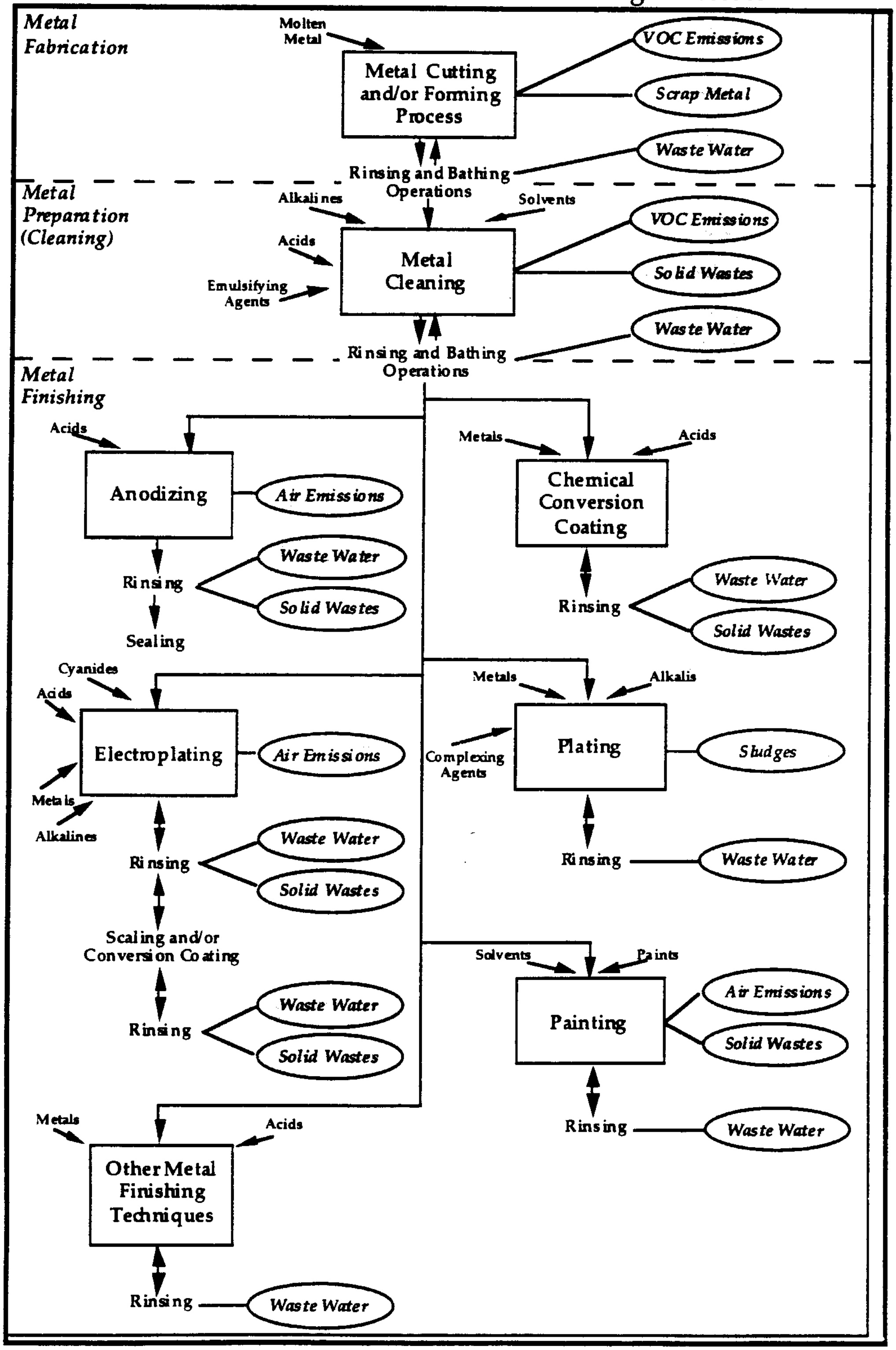
The material inputs and pollution outputs resulting from metal fabrication, surface preparation, and metal finishing processes are presented by media in Exhibit 15. Exhibit 16 illustrates the general processes associated with this industry, the pollutants generated, and the point in the process at which the pollutants are produced.

Exhibit 15
Process Materials Inputs and Outputs

Process	Material Input	Air Emission	Process Wastewater	Solid Waste
Metal Shaping				
Metal Cutting and/or Forming	Cutting oils, degreasing and cleaning solvents, acids, alkalis, and heavy metals	Solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)	Waste oils (e.g., ethylene glycol) and acid (e.g., hydrochloric, sulfuric, nitric), alkaline, and solvent wastes	Metal chips (e.g., scrap steel and aluminum), metal-bearing cutting fluid sludges, and solvent still-bottom wastes
Surface Preparation				
Solvent Degreasing and Emulsion, Alkaline, and Acid Cleaning	Solvents, emulsifying agents, alkalis, and acids	Solvents (associated with solvent degreasing and emulsion cleaning only)	Solvent, alkaline, and acid wastes	Ignitable wastes, solvent wastes, and still bottoms
Surface Finishing				
Anodizing	Acids	Metal-ion-bearing mists and acid mists	Acid wastes	Spent solutions, wastewater treatment sludges, and base metals
Chemical Conversion Coating	Metals and acids	Metal-ion-bearing mists and acid mists	Metal salts, acid, and base wastes	Spent solutions, wastewater treatment sludges, and base metals
Electroplating	Acid/alkaline solutions, heavy metal bearing solutions, and cyanide bearing solutions	Metal-ion-bearing mists and acid mists	Acid/alkaline, cyanide, and metal wastes	Metal and reactive wastes
Plating	Metals (e.g., salts), complexing agents, and alkalis	Metal-ion-bearing mists	Cyanide and metal wastes	Cyanide and metal wastes
Painting	Solvents and paints	Solvents	Solvent wastes	Still bottoms, sludges, paint solvents, and metals
Other Metal Finishing Techniques (Including Polishing, Hot Dip Coating, and Etching)	Metals and acids	Metal fumes and acid fumes	Metal and acid wastes	Polishing sludges, hot dip tank dross, and etching sludges

R0075963

Exhibit 16
Fabricated Metal Products Manufacturing Processes



R0075964

III.B.1. Metal Fabrication

Each of the metal shaping processes can result in wastes containing chemicals of concern. For example, the application of solvents to metal and machinery results in air emissions. Additionally, wastewater containing acidic or alkaline wastes and waste oils, and solid wastes, such as metals and solvents, are usually generated during this process.

Metal fabrication facilities are major users of solvents for degreasing. In cases where solvents are used solely in degreasing (not used in any other plant operations), records of the amount and frequency of purchases provide enough information to estimate emission rates, based on the assumption that all solvent purchased is eventually emitted. Section V.D., Pollution Prevention Options, illustrates techniques that may be used to reduce the loss of solvents to the atmosphere.

Metalworking fluids are applied to either the tool or the metal being tooled to facilitate the shaping operation. Metalworking fluid is used to:

- Control and reduce the temperature of tools and aid lubrication,
- Control and reduce the temperature of workpieces and aid lubrication,
- Provide a good finish,
- Wash away chips and metal debris, and
- Inhibit corrosion or surface oxidation.

Fluids resulting from this process typically become spoiled or contaminated with extended use and reuse. In general, metal working fluids can be petroleum-based, oil-water emulsions, and synthetic emulsions. When disposed, these fluids may contain high levels of metals (e.g., iron, aluminum, and copper). Additional contaminants present in fluids resulting from these processes include acids and alkalis (e.g., hydrochloric, sulfuric, nitric), waste oils, and solvent wastes.

Scrap metal may consist of metal removed from the original piece (e.g., steel), and may be combined with small amounts of metalworking fluids (e.g., solvents) used prior to and during the metal shaping operation that generates the scrap. Quite often, this scrap is reintroduced into the process as a feedstock. The scrap and metalworking fluids, however, should be tracked since they may be regulated as solid wastes.

III.B.2. Surface Preparation

Surface preparation activities usually result in air emissions, contaminated wastewater, and solid wastes. The primary air emissions from cleaning are due to the evaporation of chemicals from solvent degreasing and emulsion cleaning processes. These emissions may result through volatilization of solvents during storage, fugitive losses during use, and direct ventilation of fumes.

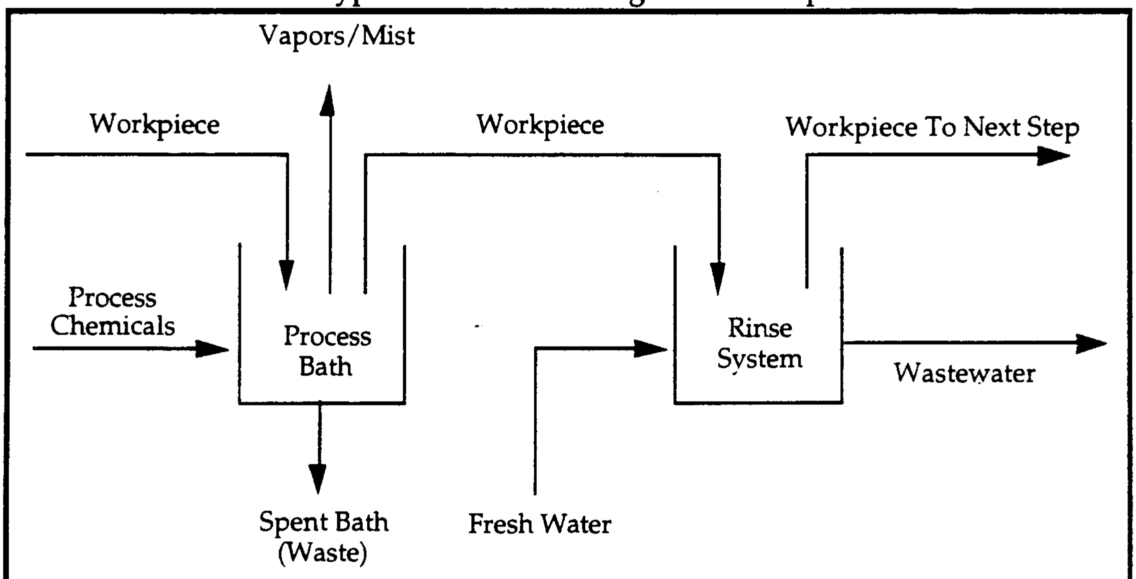
Wastewaters generated from cleaning are primarily rinse waters, which are usually combined with other metal finishing wastewaters (e.g., electroplating) and treated on-site by conventional hydroxide precipitation. Solid wastes (e.g., wastewater treatment sludges, still bottoms, cleaning tank residues, machining fluid residues, etc.) may also be generated by the cleaning operations. For example, solid wastes are generated when cleaning solutions become ineffective and are replaced. Solvent-bearing wastes are typically pre-treated to comply with any applicable National Pollutant Discharge System (NPDES) permits and then sent off-site, while aqueous wastes from alkaline and acid cleaning , which do not contain solvents, are often treated on-site.

III.B.3. Metal Finishing

Many metal finishing operations are typically performed in baths (tanks) and are then followed by rinsing cycles. Exhibit 17 illustrates a typical chemical or electrochemical process step in which a workpiece enters the process bath containing process chemicals that are carried to the rinse water (drag-out). Metal plating and related waste account for the largest volumes of metal- (e.g., cadmium, chromium, copper, lead, and nickel) and cyanide-bearing wastes. Painting operations account for the generation of solvent-bearing wastes and the direct release of solvents (including benzene, methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylene). Paint cleanup operations may contribute to the release of chlorinated solvents (including carbon tetrachloride, methylene chloride, 1,1,1-trichloroethane, and perchloroethylene). Compliance with one law through emission or effluent controls may generate waste regulated under another statute (e.g., effluent controls required by the Clean Water Act may generate sludges which are regulated by the

Resource Conservation and Recovery Act). The nature of the wastes produced by these processes is discussed further below.

Exhibit 17
Typical Metal Finishing Process Step



Source: *Guides to Pollution Prevention: The Metal Finishing Industry, U.S. EPA, ORD, October 1992.*

Anodizing

Anodizing operations produce air emissions, contaminated wastewaters, and solid wastes. Mists and gas bubbles arising from heated fluids are a source of air emissions, which may contain metals or other substances present in the bath. When dyeing of anodized coatings occurs, wastewaters produced may contain nickel acetate, non-nickel sealers, or substitutes from the dye. Other potential pollutants include complexers and metals from dyes and sealers. Wastewaters generated from anodizing are usually combined with other metal finishing wastewaters and treated on-site by conventional hydroxide precipitation. Wastewaters containing chromium must be pretreated to reduce hexavalent chromium to its trivalent state. The conventional treatment process generates a sludge that is usually sent off-site for metals reclamation and/or disposal.

Solid wastes generated from anodizing include spent solutions and wastewater treatment sludges. Anodizing solutions may be contaminated with the base metal being processed due to the anodic nature of the process. These solutions eventually reach an intolerable concentration of dissolved metal and require processing

R0075967

to remove the dissolved metal to a tolerable level or treatment/disposal.

Chemical Conversion Coating

Chemical conversion coating generally produces contaminated wastewaters and solid waste. Pollutants associated with these processes enter the wastestream through rinsing and batch dumping of process baths. The process baths usually contain metal salts, acids, bases, and dissolved basis materials. Wastewaters containing chromium are usually pretreated to reduce hexavalent chromium to its trivalent state. The conventional treatment process generates a sludge that is sent off-site for metals reclamation and/or disposal. Solid wastes generated from these processes include spent solutions and wastewater treatment sludges. Conversion coating solutions may also be contaminated with the base metal being processed. These solutions will eventually reach an intolerable concentration of dissolved metal and require processing to remove the dissolved metal to a tolerable level.

Electroplating

Electroplating operations produce air emissions, contaminated wastewaters and solid wastes. Mists arising from electroplating fluids and process gases can be a source of air emissions, which may contain metals or other substances present in the bath. The industry has recently begun adding fume suppressants to electroplating baths to reduce air emissions of chromium, one of the most frequently electroplated metals. The fume suppressants lower the surface tension of the bath, which prevents hydrogen bubbles in the bath from bursting and producing a chromium-laden mist. The fume suppressants are highly effective when used in decorative plating, but less effective when used in hard-chromium plating. Contaminated wastewaters result from workpiece rinsing and process cleanup waters. Rinse waters from electroplating are usually combined with other metal finishing wastewaters and treated on-site by conventional hydroxide precipitation. Wastewaters containing chromium must be pretreated to reduce hexavalent chromium to its trivalent state. These wastewater treatment techniques can result in solid-phase wastewater treatment sludges. Other wastes generated from electroplating include spent solutions which become contaminated during use, and therefore, diminish performance of the process. In addition to these wastes, spent process solutions and quench bathes may be discarded periodically when the concentrations of contaminants inhibit proper function of the solution or bath.

Electroless Plating

Electroless plating produces contaminated wastewater and solid wastes. The spent plating solution and rinse water are usually treated chemically to precipitate out the toxic metals and to destroy the cyanide. Electroless plating solutions can be difficult to treat; settling and simple chemical precipitation are not effective at removing the chelated metals used in the plating bath. The extent to which plating solution carry-over adds to the wastewater and enters the sludge depends on the type of article being plated and the specific plating method employed. However, most sludges may contain significant concentrations of toxic metals, and may also contain complex cyanides in high concentrations if cyanides are not properly isolated during the treatment process.

Painting

Painting operations result in emissions, contaminated wastewaters, and the generation of liquid and solid wastes. Atmospheric emissions consist primarily of the organic solvents used as carriers for the paint. Emissions also result from paint storage, mixing, application, and drying. In addition, cleanup processes can result in the release of organic solvents used to clean equipment and painting areas. Wastewaters are often generated from painting processes due primarily to the discharge of water from water curtain booths. On-site treatment processes to treat contaminated wastewater generate a sludge that is sent off-site for disposal. Sources of solid- and liquid-phase wastes include:

- Paint application emissions control devices (e.g., paint booth collection systems, ventilation filters, etc.)
- Equipment washing
- Disposal materials used to contain paint and overspray
- Excess paints discarded upon completion of a painting operation or after expiration of the paint shelf-life.

These solid and liquid wastes may contain metals from paint pigments and organic solvents, such as paint solvents and cleaning solvents. Still bottoms also contain solvent wastes. The cleaning solvents used on painting equipment and spray booths may also contribute organic solid waste to the wastes removed from the painting areas.

Other Metal Finishing Techniques

Wastewaters are often generated during other metal finishing processes. For example, following polishing operations, area cleaning and washdown can produce metal-bearing wastewaters. Hot dip coating techniques, such as galvanizing, use water for rinses following pre-cleaning and sometimes for quenching after coating. Hot dip coatings also generate solid waste, anoxide dross, that is periodically skimmed off the heated tank. These operations generate metal-bearing wastewaters. Etching solutions are comprised of strong acids (e.g., ferric chloride, nitric acid, ammonium persulfate) or bases. Resulting spent etchant solutions may contain metals and acids.

III.C. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 18 shows that the fabricated metals industry managed about 798 million pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related

R0075970

waste, 34 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 62 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (13.2 percent), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site is projected to decrease and the portions treated or managed through energy recovery on-site have increased between 1992 and 1995 (projected).

Exhibit 18
Source Reduction and Recycling Activity for SIC 34

A	B	C	D	E	F	G	H	I	J
Year	Production Related Waste Volume (10^6lbs.)*	% Reported as Released and Transferred	On-Site			Off-Site			Remaining Releases and Disposal
			% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	
1992	750	38%	23.22%	12.24%	23.11%	26.03%	1.57%	2.02%	12.05%
1993	798	34%	26.48%	11.04%	24.24%	21.31%	1.54%	2.10%	13.28%
1994	735	—	27.91%	8.90%	26.33%	22.18%	1.53%	2.32%	10.84%
1995	697	—	19.20%	13.86%	27.78%	23.94%	1.63%	2.46%	11.13%

R0075971

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Fabricated Metal Products Industry

TRI release amounts listed below are not associated with non-compliance with environmental laws. These facilities appear based on self-reported data submitted to the Toxic Release Inventory program.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear in Exhibit 19. Exhibit 20 contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, Exhibit 20 includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibits 21 - 24 illustrate the TRI releases and transfers for the Fabricated Metal Products industry (SIC 34). For the industry as a whole, solvents comprise the largest number of TRI releases. This reflects the fact that solvents are used during numerous metal shaping, surface preparation, and surface finishing operations. For example, during metal shaping and surface preparation operations, solvents are used primarily to degrease metal. Solvents are also used during painting operations. All of the processes which use solvents generally result in air emissions, contaminated wastewater, and solid wastes.

Between 1988 and 1993, the Fabricated Metals Products industry substantially reduced its TRI transfers and releases (see section V. Pollution Prevention Opportunities). Exhibits 21 and 22 show the differences in transfers and releases over time, categorized by type of transfer or release.

Exhibit 19 lists the ten facilities with the highest total TRI releases, most of which are continuous coil manufacturers (e.g., facilities that manufacture aluminum cans from long strips of metal). The wastes generated by these manufacturers are not necessarily representative of the wastes generated by the metal fabricating and finishing industries as a whole.

Exhibit 19
Top 10 TRI Releasing Fabricated Metal Products Facilities

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
3411	946,923	U.S. Can Co., Plant 20 Weirton	Weirton	WV
3411	880,500	Metal Container Corp., NWB	New Windsor	NY
3710, 3714, 3465	822,902	GMC NAO Flint OPS., BOC Flint Automotive Div.	Flint	MI
3471	708,285	Plastene Supply Co.	Portageville	MO
3731, 3441, 3443	688,540	Ingalls Shipbuilding, Inc.	Pascagoula	MS
3411	636,126	American National Can Co., Winston Salem Plant	Winston-Salem	NC
3411	624,250	Metal Container Corp. FTA	Fort Atkinson	WI
3479	619,436	Ken-Koat, Inc.	Huntington	IN
3714, 3471	618,359	Keeler Brass Automotive, Kentwood Plant	Grand Rapids	MI
3341, 3479, 3355	570,622	Commonwealth Aluminum Corp.	Lewisport	KY

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075976

Exhibit 20
Top 10 TRI Releasing Metal Fabricating & Finishing Facilities (SIC 34)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	946,923	U.S. Can Co., Plant 20, Weirton	Weirton	WV
2	880,500	Metal Container Corp., NWB	New Windsor	NY
3	708,285	Plastene Supply Co.	Portageville	MO
4	636,126	American National Can Co., Winston Salem Plant	Winston-Salem	NC
5	624,250	Metal Container Corp.	Fort Atkinson	WI
6	619,436	Ken-Koat, Inc.	Huntington	IN
7	545,505	Metal Container Corp.	Columbus	OH
8	541,654	Reynolds Metals Co.	Houston	TX
9	524,346	Hickory Springs Mfg. Co.	Fort Smith	AR
10	492,872	Tennessee Electroplating, Inc.	Ripley	TN

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 21
Reductions in TRI Releases, 1988-1993 (SIC 34)

Releases	1988	1993	Percent Reduction
Total Air Emissions	131,296,827	90,380,667	31.2
Surface Water Discharges	1,516,905	101,928	93.3
Underground Injection	386,120	1,490	99.6
Releases to Land	4,202,919	660,072	84.4

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 22
Reductions in TRI Transfers, 1988-1993 (SIC 34)

Transfers	1988	1993	Percent Reduction
Recycling	213,214,641	244,278,696	-14.6
Energy	12,331,653	13,812,271	-12.0
Treatment	34,313,199	18,561,504	45.9
POTWs	17,149,495	3,809,715	77.8
Disposal	43,529,628	19,736,496	54.7
Other Off-Site Transfers	8,303,148	369,491	95.5

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 23
TRI Reporting Metal Fabricating & Finishing Facilities (SIC 34) by State

State	Number of Facilities	State	Number of Facilities
AL	54	MS	29
AR	25	NC	35
AS	1	NE	9
AZ	17	NH	5
CA	208	NJ	60
CO	19	NV	3
CT	83	NY	101
DE	2	OH	225
FL	36	OK	29
GA	42	OR	20
HI	2	PA	123
IA	30	PR	10
ID	1	RI	30
IL	230	SC	37
IN	111	SD	3
KS	16	TN	47
KY	41	TX	107
LA	12	UT	15
MA	76	VA	30
MD	17	WA	24
ME	5	WI	103
MI	159	WV	16
MN	59	WY	2
MO	54		

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 24
Releases for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Sulfuric Acid	861	186135	149329	41032	547	54700	431743	501
Hydrochloric Acid	652	264628	265452	505	250	255	531090	815
Nitric Acid	390	81650	216384	1510	76	0	299620	768
Xylene (Mixed Isomers)	336	2982600	5985667	25	0	553	8968845	26693
Nickel	311	23285	8126	3558	0	6121	41090	132
Chromium	287	25150	6072	2162	0	30345	63729	222
Manganese	271	29884	9536	834	250	30994	71498	264
Glycol Ethers	269	4990228	13281181	5	0	5	18271419	67923
Copper	267	19231	20632	2795	0	763	43421	163
Methyl Ethyl Ketone	254	2134002	4511723	555	0	71335	6717615	26447
Zinc Compounds	228	87045	55641	13561	0	95457	251704	1104
N-Butyl Alcohol	215	3209678	7372875	0	0	5	10582558	49221
Toluene	205	1366663	3325311	7	0	300	4692281	22889
1-Trichloroethane	189	2046210	2727842	10	0	133	4774195	25260
Trichloroethylene	185	2410195	2903856	51	0	6600	5320702	28761
Chromium Compounds	176	7039	13687	1035	0	15574	37335	212
Phosphoric Acid	175	49587	32213	0	319	0	82119	469
Nickel Compounds	158	7538	9311	876	48	1530	19303	122
Methyl Isobutyl Ketone	114	501363	1156914	5	0	5	1658287	14546
Cyanide Compounds	103	7686	8960	298	0	283	17227	167
Copper Compounds	93	4912	6028	1398	0	256	12594	135
Lead	83	5758	4400	809	0	254	11221	135
Ammonia	79	87916	412960	250	0	0	501126	6343
Ethylbenzene	74	234540	308927	5	0	0	543472	7344
Hydrogen Fluoride	74	12924	27671	0	0	0	40595	549
Zinc (Fume Or Dust)	70	100770	41693	290	0	10146	152899	2184
Acetone	61	407417	1090972	0	0	0	1498389	24564
Manganese Compounds	58	2197	795	0	0	12785	15777	272
Dichloromethane	57	991302	1159594	5	0	6829	2157730	37855
4-Trimethylbenzene	53	255913	319541	5	0	0	575459	10858
Tetrachloroethylene	49	809152	434749	22	0	0	1243923	25386
Methanol	48	64182	182883	0	0	0	247065	5147
Chlorine	40	9181	1021	15	0	0	10217	255
Methylenebis(Phenylisocyanate)	35	2562	1179	0	0	0	3741	107
Naphthalene	33	57791	70271	0	0	0	128062	3881
Cobalt	28	1534	1608	755	0	500	4397	157
Barium Compounds	25	3606	803	250	0	3114	7773	311
Freon 113	19	282200	102624	0	0	0	384824	20254
Lead Compounds	19	967	1840	38	0	0	2845	150
Styrene	17	154377	25726	0	0	0	180103	10594
Cadmium	16	62	6	5	0	250	323	20
Formaldehyde	16	15561	9618	209	0	0	25388	1587
Aluminum (Fume Or Dust)	13	7042	506	0	0	0	7548	581
Trichlorofluoro-methane	13	45312	122318	0	0	250	167880	12914
Cadmium Compounds	11	276	266	0	0	0	542	49
Ethylene Glycol	11	37417	160907	0	0	0	198324	18029
Propylene	11	25423	771	0	0	0	26194	2381
Cumene	9	10383	24238	5	0	0	34626	3847
2-Ethoxyethanol	8	14361	19390	0	0	0	33751	4219
Cyclohexane	7	611237	55929	0	0	0	667166	95309
Isopropyl Alcohol (Manufacturing	6	22111	29351	0	0	0	51462	8577
Antimony Compounds	5	4505	661	260	0	0	5426	1085
Cobalt Compounds	5	2	113	37	0	9	161	32
M-Xylene	5	898	12297	0	0	0	13195	2639
Antimony	4	0	423	0	0	0	423	106

Exhibit 24 (cont'd)
Releases for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Bis(2-Ethylhexyl) Adipate	4	8850	14000	0	0	0	22850	5713
Dimethyl Phthalate	4	2407	6387	0	0	0	8794	2199
Phenol	4	12922	0	3	0	0	12925	3231
Sec-Butyl Alcohol	4	6350	19600	0	0	0	25950	6488
Aluminum Oxide (Fibrous Form)	3	250	250	0	0	0	500	167
Di(2-Ethylhexyl) Phthalate	3	250	3000	0	0	5	3255	1085
Dichlorodifluoro-methane	3	7406	16443	0	0	0	23849	7950
Silver	3	5	0	5	0	0	10	3
Asbestos (Friable)	2	10	0	0	0	0	10	5
Barium	2	5	0	0	0	0	5	3
Butyl Benzyl Phthalate	2	0	0	0	0	0	0	0
Diethyl Phthalate	2	255	250	0	0	0	505	253
Molybdenum Trioxide	2	250	0	0	0	2000	2250	1125
O-Xylene	2	0	37928	0	0	0	37928	18964
Phosphorus (Yellow Or White)	2	10	5	5	0	0	20	10
Toluenediisocyanate (Mixed Isomers)	2	5	148	0	0	0	153	77
2-Methoxyethanol	2	255	24825	0	0	0	25080	12540
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Ammonium Sulfate (Solution)	1	0	0	0	0	0	0	0
Arsenic	1	5	0	0	0	0	5	5
Benzene	1	3122	836	0	0	0	3958	3958
Diethanolamine	1	0	0	0	0	0	0	0
Ethyl Acrylate	1	0	2578	0	0	0	2578	2578
Mercury	1	5	0	0	0	0	5	5
P-Xylene	1	0	22	0	0	0	22	22
Polychlorinated Biphenyls	1	0	0	0	0	0	0	0
Propane Sultone	1	250	0	0	0	0	250	250
Selenium	1	5	0	0	0	0	5	5
Silver Compounds	1	250	250	0	0	0	500	500
2-Dichlorobenzene	1	12000	0	0	0	0	12000	12000
2-Nitropropane	1	186	182	0	0	0	368	368
4'-Isopropylidenediphenol	1	0	250	0	0	0	250	250
Totals	----	24,768,891	46,819,995	73,195	1,490	351,356	72,014,927	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0075980

Exhibit 25
Transfers for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Sulfuric Acid	861	1132535	2871580	4011148	4636541	0	12651804	14694
Hydrochloric Acid	652	446440	2768870	1472808	3169967	0	7935080	12170
Nitric Acid	390	37256	309134	946756	623265	0	1916411	4914
Xylene (Mixed Isomers)	336	51	10852	1661765	332850	2139660	4151607	12356
Nickel	311	17355	367278	8848547	464008	0	9727271	31277
Chromium	287	30170	465237	10143210	422090	10	11121986	38753
Manganese	271	5093	834964	8774505	8299	0	9623861	35512
Glycol Ethers	269	385087	55411	824664	142591	2295807	3746528	13928
Copper	267	8784	653024	53401212	60924	667	54124861	202715
Methyl Ethyl Ketone	254	141	32971	2787367	268783	4002200	7107644	27983
Zinc Compounds	228	31969	4797726	23980836	2004640	3249	30847198	135295
N-Butyl Alcohol	215	13302	9306	100928	43711	306263	497761	2315
Toluene	205	93	31782	603704	277628	1892116	2805323	13685
1-Trichloroethane	189	65	34508	1342465	128708	101194	1606940	8502
Trichloroethylene	185	1083	34070	1045702	371432	102092	1554379	8402
Chromium Compounds	176	18099	721452	1222505	500300	2981	2490098	14148
Phosphoric Acid	175	268375	300139	5805346	280512	0	6669606	38112
Nickel Compounds	158	21635	463522	1839379	549790	6	2879204	18223
Methyl Isobutyl Ketone	114	5	1407	813193	30029	471629	1316263	11546
Cyanide Compounds	103	19581	17461	12188	140767	0	190497	1849
Copper Compounds	93	13826	341003	11781033	205196	7	12341065	132700
Lead	83	1160	78382	2392024	10184	281	2482031	29904
Ammonia	79	31527	1030	750	260	0	33567	425
Ethylbenzene	74	5	2	170492	14164	227471	412134	5569
Hydrogen Fluoride	74	382	2581	0	16618	0	19581	265
Zinc (Fume Or Dust)	70	75982	219289	666508	120336	61242	1143857	16341
Acetone	61	5	19917	705690	173168	134723	1033503	16943
Manganese Compounds	58	302	221084	1243001	1299	0	1465686	25270
Dichloromethane	57	647	5	289636	73238	26737	390263	6847
4-Trimethylbenzene	53	5	5	23532	10506	58127	92175	1739
Tetrachloroethylene	49	65	6344	555166	129891	6692	698158	14248
Methanol	48	29686	0	35726	34952	80494	180858	3768
Chlorine	40	4470	750	250	6226	0	11696	292
Methylenebis(Phenylisocyanate)	35	0	25420	250	7014	500	33184	948
Naphthalene	33	0	70	34926	14821	39431	89248	2704
Cobalt	28	319	10978	405387	753	0	440451	15730
Barium Compounds	25	12	56251	2079	20823	0	79165	3167
Freon 113	19	0	0	93230	21794	1917	116941	6155
Lead Compounds	19	797	198398	798893	1590	501	1000179	52641
Styrene	17	0	12000	1180	750	250	14180	834
Cadmium	16	1829	8006	9432	31506	0	50773	3173
Formaldehyde	16	41510	5	0	1611	7202	50328	3146
Aluminum (Fume Or Dust)	13	500	250	157757	5460	0	163967	12613
Trichlorofluoro-methane	13	0	7374	0	4263	0	11637	895
Cadmium Compounds	11	1288	65324	27000	42512	0	136124	12375
Ethylene Glycol	11	22685	86000	17100	19170	3110	148065	13460
Propylene	11	0	0	0	0	0	0	0
Cumene	9	5	0	2020	441	5618	8084	898
2-Ethoxyethanol	8	5	0	516	0	2600	3121	390
Cyclohexane	7	0	750	0	1250	255	2255	322

R0075981

Exhibit 25 (cont'd)
Transfers for Metal Fabricating & Finishing Facilities (SIC 34) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Isopropyl Alcohol (Manufacturing	6	0	613	97513	15	5688	103829	17305
Antimony Compounds	5	10	104158	0	1104	0	105272	21054
Cobalt Compounds	5	15	18403	41566	5	1	59990	11998
M-Xylene	5	0	0	0	109	3819	3928	786
Antimony	4	0	0	3187	375	0	3562	891
Bis(2-Ethylhexyl) Adipate	4	6400	3145	0	0	0	9545	2386
Dimethyl Phthalate	4	0	0	0	269	1802	2071	518
Phenol	4	250	1176	0	0	0	1426	357
Sec-Butyl Alcohol	4	0	0	0	840	250	1090	273
Aluminum Oxide (Fibrous Form)	3	0	0	25000	0	0	25000	8333
Di(2-Ethylhexyl) Phthalate	3	5	8440	0	0	0	8445	2815
Dichlorodifluoromethane	3	0	0	0	0	0	0	0
Silver	3	10	15	250	0	0	275	92
Asbestos (Friable)	2	0	73822	0	0	0	73822	36911
Barium	2	5	10	0	0	0	15	8
Butyl Benzyl Phthalate	2	0	0	0	0	0	0	0
Diethyl Phthalate	2	500	0	2052	2061	0	4613	2307
Molybdenum Trioxide	2	0	419	3900	0	0	4319	2160
O-Xylene	2	0	0	0	61	0	61	31
Phosphorus (Yellow Or White)	2	0	0	12250	0	0	12250	6125
Toluenediisocyanate (Mixed Isomers)	2	0	0	0	0	1374	1374	687
2-Methoxyethanol	2	5	0	0	0	8520	8525	4263
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Ammonium Sulfate (Solution)	1	128241	0	0	0	0	128241	128241
Arsenic	1	5	10	0	0	0	15	15
Benzene	1	0	0	0	0	0	0	0
Diethanolamine	1	0	0	440	0	0	440	440
Ethyl Acrylate	1	0	0	0	0	0	0	0
Mercury	1	5	10	0	0	0	15	15
P-Xylene	1	0	0	0	51	0	51	51
Polychlorinated Biphenyls	1	0	0	0	2286	0	2286	2286
Propane Sultone	1	0	0	0	0	0	0	0
Selenium	1	5	10	0	0	0	15	15
Silver Compounds	1	250	0	4000	0	0	4250	4250
2-Dichlorobenzene	1	0	0	0	0	0	0	0
2-Nitropropane	1	0	0	0	95	103	198	198
4'-Isopropylidene-diphenol	1	0	250	0	0	0	250	250
Totals	----	2,800,087	16,352,393	149,241,964	15,433,902	12,002,720	196,188,152	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0075982

Exhibits 26 - 29 illustrate the TRI releases and transfers for the coating, engraving, and allied services portion (SIC 347) of the fabricated metal products industry. For these activities, solvents, as well as acids, constitute the largest number of TRI releases. Solvents are primarily used during painting operations, while acids are used during most finishing operations (e.g., anodizing, chemical conversion coating, electroplating). The solvents usually produce air emissions, contaminated wastewater, and solid-phase wastes, while the acids generally result in contaminated wastewater. Because NPDES permits do not allow low PH levels, the wastewater is pretreated to reduce the acidity prior to being discharged from the facility.

Exhibit 26
Top 10 TRI Releasing Metal Finishing Facilities (SIC 347)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	708,285	Plastene Supply Co.	Portageville	MO
2	619,436	Ken-Koat, Inc.	Huntington	IN
3	492,872	Tennessee Electroplating, Inc.	Ripley	TN
4	430,781	SR of Tennessee	Ripley	TN
5	418,912	Ken-Koat of Tennessee, Inc., Plant 1	Lewisburg	TN
6	408,628	Anomatic Corp.	Newark	OH
7	406,419	Roll Coater, Inc.	Greenfield	IN
8	381,788	Reynolds Metals Co.,.Sheffield Plant	Sheffield	AL
9	368,014	Roll Coater, Inc.	Kingsbury	IN
10	344,572	Mottley Foils, Inc.	Farmville	VA

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0075983

Exhibit 27
TRI Reporting Metal Finishing Facilities (SIC 347) by State

State	Number of Facilities	State	Number of Facilities
AL	19	MO	23
AR	4	MS	6
AZ	9	NC	11
CA	117	NE	1
CO	11	NH	1
CT	36	NJ	27
DE	1	NY	43
FL	14	OH	112
GA	14	OK	9
HI	1	OR	11
IA	6	PA	41
IL	121	PR	4
IN	49	RI	23
KS	7	SC	9
KY	13	TN	17
LA	5	TX	48
MA	39	UT	4
MD	7	VA	7
ME	1	WA	14
MI	109	WI	35
MN	36	WV	4

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 28
Releases for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Sulfuric Acid	577	159575	103935	38232	0	54450	356192	617
Hydrochloric Acid	490	229596	186461	505	250	255	417067	851
Nitric Acid	290	51229	140639	1510	0	0	193378	667
Zinc Compounds	158	75329	23316	12202	0	93054	203901	1291
Phosphoric Acid	120	24772	26993	0	0	0	51765	431
Methyl Ethyl Ketone	103	945484	2251059	555	0	71335	3268433	31732
Chromium Compounds	101	4572	10765	625	0	15	15977	158
Nickel Compounds	95	5821	4572	564	0	0	10957	115
Cyanide Compounds	87	6759	4098	224	0	283	11364	131
Nickel	87	4685	3257	1433	0	500	9875	114
Trichloroethylene	81	844061	847701	20	0	0	1691782	20886
Xylene (Mixed Isomers)	79	395089	1226943	5	0	0	1622037	20532
1,1,1-Trichloroethane	73	763993	817417	5	0	0	1581415	21663
Toluene	69	375222	1566048	5	0	300	1941575	28139
Glycol Ethers	59	344040	1463579	0	0	0	1807619	30638
Copper	54	880	3508	1646	0	0	6034	112
Chromium	48	2517	2372	131	0	255	5275	110
N-Butyl Alcohol	44	114102	188305	0	0	0	302407	6873
Copper Compounds	43	2874	1955	207	0	0	5036	117
Ammonia	35	75738	11644	0	0	0	87382	2497
Chlorine	32	5828	1011	5	0	0	6844	214
Lead	31	89	1715	536	0	0	2340	75

R0075984

Exhibit 28 (cont'd)
Releases for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Average Releases per Facility
Methyl Isobutyl Ketone	30	127088	269586	0	0	0	396674	13222
Tetrachloroethylene	25	401718	211664	0	0	0	613382	24535
Acetone	21	166232	250318	0	0	0	416550	19836
Ethylbenzene	20	46499	68675	0	0	0	115174	5759
Naphthalene	20	25677	52326	0	0	0	78003	3900
Zinc (Fume Or Dust)	20	14713	405	0	0	0	15118	756
1,2,4-Trimethylbenzene	20	87617	118935	0	0	0	206552	10328
Dichloromethane	15	420391	395882	5	0	0	816278	54419
Formaldehyde	15	14409	8992	209	0	0	23610	1574
Methanol	15	53243	138202	0	0	0	191445	12763
Cadmium	13	57	6	0	0	0	63	5
Barium Compounds	12	1601	482	0	0	0	2083	174
Hydrogen Fluoride	10	6216	3208	0	0	0	9424	942
Cadmium Compounds	9	266	11	0	0	0	277	31
Manganese	8	21	69	0	0	0	90	11
Cumene	7	9178	18933	0	0	0	28111	4016
Cobalt	6	12	542	5	0	0	559	93
Freon 113	6	93785	0	0	0	0	93785	15631
Lead Compounds	5	255	500	0	0	0	755	151
Manganese Compounds	4	15	5	0	0	0	20	5
Methylenebis (Phenylisocyanate)	4	5	150	0	0	0	155	39
Aluminum (Fume Or Dust)	3	250	250	0	0	0	500	167
Antimony	3	0	418	0	0	0	418	139
Dimethyl Phthalate	3	2407	5438	0	0	0	7845	2615
Ethylene Glycol	3	1160	18552	0	0	0	19712	6571
Propylene	3	503	516	0	0	0	1019	340
Aluminum Oxide (Fibrous Form)	2	0	0	0	0	0	0	0
Isopropyl Alcohol (Manufacturing)	2	250	15000	0	0	0	15250	7625
M-Xylene	2	0	6109	0	0	0	6109	3055
Sec-Butyl Alcohol	2	1000	3000	0	0	0	4000	2000
Silver	2	5	0	0	0	0	5	3
2-Methoxyethanol	2	255	24825	0	0	0	25080	12540
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Arsenic	1	5	0	0	0	0	5	5
Barium	1	0	0	0	0	0	0	0
Bis(2-Ethylhexyl) Adipate	1	0	0	0	0	0	0	0
Ethyl Acrylate	1	0	2578	0	0	0	2578	2578
Mercury	1	5	0	0	0	0	5	5
O-Xylene	1	0	37911	0	0	0	37911	37911
Phenol	1	12000	0	0	0	0	12000	12000
Selenium	1	5	0	0	0	0	5	5
Silver Compounds	1	250	250	0	0	0	500	500
Trichlorofluoromethane	1	5	12000	0	0	0	12005	12005
1,2-Dichlorobenzene	1	12000	0	0	0	0	12000	12000
2-Ethoxyethanol	1	250	7000	0	0	0	7250	7250
2-Nitropropane	1	186	182	0	0	0	368	368
4,4-Isopropylidenediphenol	1	0	250	0	0	0	250	250
Total	----	**5,931,789**	**10,560,463**	**58,629**	**250**	**220,447**	**16,771,578**	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 29
Transfers for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Sulfuric Acid	577	804908	1947304	3112900	2266082	0	8131194	14092
Hydrochloric Acid	490	382255	2691567	1467208	3058084	0	7676109	15666
Nitric Acid	290	32756	274177	822830	562997	0	1692760	5837
Zinc Compounds	158	25225	4286331	16726872	1865137	2994	22906591	144978
Phosphoric Acid	120	160428	296366	5126632	120242	0	5718883	47657
Methyl Ethyl Ketone	103	10	0	2060497	110831	1994068	4181588	40598
Chromium Compounds	101	14423	594848	249365	364291	2980	1244457	12321
Nickel Compounds	95	17937	375149	1171327	501971	0	2066384	21751
Cyanide Compounds	87	18577	16451	12127	126143	0	173798	1998
Nickel	87	12239	255282	777750	399252	0	1445523	16615
Trichloroethylene	81	353	4873	214013	103537	63712	386488	4771
Xylene (Mixed Isomers)	79	10	2465	373083	110740	499378	985676	12477
1,1,1-Trichloroethane	73	45	1090	359456	30856	25528	416975	5712
Toluene	69	6	3248	323174	212714	912937	1452079	21045
Glycol Ethers	59	206381	4168	209411	44590	530166	994966	16864
Copper	54	3810	215903	4247604	14524	0	4481841	82997
Chromium	48	4297	253964	245168	402593	0	923657	19243
N-Butyl Alcohol	44	13300	1615	19334	19951	68165	122365	2781
Copper Compounds	43	8404	109090	3397732	118222	0	3633448	84499
Ammonia	35	19727	260	0	255	0	20242	578
Chlorine	32	4210	750	250	6221	0	11431	357
Lead	31	61	10814	428225	7169	0	446269	14396
Methyl Isobutyl Ketone	30	0	0	467583	8208	70164	545955	18199
Tetrachloroethylene	25	20	0	198381	10999	4542	213942	8558
Acetone	21	5	0	482911	134524	37649	655089	31195
Ethylbenzene	20	0	0	95670	2795	67994	166459	8323
Naphthalene	20	0	0	1000	7046	23833	31879	1594
Zinc (Fume Or Dust)	20	4580	9250	181479	75065	0	270624	13531
1,2,4-Trimethylbenzene	20	0	0	12825	8538	37488	58851	2943
Dichloromethane	15	377	0	92499	22453	15138	130467	8698
Formaldehyde	15	41510	5	0	1588	7202	50305	3354
Methanol	15	29686	0	1513	34930	56354	122483	8166
Cadmium	13	1814	6186	9432	31256	0	48688	3745
Barium Compounds	12	5	26665	29	7756	0	34455	2871
Hydrogen Fluoride	10	0	2581	0	16618	0	19199	1920
Cadmium Compounds	9	1287	65319	27000	250	0	93856	10428
Manganese	8	889	851	113	1751	0	3604	451
Cumene	7	0	0	2020	400	5618	8038	1148
Cobalt	6	30	7590	1431	193	0	9244	1541
Freon 113	6	0	0	3900	0	0	3900	650
Lead Compounds	5	751	1520	42677	319	0	45267	9053
Manganese Compounds	4	5	22024	87789	0	0	109818	27455
Methylenebis (Phenylisocyanate)	4	0	0	0	0	0	0	0
Aluminum (Fume Or Dust)	3	250	0	0	5460	0	5710	1903
Antimony	3	0	0	1955	375	0	2330	777
Dimethyl Phthalate	3	0	0	0	269	1802	2071	690
Ethylene Glycol	3	5	0	0	250	994	1249	416
Propylene	3	0	0	0	0	0	0	0
Aluminum Oxide (Fibrous Form)	2	0	0	25000	0	0	25000	12500
Isopropyl Alcohol (Manufacturing)	2	0	0	87932	0	2300	90232	45116
M-Xylene	2	0	0	0	0	0	0	0
Sec-Butyl Alcohol	2	0	0	0	0	0	0	0
Silver	2	5	10	250	0	0	265	133
2-Methoxyethanol	2	5	0	0	0	8520	8525	4263

Exhibit 29 (cont'd)
Transfers for Metal Finishing (SIC 347) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Ammonium Nitrate (Solution)	1	0	0	0	0	0	0	0
Arsenic	1	5	10	0	0	0	15	15
Barium	1	5	10	0	0	0	15	15
Bis(2-Ethylhexyl) Adipate	1	0	250	0	0	0	250	250
Ethyl Acrylate	1	0	0	0	0	0	0	0
Mercury	1	5	10	0	0	0	15	15
O-Xylene	1	0	0	0	20	0	20	20
Phenol	1	0	0	0	0	0	0	0
Selenium	1	5	10	0	0	0	15	15
Silver Compounds	1	250	0	4000	0	0	4250	4250
Trichlorofluoromethane	1	0	3400	0	0	0	3400	3400
1,2-Dichlorobenzene	1	0	0	0	0	0	0	0
2-Ethoxyethanol	1	5	0	0	0	750	755	755
2-Nitropropane	1	0	0	0	95	103	198	198
4,4-Isopropylidenediphenol	1	0	250	0	0	0	250	250
Totals	----	**1,810,861**	**11,491,656**	**43,172,347**	**10,817,560**	**4,440,379**	**71,879,412**	---

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of the Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[1]. The

1 TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR

information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

The top ten TRI releases for the Fabricated Metal Products industry (SIC 34) as a whole include: glycol ethers, n-butyl, xylene, methyl ethyl ketone, trichloroethylene, toluene-1, dichloromethane, methyl isobutyl ketone, acetone, and tetrachloroethylene. The top ten TRI releases for the coating, engraving, and allied services portion of the fabricated metal products industry (SIC 347) include: methyl ethyl ketone, toluene, glycol ethers, trichloroethylene, xylene (mixed isomers), 1,1,1-trichloroethane, dichloromethane, tetrachloroethylene, hydrochloric acid, and methyl isobutyl ketone. Summaries of most of these chemicals follow.

Acetone

Toxicity. Acetone is irritating to the eyes, nose, and throat. Symptoms of exposure to large quantities of acetone may include headache, unsteadiness, confusion, lassitude, drowsiness, vomiting, and respiratory depression.

Reactions of acetone (see environmental fate) in the lower atmosphere contribute to the formation of ground-level ozone. Ozone (a major component of urban smog) can affect the respiratory system, especially in sensitive individuals such as asthmatics or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released into water, acetone will be degraded by microorganisms or will evaporate into the atmosphere.

(Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

Degradation by microorganisms will be the primary removal mechanism.

Acetone is highly volatile, and once it reaches the troposphere (lower atmosphere), it will react with other gases, contributing to the formation of ground-level ozone and other air pollutants. EPA is reevaluating acetone's reactivity in the lower atmosphere to determine whether this contribution is significant.

Physical Properties. Acetone is a volatile and flammable organic chemical.

Note: Acetone was removed from the list of TRI chemicals on June 16, 1995 (60 FR 31643) and will not be reported for 1994 or subsequent years.

Glycol Ethers

Due to data limitations, data on diethylene glycol (glycol ether) are used to represent all glycol ethers.

Toxicity. Diethylene glycol is only a hazard to human health if concentrated vapors are generated through heating or vigorous agitation or if appreciable skin contact or ingestion occurs over an extended period of time. Under normal occupational and ambient exposures, diethylene glycol is low in oral toxicity, is not irritating to the eyes or skin, is not readily absorbed through the skin, and has a low vapor pressure so that toxic concentrations of the vapor can not occur in the air at room temperatures.

At high levels of exposure, diethylene glycol causes central nervous depression and liver and kidney damage. Symptoms of moderate diethylene glycol poisoning include nausea, vomiting, headache, diarrhea, abdominal pain, and damage to the pulmonary and cardiovascular systems. Sulfanilamide in diethylene glycol was once used therapeutically against bacterial infection; it was withdrawn from the market after causing over 100 deaths from acute kidney failure.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Diethylene glycol is a water-soluble, volatile organic chemical. It may enter the environment in liquid form via petrochemical plant effluents or as an unburned gas from combustion sources. Diethylene glycol typically does not occur in sufficient concentrations to pose a hazard to human health.

Hydrochloric Acid

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Methylene Chloride (Dichloromethane)

Toxicity. Short-term exposure to dichloromethane (DCM) is associated with central nervous system effects, including headache, giddiness, stupor, irritability, and numbness and tingling in the limbs. More severe neurological effects are reported from longer-term exposure, apparently due to increased carbon monoxide in the blood from the break down of DCM. Contact with DCM causes irritation of the eyes, skin, and respiratory tract.

Occupational exposure to DCM has also been linked to increased incidence of spontaneous abortions in women. Acute damage to the eyes and upper respiratory tract, unconsciousness, and death were reported in workers exposed to high concentrations of DCM. Phosgene (a degradation product of DCM) poisoning has been reported to occur in several cases where DCM was used in the presence of an open fire.

Populations at special risk from exposure to DCM include obese people (due to accumulation of DCM in fat), and people with impaired cardiovascular systems.

Carcinogenicity. DCM is a probable human carcinogen via both oral and inhalation exposure, based on inadequate human data and sufficient evidence in animals.

Environmental Fate. When spilled on land, DCM is rapidly lost from the soil surface through volatilization. The remainder leaches through the subsoil into the groundwater.

Biodegradation is possible in natural waters but will probably be very slow compared with evaporation. Little is known about bioconcentration in aquatic organisms or adsorption to sediments but these are not likely to be significant processes. Hydrolysis is not an important process under normal environmental conditions.

DCM released into the atmosphere degrades via contact with other gases with a half-life of several months. A small fraction of the chemical diffuses to the stratosphere where it rapidly degrades through exposure to ultraviolet radiation and contact with chlorine ions. Being a moderately soluble chemical, DCM is expected to partially return to earth in rain.

Methyl Ethyl Ketone

Toxicity. Breathing moderate amounts of methyl ethyl ketone (MEK) for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes, nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. No agreement exists over the carcinogenicity of MEK. One source believes MEK is a possible carcinogen in humans based on limited animal evidence. Other sources believe that there is insufficient evidence to make any statements about possible carcinogenicity.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a flammable liquid.

Toluene

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also affect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene is a volatile organic chemical.

1,1,1-Trichloroethane

Toxicity. Repeated contact of 1,1,1-trichloroethane (TCE) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCE causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCE leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsions and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCE to surface water or land will almost entirely volatilize. Releases to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCE degrades very slowly by photooxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCE that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCE does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Trichloroethylene

Toxicity. Trichloroethylene was once used as an anesthetic, though its use caused several fatalities due to liver failure. Short term inhalation exposure to high levels of trichloroethylene may cause rapid coma followed by eventual death from liver, kidney, or heart failure. Short-term exposure to lower concentrations of trichloroethylene causes eye, skin, and respiratory tract irritation. Ingestion causes a burning sensation in the mouth, nausea, vomiting and abdominal pain. Delayed effects from short-term trichloroethylene poisoning include liver and kidney lesions, reversible nerve degeneration, and psychic disturbances. Long-term exposure can produce headache, dizziness, weight loss, nerve damage, heart damage, nausea, fatigue, insomnia, visual impairment, mood perturbation, sexual problems, dermatitis, and rarely jaundice. Degradation products of trichloroethylene (particularly phosgene) may cause rapid death due to respiratory collapse.

Carcinogenicity. Trichloroethylene is a probable human carcinogen via both oral and inhalation exposure, based on limited human evidence and sufficient animal evidence.

Environmental Fate. Trichloroethylene breaks down slowly in water in the presence of sunlight and bioconcentrates moderately in aquatic organisms. The main removal of trichloroethylene from water is via rapid evaporation.

Trichloroethylene does not photodegrade in the atmosphere, though it breaks down quickly under smog conditions, forming other pollutants such as phosgene, dichloroacetyl chloride, and formyl chloride. In addition, trichloroethylene vapors may be decomposed to toxic levels of phosgene in the presence of an intense heat source such as an open arc welder.

When spilled on the land, trichloroethylene rapidly volatilizes from surface soils. The remaining chemical leaches through the soil to groundwater.

Xylene (Mixed Isomers)

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylenes can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylenes (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur.

Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years.

Xylenes are volatile organic chemicals. As such, xylenes in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

IV.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 30 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 30
Pollutant Releases (Short Tons/Years)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	**3,851**	**16,424**	**1,185**	**3,136**	**4,019**	**102,186**
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

R0075995

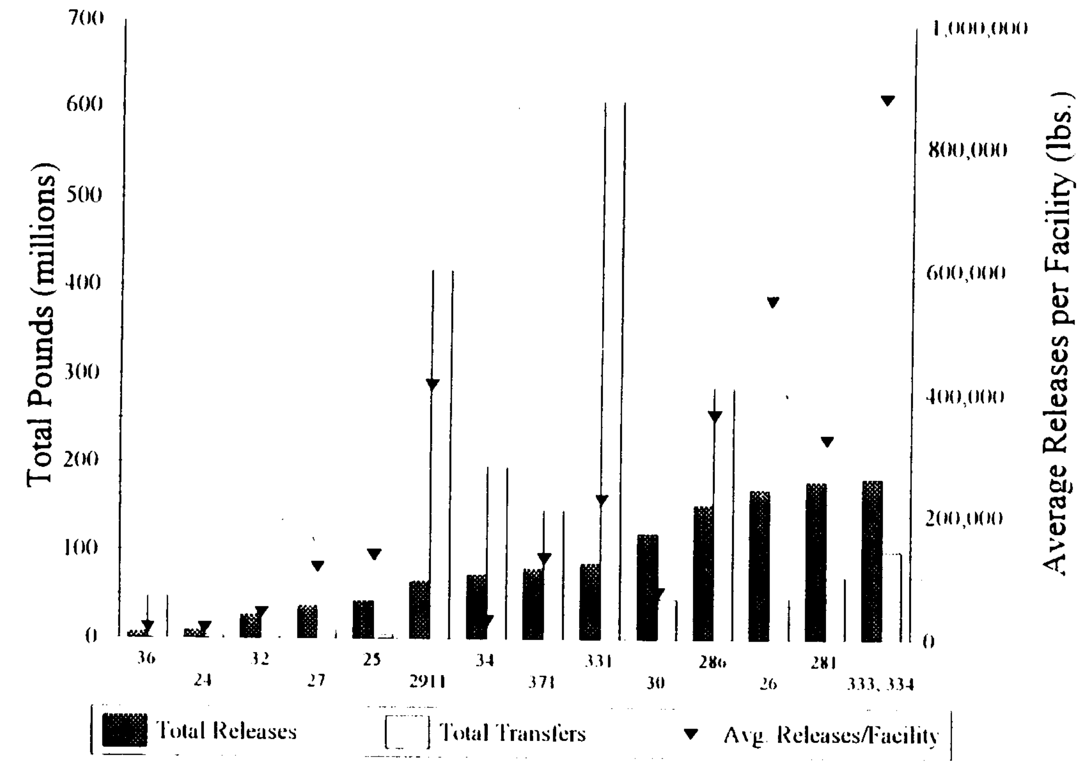
IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 31 is a graphical representation of a summary of the 1993 TRI data for the Fabricated Metals Products industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 32 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of Fabricated Metal Products industry, the 1993 TRI data presented here covers 2,363 facilities. These facilities listed SIC 34 (Fabricated Metal Products industry) as a primary SIC code.

R0075996

Exhibit 31: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accecessories	281	Inorganic Chemical Mfg
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0075997

Exhibit 32
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases		Transfers		Total Releases + Transfers (10^6 pounds)	Average Release+ Transfers per Facility (pounds)
			Total Releases (10^6 pounds)	Average Releases per Facility (pounds)	1993 Total (10^6 pounds)	Average Transfers per Facility (pounds)		
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	24	491	8.4	17,036	3.5	7,228	11.9	24,000
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronics/Computers	36	406	6.7	16,520	47.1	115,917	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	371	609	79.3	130,158	145.5	238,938	224.8	369,000
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	**34**	**2,363**	**72.0**	**30,476**	**195.7**	**82,802**	**267.7**	**123,000**
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,269	98.2	472,335	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the Fabricated Metal Products industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

V.A. Identification of Pollution Prevention Activities in Use and Environmental and Economic Benefits of Each Pollution Prevention Activity

Pollution prevention (sometimes referred to as source reduction) is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water or other resources, and practices that protect natural resources through conservation or more efficient use.

EPA and the Fabricated Metal Products industry are working together to promote pollution prevention because it is often the most cost-effective way to reduce pollution and the associated risks to human health and the environment. Pollution prevention is often cost effective because it may reduce raw material losses; reduce reliance on expensive "end-of-pipe" treatment technologies and disposal practices; conserve energy, water, chemicals, and other inputs; and mitigate the potential liability associated with waste generation and disposal. Pollution prevention often involves complex re-engineering however, and companies must balance the desired savings in materials and benefits to the environment against the cost of changing operating practices.

All companies in the Fabricated Metal Products industry, regardless of their size, must comply with environmental regulations related to metal fabricating and/or metal finishing processes. Therefore, all companies benefit from the knowledge of pollution prevention techniques which, if implemented, may increase a company's ability to meet these requirements. Many large companies have been successful in identifying and implementing pollution prevention and other techniques allowing them to operate in an efficient and environmentally protective manner. This capability may be due in part because large companies often have resources to devote to tracking and implementing pollution prevention techniques, and maintaining an awareness and understanding of regulations that apply to their facilities.

Smaller companies may have limited resources to devote to these activities, which may make monitoring and understanding regulations more difficult and may result in limited pollution prevention participation. Increased awareness and publication of pollution prevention techniques improve the ability of companies to comply with regulations. Pollution prevention techniques also permit industrial processes to be more efficient and less costly, providing all companies with an opportunity to maximize the efficiency of their operations and reduce their costs while protecting the environment.

Pollution Prevention techniques and processes currently used by the metal fabricating and finishing industry can be grouped into seven general categories:

- Production planning and sequencing
- Process or equipment modification
- Raw material substitution or elimination
- Loss prevention and housekeeping

- Waste segregation and separation
- Closed-loop recycling
- Training and supervision.

Each of these categories is discussed briefly below. Refer to Section V.D. for a list of specific pollution prevention techniques and associated costs, savings, and other information. It should be kept in mind that every pollution prevention option may not be available for each facility.

Production planning and sequencing is used to ensure that only necessary operations are performed and that no operation is needlessly reversed or obviated by a following operation. One example is to sort out substandard parts prior to painting or electroplating. A second example is to reduce the frequency with which equipment requires cleaning by painting all products of the same color at the same time. A third example is to schedule batch processing in a manner that allows the wastes or residues from one batch to be used as an input for the subsequent batch (e.g., to schedule paint formulation from lighter shades to darker) so that equipment need not be cleaned between batches.

Process or equipment modification is used to reduce the amount of waste generated. For example, manufacturers can change to a paint application technique that is more efficient than spray painting, reduce overspray by reducing the atomizing air pressure, reduce drag-out by reducing the withdrawal speed of parts from plating tanks, or improve a plating line by incorporating drag-out recovery tanks or reactive rinsing.

Raw material substitution or elimination is the replacement of existing raw materials with other materials that produce less waste, or a non-toxic waste. Examples include substituting alkali washes for solvent degreasers, and replacing oil with lime or borax soap as the drawing agent in cold forming.

Loss prevention and housekeeping is the performance of preventive maintenance and equipment and materials management so as to minimize opportunities for leaks, spills, evaporative losses, and other releases of potentially toxic chemicals. For example, spray guns can be cleaned in a manner that does not damage leather packings and cause the guns to leak; or drip pans can be placed under leaking machinery to allow recovery of the leaking fluid.

Waste segregation and separation involves avoiding the mixture of different types of wastes and avoiding the mixture of hazardous wastes with non-hazardous wastes. This makes the recovery of hazardous wastes easier by minimizing the number of different hazardous constituents in a given waste stream. It also prevents the contamination of non-hazardous wastes. Specific examples include segregating scrap metal by metal type, and segregating different kinds of used oils.

Closed-loop recycling is the on-site use or reuse of a waste as an ingredient or feedstock in the production process. For example, in-plant paper fiber waste can be collected and recycled to make pre-consumer recycled paper products.

Training and supervision provides employees with the information and the incentive to minimize waste generation in their daily duties. This might include ensuring that employees know and practice proper and efficient use of tools and supplies, and that they are aware of, understand, and support the company's pollution prevention goals.

V.B. Possible Pollution Prevention Future Trends

There are numerous pollution prevention trends in the metal fabrication and finishing industry. These include recycling liquids, employing better waste control techniques, using mechanical forms of surface preparation, and/or substituting raw materials. One major trend is the increased recycling (e.g., reuse) of most process liquids (e.g., rinse water, acids, alkali cleaning compounds, solvents, etc.) used during the metal forming and finishing processes. For instance, instead of discarding liquids, companies are containing them and reusing them to cut down on the volume of process liquids that must eventually be disposed of. Also, many companies are replacing aqueous plating with ion vapor deposition.

Another common approach to reducing pollution is to reduce rinse contamination via drag-out by slowing and smoothing the removal of parts (rotating them if necessary), maximizing drip time, using drainage boards to direct dripping solutions back to process tanks, and/or installing drag-out recovery tanks to capture dripping solutions. By slowing down the processes and developing structures to contain the dripping solutions, a facility can better control the potential wastes emitted.

To reduce the use of acids when cleaning parts, the industry is using and encouraging the use of mechanical scraping/scrubbing techniques to clean and prepare the metal surface. Emphasizing mechanical approaches would greatly diminish the need for acids, solvents, and alkalis. In addition to the mechanical technique for cleaning surfaces, companies are encouraged to substitute acids and solvents with less harmful liquids (e.g., alcohol). Section V.D. lists numerous specific pollution prevention techniques that have been employed in the industry.

V.C. Pollution Prevention Case Studies

Numerous pollution prevention case histories have been documented for the metal fabricating and finishing industries. Many of these have dealt primarily with electroplating or general finishing operations. The Eastside Plating case, presented in this section, is a classic example of the numerous pollution prevention techniques that can be implemented at an electroplating company. For other pollution prevention case studies, see section V.D. Pollution Prevention Options, and the list of pollution prevention contacts in section V.E.

Eastside Plating, an Oregon-based company, has made money complying with new environmental regulations. Under the direction of its Maintenance and Water Treatment Manager, the electroplating firm implemented operational changes that save more than $300,000 annually. Eastside Plating management made the commitment to implement a hazardous waste reduction program in 1982. By changing rinsing techniques, substituting materials, and segregating wastes for treatment, the firm has become a more cost-effective operation.

By setting priorities and upgrading in phases, the firm was able to work toward compliance yet meet increased demand for services during a period of rapid growth. The first operational modification addressed counterflow and cascade rinsing systems. The changes decreased water used for rinsing, a process that accounts for 90 percent of all water used in electroplating. In counterflow rinsing, water is used a number of times, thus dramatically reducing volume. Cascade rinsing requires only one tank with a center divider which allows water to spill into the other side. The filling/draining process is continuous and very slow to reduce the amount of water used. Both systems cut water bills and wastewater treatment costs.

Management next searched for waste treatment chemicals that decreased, rather than increased, the production of sludge. Total chromium and cyanide wastes were cut in half simply by changing reducing agents. Chromium acid wastes are now oxidized by using sodium bisulfite and sulfuric acid instead of ferrous sulfate, while cyanide reduction is now accomplished more efficiently with gaseous, instead of liquid, chlorine.

Eastside Plating also upgraded its three major waste treatment components: the cyanide oxidation tank, the chromium reduction tank, and the acid/alkaline neutralizing tank. The goal was to separate tank flow, eliminate contamination of the acid/alkaline neutralizing tank, and increase efficiency. Automated metering equipment reduced the quantity of costly caustic chemicals needed to treat acid wastes by 50 percent. To eliminate the risks associated with pump failure and the equalize flow rate, cyanide and chromic acid oxidation and reduction tanks were redesigned as gravity flow systems. Additionally, plumbing was segregated to prevent cross-contamination. These simple solutions saved Eastside Plating hundreds of thousands of dollars.

Next, management consulted with suppliers when they modified the company's mixing sump (sometimes called a reaction tank) and a flocculent mix tank (sometimes called a neutralizing tank). The modification to each prohibits 'indigestion' in the mixing sump interfering with the neutralization process. The suppliers helped resolve the problems of inadequate mixing by baffling the neutralization tank.

Since employees can make or break the best anti-pollution plan, Eastside Plating offers an extensive employee education program. The company says "it's a matter of changing how we do business." In addition, Eastside Plating's Safety Committee helps all employees work together more safely. Additionally, the company reported that working with regulators helped the company make the move toward compliance: "The City of Portland and the Department of Environmental Quality were more interested in helping us solve our problems than in blaming us."

Industry Pollution Prevention Activities

Several pollution prevention initiatives focus on the fabricated metal products industry. As identified below, some efforts include Georgia's Pollution Prevention Assistance Division (P^2AD) strategy, the Industrial Technology Corporation collaborative effort, and the Merit Partnership.

R0076004

Georgia Department of Natural Resources

A core strategy of the Pollution Prevention Assistance Division (P^2AD) of the Georgia Department of Natural Resources (DNR) is to focus technical assistance efforts on Georgia manufacturers that release chemicals posing the greatest risk to the public and the environment. After reviewing those industries which provide significant opportunities for pollution prevention, various strategies will be developed, including on-site technical assistance, financial assistance, fact sheets, workshops, and other outreach activities that will help manufacturers reduce their generation of toxic chemicals. The first phase is an on-going targeting effort, which evaluates waste generation characteristics of Georgia manufacturers producing toxic and hazardous wastes. The fabricated metal products industry was selected as a high priority manufacturing sector, along with the paper and paper products industry, chemical and allied products industry, transportation equipment industry, rubber and plastic products, and printing and publishing.

ITAC

The Industrial Technology Assistance Corporation (ITAC), in collaboration with the New York Branch of the AESF, the New York Masters Association of Metal Finishers, Utility Metal Research Corporation, and ten electroplating companies applied for and received funding to deliver a program coordinated and written by the Wastewater Technology Center of Canada. This is an industry-specific hands on 24 hour training session that integrates the assessment and incorporation of pollution prevention techniques into all types of electroplating and metal finishing operations. The training also includes an economic evaluation of the benefits of resource recovery on a multi-media basis.

Merit Partnership

The Merit Partnership brings industry and government representatives together to identify pollution prevention needs and accelerate pollution prevention technology diffusion. Merit partners and participants include EPA Region 9, The Metal Finishing Association of Southern California (MFASC), the National Institute of Standards and Testing/California Manufacturing Technology Center, EPA's Office of Research and Development/Risk Reduction Engineering Lab, large companies processing pollution prevention technologies applicable to the metal finishing industry, local regulatory agencies, and participating companies. The Merit Partnership is working closely with its members to develop metal finishing projects that are transferable to small businesses. There is an emphasis on having large companies that are involved with metal finishing share their proven metal finishing methods with smaller companies. The Merit Partnership and MFASC have already begun to identify programmatic areas for metal plating pollution prevention opportunities, from which potential projects will be chosen.

V.D. Pollution Prevention Options

The following sections list numerous pollution prevention techniques that may be useful to companies specializing in metal fabrication and finishing operations. These are options available to facilities, but are not to be construed as requirements. The information is organized by metal shaping, surface preparation, plating, and other finishing operations.

V.D.1. Metal Shaping Operations

Technique - Production Planning and Sequencing

Option 1 - Improve scheduling of processes that require use of varying oil types in order to reduce the number of cleanouts.

Technique - Process or Equipment Modification

Option 1 - Standardize the oil types used for machining, turning, lathing, etc. This reduces the number of equipment cleanouts, and the amount of leftovers and mixed wastes.

Option 2 - Use specific pipes and lines for each set of metals or processes that require a specific oil in order to reduce the amount of cleanouts.

Option 3 - Save on coolant costs by extending machine coolant life through the use of a centrifuge and the addition of biocides. **Costs and Savings:** Waste Savings/Reductions: 25 percent reduction in plant-wide waste coolant generation. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 4 - Install a second high speed centrifuge on a system already operating with a single centrifuge to improve recovery efficiency even more. **Costs and Savings:** Capital Investment: $126,000. Payback Period: 3.1 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 5 - Install a chip wringer to recover excess coolant on aluminum chips. **Costs and Savings**: Capital Investment: $11,000 to $23,000 (chip wringer and centrifuge system).Payback Period: 0.9 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 6 - Install a coolant recovery system and collection vehicle for machines not on a central coolant sump. **Costs and Savings:** Capital Investment: $104,000. Payback Period: 1.9 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 7 - Use a coolant analyzer to allow better control of coolant quality. **Costs and Savings:** Capital Investment: $5,000. Payback Period: 0.7 years. Product/Waste Throughput Information: based on handling 20,600 gallons of coolant per year.

Option 8 - Use an ultrafiltration system to remove soluble oils from wastewater streams. **Costs and Savings:** Annual Savings: $200,000 (in disposal costs). Product/Waste Throughput Information: based on a wastewater flow rate of 860 to 1,800 gallons per day.

Option 9 - Use disk or belt skimmers to remove oil from machine coolants and prolong coolant life. Also, design sumps for ease of cleaning. **Costs and Savings:** Waste Savings/Reduction: coolant is now disposed once per year rather than 3-6 times per year.

Technique - Raw Material Substitution

Option 1 - In cold forming or other processes where oil is used only as a lubricant, substitute a hot lime bath or borax soap for oil.

Option 2 - Use a stamping lubricant that can remain on the piece until the annealing process, where it is burned off. This eliminates the need for hazardous degreasing solvents and alkali cleaners. **Costs and Savings:** Annual Savings: $12,000 (results from reduced disposal, raw material, and labor costs). Waste Throughput Information: The amount of waste solvents and cleaners was reduced from 30,000 pounds in 1982 to 13,000 pounds in 1986. Employee working conditions were also improved by removing vapors associated with the old cleaners.

Technique - Waste Segregation and Separation

Option 1 - If filtration or reclamation of oil is required before reuse, segregate the used oils in order to prevent mixing wastes.

Option 2 - Segregation of metal dust or scrap by type often increases the value of metal for resale (e.g., sell metallic dust to a zinc smelter instead of disposing of it in a landfill). **Costs and Savings:** Capital Investment: $0. Annual Savings: $130,000. Payback Period: immediate. Waste Savings/Reduction: 2,700 tons per year. (Savings will vary with metal type and market conditions.)

Option 3 - Improve housekeeping techniques and segregate waste streams (e.g., use care when cleaning cutting equipment to prevent the mixture of cutting oil and cleaning solvent). **Costs and Savings:** Capital Investment: $0. Annual Savings: $3,000 in disposal costs. Waste Savings/Reduction: 66 percent (30 tons reduced to 10 tons).

Technique - Recycling

Option 1 - Where possible, recycle oil from cutting/machining operations. Often oils need no treatment before recycling. **Costs and Savings:** Capital Investment: $1,900,000. Annual Savings: $156,000. Waste Throughput Information: 2 million gallons per year. Facility reclaims oil and metal from process water.

Option 2 - Oil scrap mixtures can be centrifuged to recover the bulk of the oil for reuse.

Option 3 - Follow-up magnetic and paper filtration of cutting fluids with ultrafiltration. By so doing, a much larger percentage of cutting fluids can be reused. **Costs and Savings:** Capital Investment: $42,000 (1976). Annual Savings: $33,800 (1980).

Option 4 - Perform on-site purification of hydraulic oils using commercial "off-the-shelf" cartridge filter systems. **Costs and Savings:** Capital Investment: $28,000. Annual Savings: $17,800/year based on operating costs, avoided new oil purchase, and lost resale revenues. Payback Period: less than 2 years. Product/Waste Throughput Information: example facility handles 12,300 gallons/year of waste hydraulic oil.

Option 5 - Use a continuos flow treatment system to regenerate and reuse aluminum chemical milling solutions. **Costs and Savings:** Capital Investment: $465,000. Annual Savings: $342,000. Payback Period: less than 2 years. Waste Savings/Reduction: 90 percent

Option 6 - Use a settling tank (to remove solids) and a coalescing unit (to remove tramp oils) to recover metal-working fluids. **Costs and Savings:** Annual Savings: $26,800 (resulting from reduced material, labor, and disposal costs).

V.D.2. Surface Preparation Operations

SOLVENT CLEANING

Technique - Training and Supervision

Option 1 - Improve solvent management by requiring employees to obtain solvent through their shop foreman. Also, reuse "waste" solvents from cleaner up-stream operations in down-stream, machines shop-type processes. **Costs and Savings:** Capital Investnent: $0. Annual Savings: $7,200. Waste Savings/Reduction 49 percent (310 tons reduced to 152 tons). Product/Waste Throughput Information: original waste stream history: reactive anions (6,100 gallons/year), waste oils (1,250 gallons/year), halogenated solvents (500 gallons/year).

Technique - Production Planning and Sequencing

Option 1 - Pre-cleaning will extent the life of the aqueous or vapor degreasing solvent (wipe, squeeze, or blow part with air, shot, etc.). **Costs and Savings:** Annual Savings: $40,000. Payback Period: 2 years. Waste Savings/Reduction: 48,000 gallons of aqueous waste. Aluminum shot was used to preclean parts.

Option 2 - Use countercurrent solvent cleaning (i.e., rinse initially in previously used solvent and progress to new, clean solvent).

Options 3 - Cold clean with a recycled mineral spirits stream to remove the bulk of oil before final vapor degreasing.

Option 4 - Only degrease parts that must be cleaned. Do not routinely degrease all parts.

Technique - Process or Equipment Modification

Option 1 - The loss of solvent to the atmosphere from vapor degreasing equipment can be reduced by:

- increasing the freeboard height above the vapor level to 100 percent of tank width;
- covering the degreasing unit (automatic covers are available);
- installing refrigerator coils (or additional coils) above the vapor zone;
- rotating parts before removal from the vapor degreaser to allow all condensed solvent to return to degreasing unit;
- controlling the speed at which parts are removed (10 feet or less per minute is desirable) so as not to disturb the vapor line;
- installing thermostatic heating controls on solvent tanks; and
- adding in-line filters to prevent particulate buildup in the degreaser.

Option 2 - Reduce grease accumulation by adding automatic oilers to avoid excess oil applications.

Option 3 - Use plastic blast media for paint stripping rather than conventional solvent stripping techniques. **Costs and Savings:** Waste Savings/Reduction: volume of waste sludge is reduced by as much as 99 percent over chemical solvents; wastewater fees are eliminated.

Technique - Raw Material Substitution

Option 1 - Use less hazardous degreasing agents such as petroleum solvents or alkali washes. For example, replace halogenated solvents (e.g., trichloroethylene) with liquid alkali cleaning compounds. (Note that compatibility of aqueous cleaners with wastewater treatment systems should be ensured.) **Costs and Savings:** Capital Investment: $0. Annual Savings: $12,000. Payback Period: immediate. Waste Savings/Reduction: 30 percent of 1,1,1-trichloroethane replaced with an aqueous cleaner.

Option 2 - Substitute chromic acid cleaner with non-fuming cleaners such as sulfuric acid and hydrogen peroxide. **Costs and Savings:** Annual Savings: $10,000 in treatment equipment costs and $2.50/lb. of chromium in treatment chemical costs. Product/Waste Throughput Information: rinse water flowrate of 2 gallons per minute.

Option 3 - Substitute less polluting cleaners such as trisodium phosphate or ammonia for cyanide cleaners. **Costs and Savings:** Annual Savings: $12,000 in equipment costs and $3.00/lb. of cyanide in treatment chemical costs. Product/Waste Throughput Information: rinse water flowrate of 2 gallons per minute.

Technique - Recycling

Option 1 - Recycle spent degreasing solvents on site using batch stills. **Costs and Savings:** Capital Investment: $2,600-$4,100 and $4,200-$17,000. Product Throughput Information: 35-60 gallons per hour and 0.6-20 gallons per hour, respectively. Two cost and throughput estimates for distillation units from two vendors.

Option 2 - Use simple batch distillation to extend the life of 1,1,1-trichloroethane. **Costs and Savings:** Capital Investment: $3,500 (1978). Annual Savings: $50,400. Product/Waste Throughput Information: facility handles 40,450 gallons 1,1,1-trichloroethane per year.

Option 3 - When on-site recycling is not possible, agreements can be made with supply companies to remove old solvents. **Costs and Savings:** Capital Investment: $3,250 for a temporary storage building. Annual Savings: $8,260. Payback Period: less than 6 months. Waste Savings/Reduction: 38,000 pounds per year of solvent sent off site for recycling.

Option 4 - Arrange a cooperative agreement with other small companies to centrally recycle solvent.

CHEMICAL TREATMENT

Technique - Process or Equipment Modification

Option 1- Increase the number of rinses after each process bath and keep the rinsing counter-current in order to reduce drag-out losses.

Option 2 - Recover unmixed acids in the wastewater by evaporation.

Option 3 - Reduce rinse contamination via drag-out by:

- slowing and smoothing removal of parts, rotating them if necessary;
- using surfactants and other wetting agents;
- maximizing drip time;
- using drainage boards to direct dripping solutions back to process tanks;
- installing drag-out recovery tanks to capture dripping solutions;
- using a fog spray rinsing technique above process tanks;
- using techniques such as air knives or squeegees to wipe bath solutions off of the part; and
- changing bath temperature or concentrations to reduce the solution surface tension.

Option 4 - Instead of pickling brass parts in nitric acid, place them in a vibrating apparatus with abrasive glass marbles or steel balls. A slightly acidic additive is used with the glass marbles, and a slightly basic additive is used with the steel balls. **Costs and Savings:** Capital Investment: $62,300 (1979); 50 percent less than conventional nitric acid pickling.

Option 5 - Use mechanical scraping instead of acid solution to remove oxides of titanium. **Costs and Savings:** Annual Savings: $0; cost of mechanical stripping equals cost of chemical disposal. Waste Savings/Reduction: 100 percent. Waste Throughput Information: previously disposed 15 tons/year of acid with metals.

Option 6 - For cleaning nickel and titanium alloy, replace alkaline etching bath with a mechanical abrasive system that uses a silk and carbide pad and pressure to clean or "brighten" the metal. **Costs and Savings:** Capital Investment: $3,250. Annual Savings: $7,500. Waste Savings/Reduction: 100 percent. Waste Throughput Information: previous etching bath waste total was 12,000 gallons/year.

Option 7 - Clean copper sheeting mechanically with a rotating brush machine that scrubs with pumice, instead of cleaning with ammonium persulfate, phosphoric acid, or sulfuric acid; may generate non-hazardous waste sludge. **Costs and Savings:** Capital Investment: $59,000. Annual Savings: more than $15,000. Payback Period: 3 years. Waste Savings/Reduction: 40,000 pounds of copper etching waste reduced to zero.

Option 8- Reduce molybdenum concentration in wastewaters by using a reverse osmosis/precipitation system. **Costs and Savings:** Capital Investment: $320,000. Waste Throughput Information: permeate capacity of 18,000 gallons per day. Savings Relative to an Evaporative System: installed capital cost savings: $150,000; annual operating cost savings: $90,000.

Option 9 - When refining precious metals, reduce the acid/metals waste stream by maximizing reaction time in the gold and silver extraction process. **Costs and Savings:** Capital Investment: $0. Annual Savings: $9,000. Waste Savings/Reduction: 70 percent (waste total reduced from 50 tons to 15 tons).

Technique - Raw Material Substitution

Option 1 - Change copper bright-dipping process from a cyanide dip and chromic acid dip to a sulfuric acid/hydrogen peroxide dip. The new bath is less toxic and copper can be recovered.

Option 2 - Use alcohol instead of sulfuric acid to clean copper wire. One ton of wire requires 4 liters of alcohol solution, versus 2 kilograms of sulfuric acid. **Costs and Savings:** Capital Investment: $0.

Option 3 - Replace caustic wire cleaner with a biodegradable detergent.

Option 4 - Replace chromated desmutting solutions with nonchromated solutions for alkaline etch cleaning of wrought aluminum. **Costs and Savings:** Annual Savings: $44,541. Waste Savings/Reduction: sludge disposal costs reduced by 50 percent.

Option 5 - Replace barium and cyanide salt heat treating with a carbonate/chloride carbon mixture, or with furnace heat treating.

Option 6 - Replace thermal treatment of metals with condensation of saturated chlorite vapors on the surface to be heated. **Costs and Savings:** Waste Savings/Reduction: this process is fast, nonoxidizing, and uniform; pickling is no longer necessary.

Technique - Recycling

Option 1 - Sell waste pickling acids as feedstock for fertilizer manufacture or neutralization/precipitation.

Option 2 - Recover metals from solutions for resale. **Costs and Savings:** Annual Savings: $22,000. Payback Period: 14 months. Company sells copper recovered from a bright-dip bath regeneration process employing ion exchange and electrolytic recovery.

Option 3 - Send used copper pickling baths to a continuous electrolysis process for regeneration and copper recovery. **Costs and Savings:** Capital Investment: $28,500 (1977). Product Throughput Information: pickling 12,000 tons of copper; copper recovery is at the rate of 200 gallons/ton of processed copper.

Option 4 - Recover copper from brass bright dipping solutions using a commercially available ion exchange system. **Costs and Savings:** Annual Savings: $17,047; based on labor savings, coppers sulfate elimination, sludge reduction, copper metal savings, and bright dip chemicals savings. Product Throughput Information: example facility processes approximately 225,000 pounds of brass per month.

Option 5 - Treat industrial wastewater high in soluble iron and heavy metals by chemical precipitation. **Costs and Savings:** Annual Savings: $28,000; based on reduced water and sewer rates. Waste Throughput Information: wastewater flow from facility's "patening" line is 100 gallons per minute.

Option 6 - Oil quench baths may be recycled on site by filtering out the metals.

Option 7 - Alkaline wash life can be extended by skimming the layer of oil (the skimmed oil may be reclaimed).

V.D.3. Plating Operations

Technique - Training and Supervision

Option 1 - Educate plating shop personnel in the conservation of water during processing and in material segregation.

Technique - Production Planning and Sequencing

Option 1 - Preinspect parts to prevent processing of obvious rejects.

Technique - Process or Equipment Modification

Option 1 - Modify rinsing methods to control drag-out by:
- Increasing bath temperature
- Decreasing withdrawal rate of parts from plating bath
- Increasing drip time over solution tanks; racking parts to avoid cupping solution within part cavities
- Shaking, vibrating, or passing the parts through an air knife, angling drain boards between tanks
- Using wetting agents to decrease surface tension in tank.

Contact: Braun Intertec Environmental, Inc., and MN Office of Waste Management (612) 649-5750.

Option 2 - Utilize water conservation methods including:
- Flow restrictors on flowing rinses
- Counter current rinsing systems
- Fog or spray rinsing
- Reactive rinsing
- Purified or softened water
- Dead rinses
- Conductivity controllers
- Agitation to assure adequate rinsing and homogeneity in rinse tank
- Flow control valves.

Contact: Braun Intertec Environmental, Inc., and MN Office of Waste Management (612) 649-5750.

Option 3 - Implement counter flow rinsing and cascade rinsing systems to conserve consumption of water. **Costs and Savings:** Costs: $75,000 to upgrade existing equipment and purchasing new and used equipment. Waste Savings/Reduction: reduce water use and wastewater treatment costs. **Contact:** Eastside Plating and OR Department of Environmental Quality (800)452-4011.

Option 4 - Use drip bars to reduce drag-out. **Costs and Savings:** Capital Investment: $100 per tank. Savings: $600. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 5 - Use drain boards between tanks to reduce generations of drag-out. **Costs and Savings:** Capital Investment: $25 per tank. Savings: $450. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 6 - Install racking to reduce generations of drag-out. **Costs and Savings:** Capital Investment: zero dollars. Operating Costs: minimal. Savings: $600. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 7 - Employ drag out recovery tanks to reduce generations of drag-out. **Costs and Savings:** Capital Investment: $500 per tank. Savings: $4,700. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 8 - Install counter-current rinsing operation to reduce water consumption. **Costs and Savings:** Capital Investment: $1,800-2,300. Savings: $1,350 per year. Waste Savings/Reductions: reduce water use by 90-99 percent. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 9 - Redesign rinse tank to reduce water conservation. **Costs and Savings:** Capital Investment: $100. Savings: $750 per year. **Contact:** NC Department of Natural Resources & Community Development, Gary Hunt (919) 733-7015.

Option 10 - Increase parts drainage time to reduce drag-out. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 11 - Regenerate plating bath by activated carbon filtration to remove built up organic contaminants. **Costs and Savings:** Capital Investment: $9,192. Costs: $7,973. Savings: $122,420. Waste Savings/Reduction: 10,800 gallons. Reduce volume of plating baths disposed and requirements for virgin chemicals. **Contact:** EPA Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, Harry Freeman.

Option 12 - Install pH controller to reduce the alkaline and acid concentrations in tanks. **Contact:** Securus, Inc., and DBA Hubbard Enterprises.

Option 13 - Install atmospheric evaporator to reduce metal concentrations. **Contact:** Securus, Inc., and DBA Hubbard Enterprises.

Option 14 - Install process (e.g., CALFRAN) to reduce pressure to vaporize water at cooler temperatures and recycle water by condensing the vapors in another container, thus concentrating and precipitating solutes out. **Costs and Savings:** Waste Savings/Reduction: reduce volume and quantity of aqueous waste solutions by recovering pure water. **Contact:** CALFRAN International, Inc., (413) 525-4957.

Option 15 - Use reactive rinsing and multiple drag-out baths. **Costs and Savings:** Savings: Reduce cost of treating spent process baths and rinse waters. Waste Savings/Reduction: increase lifetime of process baths and reduce the quantity or rinse water requiring treatment. **Contact:** SAIC, Edward R. Saltzberg.

Option 16 - Improve control of water level in rinse tanks, improve sludge separation, and enhance recycling of supernatant to the process by aerating the sludge. **Costs and Savings:** Savings: $2,000. Waste Savings/Reduction: reduce sludge generation by 32 percent. **Contact:** NJ Hazardous Waste Facilities Siting Commission, Hazardous Waste Source Reduction and Recycling Task Force.

Option 17 - Install system (e.g., Low Solids Fluxer) that applies flux to printed wiring boards, leaving little residue and eliminates the need for cleaning CFCs. **Costs and Savings:** Waste Savings/Reduction: reduce CFC emissions over 50 percent. **Contact:** AT&T Bell Laboratories, Princeton, NJ.

Technique - Raw Material Substitution

Option 1 - Substitute cyanide plating solutions with alkaline zinc, acid zinc, acid sulfate copper, pyrophosphate copper, alkaline copper, copper fluoborate, electroless nickel, ammonium silver, halide silver, methanesulfonate-potassium iodide silver, amino or thio complex silver, no free cyanide silver, cadmium chloride, cadmium sulfate, cadmium fluoborate, cadmium perchlorate, gold sulfite, and cobalt harden gold. **Contact:** Braun Intertec Environmental Inc., and MN Office of Waste Management (612) 649-5750.

Option 2 - Substitute sodium bisulfite and sulfuric acid for ferrous sulfate in order to oxidize chromic acid wastes, and substitute gaseous chlorine for liquid chlorine in order to reduce cyanide reduction. **Costs and Savings:** Savings: $300,000 per year. Waste Savings/Reduction: reduces feedstock by 50 percent. **Contact:** Eastside Plating and OR Department of Environmental Quality (800) 452-4011.

Option 3 - Replace hexavalent chromium with trivalent chromium plating systems. **Contact:** City of Los Angeles Hazardous and Toxic Material Project. Board of Public Works (213) 237-1209.

Option 4 - Replace cyanide with non-cyanide baths. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 5 - Replace conventional chelating agents such as tartarates, phosphates, EDTA, and ammonia with sodium sulfides and iron sulfates in removing metal from rinse water which reduces the amount of waste generated from precipitation of metals from aqueous wastestreams. **Costs and Savings:** Costs: $178,830 per year. Savings: $382,995 per year. Waste Savings/Reduction: 496 tons of sludge per year. **Contact:** Tyndall Air Force Base, FL, (904) 283-2942, Charles Carpenter, Dan Sucia, Penny Wilcoff; and John Beller at EG&G (108) 526-1149.

Option 6 - Replace methylene chloride, 1,1,1-trichloroethane, and perchloroethylene (solvent-based photochemical coatings) with aqueous base coating of 1 percent sodium carbonate. **Costs and Savings:** Waste Savings/Reduction: reduce solvent use by 60 tons per year. **Contact:** American Etching and Manufacturing, Pacoima, CA.

Option 7 - Replace methanol with nonflammable alkaline cleaners. **Costs and Savings:** Waste Savings/Reduction: eliminate 32 tons per year of flammable methyl alcohol. **Contact:** American Etching and Manufacturing, Pacoima, CA.

Option 8 - Substitute a non-cyanide for a sodium cyanide solution used in copper plating baths. **Costs and Savings:** Waste Savings/Reduction: reduce 7,630 pounds per year. Contact: Highland Plating Company, Los Angeles, CA.

Technique - Waste Segregation and Separation

Option 1 - Wastewaters containing recoverable metals should be segregated from other wastewater streams.

Technique - Recycling

Option 1 - Install ion exchange system to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $78,000. Operating Costs: $3,200 per year. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 2 - Employ reverse osmosis system to reduce generation of drag-out. **Costs and Savings:** Savings: $40,000 per year. Capital Investment: $62,000. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 3 - Use electrolytic metal recovery to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $1,000. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 4 - Utilize electrodialysis to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $50,000. **Contact:** NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program Gary Hunt (919) 733-7015.

Option 5 - Implement evaporative recovery to reduce generation of drag-out. **Costs and Savings:** Capital Investment: $2,500. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 6- Reuse rinse water. **Costs and Savings:** Savings: $1,500 per year. Capital Investment: $340 per tank. No direct costs. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 7- Reuse drag-out waste back into process tank. **Contact:** NC Department of Natural Resources & Community Development; Gary Hunt (919) 733-7015.

Option 8- Recover process chemicals with fog rinsing parts over plating bath. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 9- Evaporate and concentrate rinse baths for recycling. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 10 - Use ion exchange and electrowinning, reverse osmosis, and thermal bonding when possible. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 11 - Use sludge slagging techniques to extract and recycle metals. **Costs and Savings:** Capital Investment: $80,000 for 80 tons/year and $400,000 for 1,000 tons/year. Operating Costs: $18,000 per year for an 80 ton facility. Waste Savings/Reduction: reduces volume of waste by 94 percent. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 12 - Use hydrometallurgical processes to extract metals from sludge. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 13- Convert sludge to smelter feed. **Contact:** City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works (213) 237-1209.

Option 14- Remove and recover lead and tin from boards by electrolysis or chemical precipitation. **Contact:** Control Data Corporation and MN Office of Waste Management (612) 649-5750.

Option 15 - Install a closed loop batch treatment system for rinse water to reduce water use and waste volume. **Costs and Savings:** Savings: $58,460 per year. Capital Investment: $210,000. Waste Savings/Reduction: 40,000 gallons per year (40 percent). **Contact:** Pioneer Metal Finishing, Inc., Harry Desoi (609) 694-0400.

Option 16 - Install an electrolytic cell which recovers 92 percent of dissolved copper in drag-out rinses and atmospheric evaporator to recover 95 percent of chromatic acid drag-out, and recycle it into chromic acid etch line. **Contact:** Digital Equipment Corporation and Lancy International Consulting Firm, William McLay (412) 452-9360.

Option 17 - Implement the electrodialysis reversal process for metal salts in wastewater. **Costs and Savings**: Savings: $40,100 per year in operating costs. **Contact:** Ionics, Inc., Separations Technology Division.

Option 18 - Oxidize cyanide and remove metallic copper to reduce metal concentrations. **Contact:** Securus, Inc. and DBA Hubbard Enterprises.

V.D.4. Other Finishing Operations

FINISHING OPERATIONS

Technique - Training and Supervision

Option 1 - Always use proper spraying techniques.

Option 2 - Improved paint quality, work efficiency, and lower vapor emissions can be attained by formal training of operators.

Option 3 - Avoid buying excess finishing material at one time due to its short shelf-life.

Technique - Production Planing and Sequencing

Option 1 - Use the correct spray gun for particular applications:
- conventional air spray gun for thin-film-build requirements
- airless gun for heavy film application
- air assisted airless spray gun for a wide range of fluid output.

Option 2 - Preinspect parts to prevent painting of obvious rejects.

Technique - Process or Equipment Modification

Option 1 - Ensure the spray gun air supply is free of water, oil, and dirt.

Option 2 - Replace galvanizing processes requiring high temperature and flux with one that is low temperature and does not require flux. **Costs and Savings:** Capital Investment: $900,000. Annual Savings: 50 percent (as compared to conventional galvanizing). Product Throughput Information: 1,000 kg/h.

Option 3 - Investigate use of transfer methods that reduce material loss such as:
- dip and flow coating
- electrostatic spraying
- electrodeposition.

Option 4 - Change from conventional air spray to an electrostatic finishing system. **Costs and Savings:** $15,000 per year. Payback Period: less than 2 years.

Option 5 - Use solvent recovery or incineration to reduce the emissions of volatile organics from curing ovens. **Costs and Savings:** Annual Savings: $400,000.

Option 6 - Regenerate anodizing and alkaline silking baths with contemporary recuperation of aluminum salts. **Costs and Savings:** $0.20 per meter of aluminum treated per year. Waste Throughput Information: based on an example plant that previously disposed 180,000 liters of acid solution per year at $0.07 per litre.

Technique - Raw Material Substitution

Option 1 - Use alternative coatings for solvent based paints to reduce volatile organic materials use and emissions, such as:

- high solids coatings (this may require modifying the painting process; including high speed/high pressure equipment, a paint distributing system, and paint heaters); **Costs and Savings:** Waste Savings/Reduction: 30 percent net savings in applied costs per square foot.

- water based coatings - **Costs and Savings:** Waste Savings/Reduction: 87 percent drop in solvent emissions and decreased hazardous waste production;

- powder coatings - **Costs and Savings:** Capital Investment: $1.5 million. Payback Period: 2 years. Example is for a large, wrought iron patio furniture company.

Technique - Waste Segregation and Separation

Option 1 - Segregate non-hazardous paint solids from hazardous paint solvents and thinners.

Technique - Recycling

Option 1 - Do not dispose of extended shelf life items that do not meet your facility's specifications. They may be returned to the manufacturer, or sold or donated as a raw material.

Option 2 - Recycle metal sludges through metal recovery vendors.

Option 3 - Use activated carbon to recover solvent vapors, then recover the solvent from the carbon by steam stripping, and distill the resulting water/solvent mixture. **Costs and Savings:** Capital Investment: $817,000 (1978). Waste Savings/Reduction: releases of solvent to the atmosphere were reduced from 700 kg/ton of solvent used to 20 kg/ton.

Option 4 - Regenerate caustic soda etch solution for aluminum by using hydrolysis of sodium aluminate to liberate free sodium hydroxide and produce a dry, crystalline hydrate alumina byproduct. **Costs and Savings:** Capital Investment: $260,000. Savings: $169,282 per year; from reduced caustic soda use, income from the sale of the byproduct, and a reduction in the cost of solid waste disposal. Payback Period: 1.54 years. Product/Waste Throughput Information: anodizing operation for which the surface area is processed at a rate of 200 M^2/hour.

PAINT CLEANUP

Technique - Production Planning and Sequencing

Option 1 - Reduce equipment cleaning by painting with lighter colors before darker ones.

Option 2 - Reuse cleaning solvents for the same resin system by first allowing solids to settle out of solution.

Option 3 - Flush equipment first with dirty solvent before final cleaning with virgin solvent. **Costs and Savings:** Waste Savings/Reduction: 98 percent; from 25,000 gallons of paint cleanup solvents to 400 gallons. Company uses cleanup solvents in formulation of subsequent batches.

Option 4 - Use virgin solvents for final equipment cleaning, then as paint thinner.

Option 5 - Use pressurized air mixed with a mist of solvent to clean equipment.

Technique - Raw Material Substitution

Option 1 - Replace water-based paint booth filters with dry filters. Dry filters will double paint booth life and allow more efficient treatment of wastewater. **Costs and Savings:** Savings per year: $1,500. Waste Savings/Reduction: 3,000 gallons/year.

Technique - Loss Prevention and Housekeeping

Option 1 - To prevent spray gun leakage, submerge only the front end (or fluid control) of the gun into the cleaning solvent.

Technique - Waste Segregation and Separation

Option 1 - Solvent waste streams should be kept segregated and free from water contamination.

Technique - Recycling

Option 1 - Solvent recovery units can be used to recycle spent solvents generated in flushing operations.

- Install a recovery system for solvents contained in air emissions. **Costs and Savings:** Savings: $1,000 per year.
- Use batch distillation to recover isopropyl acetate generated during equipment cleanup. **Costs and Savings:** Payback Period: 2 years.
- Use batch distillation to recover xylene from paint equipment cleanup. **Costs and Savings:** Payback Period: 13 months. Savings: $5,000 per year.
- Use a small solvent recovery still to recover spent paint thinner from spray gun cleanups and excess paint batches. **Costs and Savings:** Capital Investment: $6,000 for a 15 gallons capacity still. Savings: $3,600 per year in new thinner savings; $5,400 in disposal savings. Payback Period: less than 1 year. Waste Savings/Reduction: 75 percent (745 gallons of thinner recovered from 1,003 gallons). Product/Waste Throughput Information: 1,500 gallons of spent thinner processed per year.
- Install a methyl ethyl ketone solvent recovery system to recover and reuse waste solvents. **Costs and Savings:** Savings: $43,000 per year; MEK recovery rate: 20 gallons per day, reflecting a 90 percent reduction in waste.

Option 2 - Arrange an agreement with other small companies to jointly recycle cleaning wastes.

V.E. Pollution Prevention Contacts

Organization	Technique(s) to Promote Pollution Prevention Plating Operations	Telephone Number
Braun Intertec Environmental, Inc. Minnesota Office of Waste Management	Process or Equipment Modification Raw Material Substitution	(612) 649-5750
Eastside Plating Oregon Department of Environmental Quality	Process or Equipment Modification Raw Material Substitution	(800) 452-4011
North Carolina Department of Natural Resources & Community Development (Gary Hunt)	Process or Equipment Modification Recycling	(919) 733-7015
City of Los Angeles Hazardous and Toxic Material Project, Board of Public Works	Process or Equipment Modification Raw Material Substitution Recycling	(213) 237-1209
EPA Hazardous Waste Engineering Research Laboratory, Cincinnati, OH (Harry Freeman)	Process or Equipment Modification	
Securus, Inc. DBA Hubbard Enterprises	Process or Equipment Modification Recycling	

Organization	Technique(s) to Promote Pollution Prevention Plating Operations	Telephone Number
CALFRAN International, Inc.	Process or Equipment Modification	(413) 525-4957
SAIC (Edward R. Saltzberg)	Process or Equipment Modification	
New Jersey Hazardous Waste Facilities Siting Commission, Hazardous Waste Source Reduction and Recycling Task Force	Process or Equipment Modification	
AT&T Bell Laboratories, Princeton, NJ	Process or Equipment Modification	
Tyndall Air Force Base (Charles Carpenter)	Raw Material Substitution	(904) 283-2942
EG&G Idaho (Dan Sucia, Penny Wilcoff, John Beller)		(208) 526-1149
American Etching and Manufacturing, Pacoima, CA	Raw Material Substitution	
Highland Plating Company, Los Angeles, CA	Raw Material Substitution	
Control Data Corporation Minnesota Office of Waste Management	Recycling	(612) 649-5750
Pioneer Metal Finishing, Inc. (Harry Desoi)	Recycling	(609) 694-0400
Digital Equipment Corporation Lancy International Consulting Firm (William McLay)	Recycling	(412) 452-9360
Ionics, Inc., Separations Technology Division	Recycling	

R0076020

VI. Summary of Applicable Federal Statutes and Regulations

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements so that the reader is aware of these requirements. The section provides a summary of each major environmental statute, and a description of regulations that may specifically apply to the profiled industry. Some profiles also provide information regarding current rulemaking activity that might specifically impact this sector. The descriptions within Section VI are intended solely for guidance. No statutory or regulatory requirements are in any way altered by any statement(s) contained herein. For more in-depth information, readers should consult the United States Code and the Code of Federal Regulations as well as State or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.B. Industry Specific Regulations

A number of statutes and regulations affect the metal fabrication and finishing industry. The electroplating and metal finishing pretreatment standards promulgated under the Clean Water Act regulate the chemicals in wastewater, the Clean Air Act regulates air emissions, and the Resource Conservation and Recovery Act regulates hazardous waste generation, transportation, treatment, storage, and disposal. Each is discussed briefly below.

Clean Water Act (CWA)

Two Clean Water Act regulations affect the fabricated metal products industry (SIC 34): the Effluent Guidelines and Standards for Metal Finishing (40 CFR Part 433) and the Effluent Guidelines and Standards for Electroplating (40 CFR Part 413). The regulations targeting the electroplating industry were issued before those targeting the metal finishing industry as a whole. Companies regulated by the electroplating standards (40 CFR Part 413) before the metal finishing standards (40 CFR Part 433) were promulgated, become subject to the requirements of the metal finishing standards when (or if) they make modifications to their facility's operating functions (e.g., facility, equipment, process modifications). If companies made no such modifications, they remain regulated by the electroplating standards. All new facilities are subject to the standards set forth in 40 CFR Part 433.

The Effluent Guidelines and Standards for Metal Finishing (40 CFR Part 433) are applicable to wastewater generated by any of these operations:

- Electroplating
- Electroless Plating
- Anodizing
- Coating
- Chemical Etching and Milling
- Printed Circuit Board Manufacturing.

If any of the above processes are performed, the metal finishing standards will also apply to discharges from 40 additional processes, including: cleaning, polishing, shearing, hot dip coating, solvent degreasing, painting, etc.

The standards include daily maximums and maximum monthly average concentration limitations. The standards are based on milligrams per square meter of operation and determine the amount of wastewater pollutants from various operations that may be discharged. The uniformity in standards meets industry requests for equivalent limits for process lines often found together. The metal finishing standards also reduce the need to use the Combined Wastestream Formula.

Specific pretreatment standards may also apply to wastewater discharges from other metal finishing operations. The more specific standards will apply to those metal finishing wastestreams which appear to be covered by both standards. The requirements in the following regulations take precedence over those contained in the general metal finishing regulation:

- Iron and Steel Manufacturing (40 CFR Part 420)
- Battery Manufacturing (40 CFR Part 461)
- Plastic Molding and Forming (40 CFR Part 463)
- Coil Coating (40 CFR Part 465)
- Porcelain Enameling (40 CFR Part 466)

- Aluminum Forming (40 CFR Part 467)
- Copper Forming (40 CFR Part 468)
- Electrical and Electronic Components (40 CFR Part 469)
- Nonferrous Forming (40 CFR Part 471)
- Lead-Tin-Bismuth Forming Category (40 CFR Part 471, Subpart A)
- Zinc Forming Subcategory (40 CFR Part 471, Subpart H).

The Effluent Guidelines and Standards for Electroplating (40 CFR Part 413) cover wastewater dischargers from electroplating operations, in which metal is electroplated on any basis material, and to related metal finishing operations. As stated previously, facilities regulated by the electroplating standards may become subject to the metal finishing standards if they make modifications to their facility's operating functions (e.g., facility, equipment, process modifications). Independent printed circuit board manufacturers are defined as facilities which manufacture printed circuit boards principally for sale to other companies. These facilities remain subject only to the electroplating standards (40 CFR Part 413), primarily to minimize the economic impact to these relatively small facilities. Also excluded from the metal finishing regulations are facilities which perform metallic platemaking and gravure cylinder preparation conducted within printing and publishing facilities.

Operations similar to electroplating which are specifically exempt from coverage under the electroplating standards include:

- Continuous strip electroplating conducted within iron and steel manufacturing facilities (40 CFR Part 420)
- Electrowinning and electrorefining conducted as part of nonferrous metal smelting and refining (40 CFR Part 421)
- Electrodeposition of active electrode materials, electroimpregnation, and electroforming conducted as part of battery manufacturing (40 CFR Part 461)
- Metal surface preparation and conversion coating conducted as part of coil coating (40 CFR Part 465)
- Metal surface preparation and immersion plating or electroless plating conducted as a part of porcelain enameling (40 CFR Part 466)

- Metallic platemaking and gravure cylinder preparation conducted within printing and publishing facilities
- Surface treatment including anodizing and conversion coating conducted as part of aluminum forming (40 CFR Part 467).

Clean Air Act (CAA)

The following standards and requirements promulgated under the CAA apply to metal finishing processes:

- National Emission Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks (40 CFR Parts 9 and 63, Subpart N, 60 FR 498, January 1995)
- Standards of Performance for Surface Coating of Metal Furniture (40 CFR Part 60, Subpart EE)
- Standards of Performance for Automobile and Light-Duty Truck Surface Coating Operations (40 CFR Part 60, Subpart MM)
- Standards of Performance for Industrial Surface Coatings: Large Appliances (40 CFR Part 60, Subpart SS)
- Standards of Performance for Metal Coil Surface Coating (40 CFR Part 60, Subpart TT)
- Standards of Performance for the Beverage Can Surface Coating Industry (40 CFR Part 60, Subpart WW)
- Standards of Performance for Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines (40 CFR Part 60, Subpart TTT).

These standards and requirements, although to varying degrees, regulate the discharge of volatile organic chemicals (VOCs).

Resource Conservation and Recovery Act (RCRA)

The greatest quantities of RCRA listed waste and characteristic hazardous waste present in the fabricated metal products industry are identified in Exhibit 33. For more information on RCRA hazardous waste, refer to 40 CFR Part 261.

Exhibit 33
Hazardous Wastes Relevant to the Metal Finishing Industry

EPA Hazardous Waste No.	Hazardous Waste
D006 (cadmium) D007 (chromium) D008 (lead) D009 (mercury) D010 (selenium) D011 (silver)	Wastes which are hazardous due to the characteristic of toxicity for each of the constituents.
F001	Halogenated solvents used in degreasing: tetrachloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	Spent halogenated solvents; tetrachloroethylene, methylene chloride, trichlorethylene, 1,1,1-trichloroethane chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, one or more of the above halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	Spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of 10 percent or more (by volume) of one of those solvents listed in F001, F002, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	Spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005	Spent non-halogenated solvents: toluene, methy ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures.
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
F007	Spent cyanide plating bath solutions from electroplating operations.
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.

R0076037

Exhibit 33
Hazardous Wastes Relevant to the Metal Finishing Industry

EPA Hazardous Waste No.	Hazardous Waste
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.
F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.
F012	Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process.
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum from zirconium phosphating is an exclusive conversion coating process.
K090	Emission control dust or sludge from ferrochromiumsilicon production (ferroalloy industry).
K091	Emission control dust or sludge from ferrochromium production (ferroalloy industry).

Source: Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, OERR, June 1994.

VI.C. Pending and Proposed Regulatory Requirements

Clean Water Act (CWA)

The effluent guidelines and standards for Electroplaters (40 CFR Part 413) and Metal Finishers (40 CFR Part 433) are currently under review. EPA is also currently developing effluent guidelines and standards for the metal products and machinery industry (40 CFR Part 438), which are due by May 1996. It appears that EPA will integrate new regulatory options for the metal finishing industry into this new guideline. Under the anticipated scenario, effluent guidelines for electroplaters and metal finishers would most likely reference appropriate sections of the guideline for the metal products and machinery industry. In is unclear, however, how "job shop" operations, which are not part of the metal products and machinery industry, would be covered under this scenario.

For Phase I of the regulation, EPA will propose effluent limitation guidelines for facilities that generate wastewater while processing metal parts, metal products, and machinery, including: manufacture, assembly, rebuilding, repair, and maintenance. The Phase I regulation will cover seven major industrial groups, including: aircraft, aerospace, hardware (including machine tools, screw machines, metal forgings and stampings, metal springs, heating equipment, and fabricated structural metal, ordinance, stationary industrial equipment (including electrical equipment), mobile industrial equipment, and electronic equipment (including communication equipment). The legal deadline is May 1996.

Phase II, EPA will propose effluent limitation guidelines for facilities that generate wastewater while processing metal parts, metal products and machinery, including: manufacture, assembly, rebuilding, repair, and maintenance. The Phase II regulation will cover eight major industrial groups, including: motor vehicles, buses and trucks, household equipment, business equipment, instruments, precious and nonprecious metals, shipbuilding, and railroads. The legal deadline is December 31, 1997.

Clean Air Act (CAA)

In addition to the CAA requirements discussed above, EPA is currently working on several regulations that will directly affect the metal finishing industry. Many proposed standards will limit the air emissions from various industries by proposing Maximum Achievable Control Technology (MACT) based performance standards that will set limits on emissions based upon concentrations in the waste stream. Various potential standards are described below.

Organic Solvent Degreasing/Cleaning

EPA proposed a NESHAP (58 FR 62566, November 19, 1993) for the source category of halogenated solvent degreasing/cleaning that will directly affect the metal finishing industry. This will apply to new and existing organic halogenated solvent emissions to a MACT-equivalent level, and will apply to new and existing organic halogenated solvent cleaners (degreasers) using any of the HAPs listed in the CAA Amendments. EPA is specifically targeting vapor degreasers that use the following HAPs: methylene chloride, perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and chloroform.

This NESHAP proposes to implement a MACT-based equipment and work practice compliance standard. This would require that a facility use a designated type of pollution prevention technology along with proper operating procedures. However, EPA has also provided an alternative compliance standard. Existing operations, which utilize performance-based standards, can continue to do so if such standards can be shown to achieve the same emission limit as the equipment and work practice compliance standard.

Steel Pickling, HCl

Hydrochloric acid (HCl) and chlorine are among the pollutants listed as hazardous air pollutants in Section 112 of the Clean Air Act Amendments of 1990. Steel pickling processes that use HCl solution and HCl regeneration processes have been identified by the EPA as potentially significant sources of HCl and chlorine air emissions and, as such, a source category for which national emission standards may be warranted. EPA is required to promulgate national emission standards for 50 percent of the source categories listed in Section 112(e) by November 15, 1997.

Other Future Regulatory Actions

EPA is developing MACT standards for several industries, including: miscellaneous metal parts and products (surface coating), asphalt/coal tar application-metal pipes, metal can (surface coating), metal coil (surface coating), and metal furniture (surface coating). The legal deadline for these rulemakings is November 15, 2000.

VII. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[2] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

---

[2] EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

R0076042

Compliance and Enforcement Data Definitions

General Definitions

Facilities Indexing System (FINDS) --- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Fabricated Metal Products Industry Compliance History

Exhibit 34 presents enforcement and compliance information specific to the fabricated metal products industry. As indicated in this exhibit, Regions IV, V, and IX conduct the largest number of inspections in this industry. This is consistent with the fact that the fabricated metal products industry is geographically concentrated near industrial areas. The data also indicates that nearly all of Region IV's enforcement actions are State-lead.

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 35 - 38 provide enforcement and compliance information for selected industries. The fabricated metal products industry comprises the largest number of facilities tracked by EPA across the selected industries. Likewise, it has the largest number of inspections and enforcement actions. For this industry, RCRA inspections comprise over half of all inspections conducted, while CWA inspections account for 15 percent of these inspections. The low CWA inspection rate is in conflict with the large number of water discharges that are generated by this industry.

Exhibit 34
Five Year Enforcement and Compliance Summary for the Fabricated Metal Industry

A	B	C	D	E	F	G	H	I	J
Fabricated Metal SIC 34	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	199	139	585	20	40	99	66%	34%	0.17
Region II	171	127	515	20	39	139	78%	22%	0.27
Region III	186	130	626	18	43	156	86%	14%	0.25
Region IV	320	220	1480	13	48	178	94%	6%	0.12
Region V	880	466	1549	34	54	128	75%	25%	0.08
Region VI	171	85	268	38	17	54	89%	11%	0.20
Region VII	109	71	238	27	13	31	71%	29%	0.13
Region VIII	36	14	50	43	7	8	38%	63%	0.16
Region IX	228	65	125	109	7	20	65%	35%	0.16
Region X	46	23	73	38	12	27	63%	37%	0.37
Total/Average	2,346	1,340	5,509	26	280	840	80%	20%	0.15

Exhibit 35
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	**2,346**	**1,340**	**5,509**	**26**	**280**	**840**	**80%**	**20%**	**0.15**
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 36
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	**2,346**	**477**	**746**	**525**	**110%**	**46**	**10%**	**114**	**0.15**
Electronics/Computers	405	60	87	80	133%	8	13%	21	0.24
Motor Vehicle Assembly	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 37
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

Exhibit 38
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	**477**	**746**	**114**	**25%**	**14%**	**14%**	**8%**	**61%**	**77%**	**<1%**	**2%**
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

VII.C. Review of Major Legal Actions

VII.C.1 Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* publications, 15 significant enforcement actions were resolved between 1991 and 1993 for the metal finishing industry. CWA violations comprised eight of these actions, the most of any statute. Following CWA violations were five actions involving RCRA violations, three involving CERCLA violations, one with a CAA violation, and one with a SDWA violation. The companies against which the cases were brought are primarily metal finishers, including those that provide electroplating, coating, and plating services. Two of the companies perform metal forming and fabrication functions.

Twelve of the fifteen cases resulted in the assessment of a penalty. Penalties ranged from $15,000 to $500,000, and in four cases, additional money was spent by the defendant to improve the processes or technologies and to increase future compliance. For example, in U.S. v. North American Philips Corp. (1992), the company paid a $500,000 penalty and spent approximately $583,000 to eliminate wastewater discharges from some of its non-federally regulated processes. The average penalty per case was approximately $322,000. Supplemental Environmental Projects (SEPs) were required in two of the cases. Texas Instruments, Inc. (1993), for example, was required to pay a penalty and replace a vapor degreaser unit with a more environmentally-protective unit.

Although many cases involved civil penalties, four of the cases involved criminal convictions, resulting in penalties and/or jail sentences for the owners and/or operators of the facilities. For example, the case of U.S. v. John Borowski and Borjohn Optical Technology, Inc., resulted in the first criminal endangerment conviction under CWA; the company president was sentenced to 26 months in prison, folloshwed by two years of supervised release.

VII.C.2 Supplemental Environmental Projects

Supplementary Environmental Projects (SEPs) are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. The following exhibit contains a representative sample of the Regional responses addressing the fabricated metal products industry. The information contained in the exhibit is not comprehensive and provides only a sample of the types of SEPs developed for the fabricated metal products industry. Please note that the projects describes in this section do not necessarily apply to all facilities in this sector. Facility-specific conditions must be considered carefully when evaluating potential supplemental environmental projects.

Exhibit 39
Supplemental Environmental Projects
Fabrication of Metal Products (SIC 34)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Truex, Inc. Pawtucket, RI (metal parts manufacturing)	1	EPCRA	Pollution Reduction	$ 70,000	Install and operate a cooling water and process rinse recycling system and a metal recovery system to reduce the water used and to recover copper and zinc process waste for recycling.	$ 54,000	$ 29,000
Walton & Lonsbury Attleboro, MA (electroplating facility)	1	RCRA	Pollution Prevention and Pollution Reduction	$ 18,270	Implement a system to reclaim and reuse chromic acid rinse waters. Eliminate the use of trichloroethane in the degreasing operation. Install a filtration system which will extend the life of the hydrochloric acid strip solution.	$ 15,100	$ 15,100
Verilyte Gold, Inc. Chelsea, MA (electroplatting facility)	1	RCRA	Pollution Prevention	$ 21,450	Install a hot-air metal parts drying unit which eliminates 100 percent of the use of freon.	$ 26,400	$ 15,675
The Torrington Company (precision bearings, assemblies, gears, and couplings manufacture)	1	EPCRA	Equipment Donation	$ 16,792	Donate emergency and/or computer equipment to the Local Emergency Planning Committee (LEPC) to respond to and/or plan for chemical emergencies. Participate in LEPC activities.	$ 35,364	$ 18,572
Texas Instruments, Inc. Attleboro, MA (metallurgic materials manufacture)	1	EPCRA	Equipment Donation	$ 8,063	Purchase computer hardware and software for the LEPC and Attleboro Fire Department (AFD) to assist the LEPC in tracking and storing information about identity and location of hazardous chemicals and to assist the AFD in responding to accidental releases.	$ 14,025	$ 5,962

Exhibit 39
Supplemental Environmental Projects
Fabrication of Metal Products (SIC 34)

Texas Instruments, Inc. Attleboro, MA (metal finishing)	1	CAA	Pollution Prevention	$ 170,000	Replace the current vapor degreasor unit with a closed-loop degreaser unit to prevent the use of Freon 113.	$ 90,000	$ 49,900
L.S. Starrlett Company, Inc. Athol, MA (tool manufacture)	1	EPCRA	Pollution Prevention	$ 290,000	Install three alkaline-based aqueous agitation wash systems, replace Freon cleaning units in two departments, and a methylene chloride cleaning unit in a third department to reduce Freon and methylene chloride by 100 percent.	$ 176,800	$ 83,200
Teradyne, Inc Nashua, NH (soldering products manufacture)	1	RCRA	Pollution Prevention	$ 800,000	Purchase and install solvent replacement units for two facilities. Stop using Freon 113 in manufacturing operations at one facility and stop using 1,1,1-trichloroethane (except in water sensitive assemblies) at another facility.	$ 120,000	$ 50,000
M.W. Dunton Company West Warwick, RI (soldering products manufacture)	1	EPCRA	SERC/LERC	$ 4,754	Donate emergency response equipment to the volunteer fire department to assist the LEPC in tracking and storing information about identity and location of hazardous chemicals and to assist the fire department in responding to accidental releases.	$ 9,500	$ 4,745

Exhibit 39
Supplemental Environmental Projects
Fabrication of Metal Products (SIC 34)

The Drawn Metal Tube Company Thomaston, CT	1	CWA	Pollution Prevention	$ 145,000	Install a closed loop evaporator system to eliminate the discharge of copper forming wastewater to the river.	$ 77,624	$ 45,000
Pioneer Metal Finishing	2	EPCRA	Pollution Prevention	$ 13,128	Pretreat used nickel bags and used filter bags from nickel filters to recover waste nickel, thus minimizing the disposal of hazardous nickel waste.		$ 5,000
Elken Metals Company Alloy, WV	3	xxxx	Pollution Reduction	$ 449,000	Remove PCB transforers, PCB capapcitors, and retrofilling PCB-contaminated transformers to reduce the amount of PCBs which may be released.	$ 280,000	$ 17,250
Southern Foundry Supply	4	EPCRA	Pollution Reduction	$ 34,000	Assess the feasibility of a process to recover pure nickel from plant wastestreams and construct a pilot plant to perform the recovery to reduce the quantity of heavy metals entering the environment.	$ 15,840	$ 2,376
Cerro Metal Products, Inc. Bellefonte, PA	3	TSCA	Accelerated Compliance	$ 40,000	Replace PCB transformers fluid with non-PCB fluid to eliminate the potential for uncontrolled releases of PCBs.	$ 31,700	$ 18,450

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

Numerous compliance activities and initiatives are occurring throughout the fabricated metal products industry. Many companies are conducting private research on developing new alloys and experimenting with the use of citric acid oils or terpenes instead of the more toxic degreasers (e.g., 1,1,1-trichloroethane).

Several projects currently underway are sponsored by Federal, State, and county governments; universities; and trade associations. Several of these initiatives are described below.

Common Sense Initiative

The Common Sense Initiative (CSI), a partnership between EPA and private industry, aims to create environmental protection strategies that are cleaner for the environment and cheaper for industry and taxpayers. As part of CSI, representatives from Federal, State, and local governments; industry; community-based and national environmental organizations; environmental justice groups; and labor organizations, come together to examine the full range of environmental requirements affecting the following six selected industries: automobile manufacturing; computers and electronics, iron and steel, metal finishing, petroleum refining; and printing.

CSI participants are looking for solutions that:

- Focus on the industry as a whole rather than one pollutant
- Seek consensus-based solutions
- Focus on pollution prevention rather than end-of-pipe controls
- Are industry-specific.

R0076057

The Common Sense Initiative Council (CSIC), chaired by EPA Administrator Browner, consists of a parent council and six subcommittees (one per industry sector). Each of the subcommittees have met and identified issues and project areas for emphasis, and workgroups have been established to analyze and make recommendation on these issues. (Contact: Greg Waldrip at (202) 564-7024)

Design for the Environment (DfE)

DfE is an EPA program operated by the Office of Pollution Prevention and Toxics. DfE is a voluntary program which promotes the use of safer chemicals, processes, and technologies in the earliest product design stages. The DfE program assists industry in making informed, environmentally responsible design choices by providing standardized analytical tools for industry application and providing information on the comparative environmental and human health risk, cost, and performance of chemicals, processes, and technologies. DfE also helps small businesses by analyzing pollution prevention alternatives and disseminating the information to industry and the public. By helping to translate pollution prevention into meaningful terms, DfE contributes to building the institutional structure in corporations to support pollution prevention. DfE activities fall into two broad categories: (1) the industry-specific projects which encourage businesses to incorporate pollution prevention into their designs; and (2) long-term projects that translate pollution prevention into terms that make sense to professions such as chemistry, chemical engineering, marketing, accounting, and insurance.

One DfE effort (in partnership with the Manufacturing Extension Partnership) is the development of a benchmarking database and accompanying questionnaire to serve as an incentive mechanism for companies. Metal fabricators are encouraged to complete a company-specific questionnaire and return it to the Manufacturing Extension Partnership for analysis. The company will then receive a report comparing its data to that of other companies. Based on the results, companies are encouraged to voluntarily implement mechanisms that will minimize environmental damage resulting from the manufacturing processes. Subjects included in the questionnaire, database, and report range from the use of automation and monitoring technologies to the volumes of wastes generated, treated, and recycled.

Minnesota Technical Assistance Program (MnTAP)

In the State of Minnesota, waste reduction is receiving increased attention as an alternative to waste disposal. To help companies reduce waste, Minnesota developed MnTAP, a program that helps facilities identify waste reduction opportunities. MnTAP recognizes that each company's operations are unique and has, therefore, developed a series of checklists to help identify waste reduction possibilities. The checklists are designed to assist each facility evaluate wastestreams and identify waste reduction opportunities. The checklists cover several areas relevant to this profile, including operating procedures, cleaning, machining, plating/metal finishing, coating/painting, and formulating.

To ensure effective use of MnTAP's checklists, staff is available to answer questions over the phone or on-site once checklists have been completed. MnTAP has also gathered vendor and technical information for many of the options listed which may be useful in assessing a facility's waste reduction opportunities. In addition, MnTAP has developed lists of vendors who provide recycling services on a contract basis if it is not feasible to implement the options listed on the checklists. MnTAP staff can be reached at (612) 625-4949.

Pollution Prevention and Waste Minimization in the Metal Finishing Industry Workshop

The University of Nebraska-Lincoln sponsored a Pollution Prevention and Waste Minimization in the Metal Finishing Industry workshop in 1993. The workshop was designed for managers and operators of electroplating and galvanizing operations; engineers; environmental consultants; waste management consultants; Federal, State, and local government officials; and individuals responsible for training in the area of metal finishing waste management. Topics covered included:

- Saving money and reducing risk through pollution prevention and waste minimization
- Incorporating pollution prevention into planning electroplating and galvanizing operations
- Conducting waste minimization audits
- Developing and analyzing options for pollution prevention/waste minimization

- Innovative techniques for implementing a pollution prevention/waste minimization program.

For more information concerning this workshop, contact David Montage of the University of Nebraska at W348 Nebraska Hall, Lincoln, NE 68588-0531.

Pollution Prevention Opportunities Checklists

The County Sanitation Districts of Los Angeles County developed a detailed pollution prevention opportunities checklist to help companies identify and implement pollution prevention methods where possible. The County Sanitation Districts has identified specific opportunities for the metal fabricators and metal finishing industries.

Southeast Michigan Initiative (SEMI)

EPA and the Michigan Department of Natural Resources (MDNR) have launched a geographic initiative in the Southeast Michigan area because of the magnitude of contaminant releases and human population in the area. Eight counties within the Initiative have been identified as having major environmental problems. Several rivers in the area suffer from impaired uses, polluted airsheds, combined sewer overflows, contaminated sediments, and major toxic pollutant releases.

A Steering Committee, composed of senior managers of MDNR and EPA, meet quarterly and are responsible for making decisions concerning the overall direction of the Initiative. There are also four working committees, including: public participation; remedial action plans/sediments; pollution prevention; and compliance and enforcement.

For more information regarding SEMI contact Rufus Anderson, Assistant Deputy Director, MDNR Region 5 at (313) 953-1444 or Mardi Klevs, EPA SEMI Coordinator at (312) 353-5490.

The Blackstone Project

The Blackstone Project, a joint initiative by the Massachusetts Department of Environmental Protection (DEP) and the Department of Environmental Management (DEM), is intended to make environmental protection more efficient and less costly to companies. As Doug Fine, the Compliance and Enforcement Coordinator, explains, the Blackstone Project's two goals are to encourage industry to use less toxic material in manufacturing, and to increase the efficiency of DEP's industrial inspections by conducting one-stop, facility-wide inspections. The project focused first on fabricated metal products facilities near the Blackstone River Valley and later expanded to all types of manufacturers in that region. The State of Massachusetts now conducts facility-wide inspections in a continuous effort to reduce pollution.

The NCMS/NAMF Pollution Control Assessment Project

The National Center for Manufacturing Sciences (NCMS) and the National Association of Metal Finishers (NAMF) worked jointly to develop the *Pollution Prevention and Control Technology for Plating Operations* publication which documents pollution prevention techniques and pollution control equipment used in plating operations. To develop this document and the associated database, NCMS and NAMF collected pollution prevention information through surveys, literature searches, and interviews with industry experts. The resulting publication illustrates pollution prevention techniques and equipment used, assesses the effectiveness of these techniques as illustrated by historical data, and indicates the types of facilities in which these techniques were employed.

The Sustainable Industry Project

The EPA Office of Policy, Planning, and Evaluation's Sustainable Industry Project represents a new approach to the development of environmental policy for industry. The primary goal of the Sustainable Industry Project is to develop, test, and implement industry-specific policy recommendations that will remove barriers to innovation and promote strategic environmental protection in the selected industries (i.e., photoimaging, metal finishing, and thermoset plastics). To do this, EPA gained a thorough understanding of the relevant characteristics of the industries—the industry-specific economic, institutional, cultural, technical, life-cycle, and regulatory factors that may promote or hinder environmental improvements. Further, EPA identified driving factors and barriers that influence corporate decision-making and environmental performance. Understanding the factors that influence environmental performance in a given industry provides the basis for designing policies that will encourage improved performance. Working with industries, States, non-government organizations (NGOs), and other interested parties, EPA intends to design policies that will protect the environment and human health while fostering competitive and sustainable industries.

U.S. Bureau of Mines (USBM)

The U.S. Bureau of Mines has developed a technique to regenerate chromium bearing solutions such as those used in chromate conversion aluminum electroplating. The process is in commercial use and a company is preparing to license the technology to manufacture and market solution treatment equipment. In related work, the Bureau worked with the specialty steel industry to reduce waste generated by pickling operations. Other USBM research includes the dewatering of sludges, extraction of metals from a variety of liquid and solid wastes, recycling of metals, and development of lead-free free-machining copper alloys.

Wastewater Technology Center

The Wastewater Technology Center (WTC) is an organization of scientists, chemists, technologists, and support staff dedicated to the research and development of technologies to control industrial and municipal discharges. Conducting bench-scale, pilot plant, and full-scale studies for 25 years, over 100 WTC staff have assisted industry in solving a wide variety of environmental concerns. Recently, WTC has worked closely with the Metal Finishing Task Force, a committee of Federal government, provincial government, and metal finishing industry representatives to develop a pollution prevention guide. The document is designed to assist metal finishers in establishing a pollution prevention planning process. WTC also provides assistance in interpreting and using this guide and facilitates other pollution prevention planning programs that metal finishers have or are anticipating establishing. In addition, to help metal finishers better understand and use the pollution prevention planning, WTC, in conjunction with Sheridan College, has prepared an extensive training course in pollution prevention planning in metal finishing.

Other Initiatives

The metal finishers and platers industry is being considered by EPA for several upcoming initiatives. Work has already begun by the NPDES and the RCRA programs. The NPDES Branch began an Industrial User initiative in May 1993 that targeted metal finishers who failed to report their compliance status with categorical pretreatment effluent standards (40 CFR 433). In addition, the RCRA program has an initiative that applies to iron and steel and metal plating/finishing industries. The State of Utah plans to inspect each of the iron and steel and metal plating/finishing industries in the State.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who meet their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

The number of companies that use 33/50 chemicals per industry sector ranged from a low of six in the tobacco industry to a high of 1,803 in the fabricated metal products industry. Of these companies, 187 participate in the 33/50 program. Some 33/50 chemicals that are particularly relevant to this industry include: lead and lead compounds, methyl ethyl ketone, nickel and nickel compounds, tetrachloroethylene, toluene, trichloroethane, trichlorethylene, and xylenes.

Exhibit 40 lists those companies participating in the 33/50 program that reported under SIC code 34 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to Fabricated Metal Products industry. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 40
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
A B Chance Co.	Centralia	MO	3644, 3613, 3423	1	59,907	***
ABC Holdings Inc.	Eufaula	AL	2851, 3449	4	55,230	**
Acme Metals Inc.	Riverdale	IL	3312, 3499, 3479, 3398	5	157,232	38
Adolph Coors Company	Golden	CO	2082, 3411, 3443	1	158,792	59
Aero Metal Finishing Inc.	Fenton	MO	3471	1	12,900	43
Akzo Nobel Inc.	Chicago	IL	3412	1	930,189	13
Aladdin Industries Inc.	Nashville	TN	3086, 3469, 3648	1	53,741	91
All Metal Stamping Inc.	Abbotsford	WI	3429, 3469, 3499	1	1,112	50
Allied-Signal Inc.	Morristown	NJ	3728, 3471, 3724	2	2,080,501	50
Aluminum Company Of America	Pittsburgh	PA	3463	5	2,403,017	51
America's Best Quality	Milwaukee	WI	3471	1	1,025	74
American National Can Company	Chicago	IL	3411	9	2,303,898	50
Ameron Inc. Delaware	Pasadena	CA	3272, 3317, 3443, 3479	1	184,882	**
Amsted Industries Incorporated	Chicago	IL	3315, 3496, 3471	1	1,834,493	66
Anderson Screw Products Inc.	Jamestown	NY	3451	1	7,860	100
Anomatic Corporation	Newark	OH	3471	1	403,270	50
Apogee Enterprises Inc.	Minneapolis	MN	3479	1	423,862	15
Armco Inc.	Pittsburgh	PA	3446	2	1,849,709	4
Asea Brown Boveri Inc.	Stamford	CT	3443	2	501,017	50
Asko Processing Inc.	Seattle	WA	3479	2	36,991	50
Atlas Die Inc.	Elkhart	IN	3479	1	26,400	100
Atlas Plating Inc.	Cleveland	OH	3471	1	505	33
Automatic Pltg Of Bridgeport	Bridgeport	CT	3471	1	635	***
B. L. Downey Co. Inc.	Broadview	IL	3479	1	250	75
Baker Hughes Incorporated	Houston	TX	3533, 3471	1	193,116	20
Ball And Socket Mfg. Co. Inc.	Cheshire	CT	3965, 3469, 3471	1	9,820	**
Ball Corporation	Muncie	IN	3411	7	721,859	86
Bausch & Lomb Incorporated	Rochester	NY	3471, 3851, 3827	1	51,706	*
Bead Industries Inc.	Bridgeport	CT	3499, 3679, 3432	1	107,143	***
Bethlehem Steel Corporation	Bethlehem	PA	3312, 3462	1	792,550	50
BHP Holdings (USA) Inc.	San Francisco	CA	3479	1	64,365	***

R0076064

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Black & Decker Corporation	Baltimore	MD	3429	6	487,188	50
Blaser Die Casting Co.	Seattle	WA	3471	1	38,900	78
Bmc Industries Inc.	Minneapolis	MN	3479	1	207,147	5
Brod & Mcclung-Pace Co.	Portland	OR	3433, 3564, 3585	1	20,300	**
Brooklyn Park Oil Co. Inc.	Minneapolis	MN	3364, 3471	1	12,606	13
Burnham Corporation	Lancaster	PA	3433	1	34,149	96
C. A. Dahlin Co.	Elk Grove Village	IL	3469	1	12,900	***
Caldwell Products Inc.	Abilene	TX	3471	1	11,880	50
Canon Business Machines Inc.	Costa Mesa	CA	3479	1	5	95
Cargill Detroit Corporation	Clawson	MI	3462	1	717,558	31
Channellock Inc.	Meadville	PA	3423	1	118,913	***
Chart Industries Inc.	Willoughby	OH	3443	2	8,260	79
Chrysler Corporation	Highland Park	MI	3465	2	3,623,717	80
Cold Heading Co.	Detroit	MI	3471	1	16,021	52
Collis Inc.	Clinton	IA	3496, 3471, 3499	1	63,010	60
Commercial Enameling Co.	Huntington Park	CA	3431	1	250	100
Conagra Inc.	Omaha	NE	3411	1	39,588	8
Cooper Industries Inc.	Houston	TX	3462, 3317	7	1,048,465	75
Corning Inc.	Corning	NY	3469, 3471	1	1,521,528	14
Crenlo Inc.	Rochester	MN	3444	1	66,945	***
Crown City Plating Co.	El Monte	CA	3471	1	151,509	30
Crown Cork & Seal Company	Philadelphia	PA	2752, 3479	20	1,236,689	50
Crown Metal Finishing Co. Inc.	Kenilworth	NJ	3479	1	50,282	21
Dana Corporation	Toledo	OH	3451, 3492	3	1,652,123	**
Davis & Hemphill	Elkridge	MD	3451	1	13,365	*
Delbar Products Inc.	Perkasie	PA	3089, 3465	2	102,983	50
Delta Engineering & Mfg. Co.	Tualatin	OR	3444	1	8,239	***
Disston Company	Danville	VA	3425	1	27,000	*
Duo-Fast Corp.	Franklin Park	IL	3469	1	652,519	45
Dynamic Metal Products Company	Manchester	CT	3444	1	255	***
Eagle-Picher Industries Inc.	Cincinnati	OH	3053, 3479	3	227,242	50
Eaton Corporation	Cleveland	OH	3462	4	450,211	50
Ektron Industries Inc.	Aumsville	OR	3471	1	4,354	50
Electro-Platers Of York Inc.	Wrightsville	PA	3471	1	29,462	***
Emerson Electric Co.	Saint Louis	MO	3569, 3541, 3496, 3449	4	2,140,497	50
Enamelers & Japanners Inc.	Chicago	IL	3479	1	40,000	*
Ernie Green Industries Inc.	Dayton	OH	3465	3	329,828	*
Excell Polishing & Buffing Co.	Wadsworth	OH	3471	1	13,149	***
Federal-Mogul Corporation	Southfield	MI	3365, 3366, 3471	3	255,996	50
Feldkircher Wire Fabg Co.	Nashville	TN	3471, 3496	1	750	18

R0076065

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Fleet Design Inc.	Portland	TN	3471	3	522	80
Fmc Corporation	Chicago	IL	3462, 3324, 3325	1	502,318	50
Ford Motor Company	Dearborn	MI	3465, 3711	5	15,368,032	15
Foto Mark Inc.	Mendota Heights	MN	3479	1	73,325	5
Fulcrum II Limited Partnership	New York	NY	3462	1	77,680	24
G M Nameplate Inc.	Seattle	WA	2759, 2752, 3679, 3993, 3471, 3479	1	15,405	50
G. W. Lisk Co. Inc.	Clifton Springs	NY	3499, 3451, 3471, 3491	1	15,548	*
Gates Corporation	Denver	CO	3429, 3451	1	478,941	***
Gayston Corporation	Springboro	OH	3483, 3463	1	33,355	56
Gefinor (USA) Inc.	New York	NY	3471, 3951	1	9,088	50
General Dynamics Corporation	St Louis	MO	3441, 3621	1	588,246	84
General Electric Company	Fairfield	CT	3444, 3724	7	5,010,856	50
General Motors Corporation	Detroit	MI	3651, 3694, 3679, 3672, 3471	15	16,751,198	*
Gillette Company	Boston	MA	3421	1	21,497	99
Globe Engineering Company Inc.	Wichita	KS	3728, 3724, 3444, 3599	1	18,678	*
Hager Hinge Company	Saint Louis	MO	3429	2	97,121	64
Halliburton Company	Dallas	TX	3443	1	16,884	**
Hand Industries Inc.	Warsaw	IN	3471	1	37,000	***
Handy & Harman	New York	NY	3471, 3469	3	477,150	50
Harrow Industries Inc.	Grand Rapids	MI	3429	1	128,355	*
Harsco Corporation	Camp Hill	PA	3469, 3449	8	415,574	**
Henkel Corporation	Kng Of Prussa	PA	3479	1	164,363	55
Heresite Protective Coatings	Manitowoc	WI	3479, 2851, 2821	1	367	50
Hi-Shear Industries Inc.	New Hyde Park	NY	3452, 3471, 3451, 3479	1	8,226	50
HM Anglo-American Ltd	New York	NY	3423	4	1,265,741	2
Hohman Plating & Mfg. Inc.	Dayton	OH	3471, 2851, 3479	1	13,293	**
Hoover Sys. Inc.	Dallas	TX	2542, 3444, 3441	1	510	27
Houston Plating Co.	South Houston	TX	3471	1	997	*
IBM	Armonk	NY	3672, 3579, 3471	1	1,411,304	1
Illinois Tool Works Inc.	Glenview	IL	3469	3	673,128	***
Imagineering Enterprises Inc.	South Bend	IN	3471	1	11,282	***
Inco United States Inc.	New York	NY	3462, 3463	1	346,594	26

R0076066

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Indal Ltd	Weston, Ontario, Canada		3442	3	303,909	*
Indianhead Plating Inc.	Chippewa Falls	WI	3471	1	14,005	***
Industrial Hard Chrome Ltd.	Geneva	IL	3471	2	13,213	*
Ingersoll-Rand Company	Woodcliff Lake	NJ	3429	4	96,553	60
Interlake Corporation	Lisle	IL	3441	1	159,932	37
International Paper Company	Purchase	NY	8731, 3471, 3544	1	2,784,831	50
ITT Corporation	New York	NY	3471, 3479, 3498	3	735,332	7
Jacobson Mfg Co. Inc.	Kenilworth	NJ	3452	1	12	*
Jefferson City Mfg. Co. Inc.	Jefferson City	MO	3363, 3451, 3469	1	4,850	**
Jor-Mac Company Inc.	Grafton	WI	3499, 3479	1	4,995	***
Jordan-Edmiston Group Inc.	New York	NY	3421	1	332,930	27
Kaspar Electroplating Corp	Shiner	TX	3471	1	56	*
Kelso Asi Partners L P	New York	NY	3585, 3433, 3564	1	355,557	43
Kennedy Mfg. Co.	Van Wert	OH	3469	2	69,756	80
Kitzinger Cooperage Corp	Saint Francis	WI	3412, 5085, 5805	1	84	50
Lacks Enterprises Inc.	Grand Rapids	MI	3089, 3471	3	867,354	27
Lawrence Brothers Inc.	Sterling	IL	3429	1	6,827	50
Leco Corporation	Saint Joseph	MI	3826, 3471, 3229	1	6,800	14
Litton Industries Inc.	Beverly Hills	CA	3731, 3441, 3443	1	332,264	**
Lord Corporation	Erie	PA	3069, 3471	2	1,111,309	58
Lorin Ind.	Muskegon	MI	3471, 3354	1	25,500	50
LTV Steel Co. Inc.	Cleveland	OH	3471	1	612,924	60
Luke Engineering & Mfg Corp	Wadsworth	OH	3471	1	6,600	**
Macklanburg-Duncan Co.	Oklahoma City	OK	3429	1	23,376	***
Marmon Group, Inc.	Chicago	IL	3451	5	1,092,218	1
Martin Marietta Corporation	Bethesda	MD	3769, 3499, 3479, 3471	1	223,286	73
Masco Industries Inc.	Taylor	MI	3398, 3471	13	488,484	***
Mascotech	Taylor	MI	3465	9	3,163,830	35
Matec Corporation	Hopkinton	MA	3479, 2899, 3489	1	21,800	*
Meaden Screw Products Company	Burr Ridge	IL	3451	1	12,860	40
Mechanical Galv-Plating Corp	Sidney	OH	3479	1	3,448	***
Meco Inc.	Paris	IL	3443	1	51,864	***
Metallics Inc.	Onalaska	WI	3479	1	27,720	50
Metromedia Company	E Rutherford	NJ	3451, 3499	1	295,322	*
Midwest Plating Company Inc.	Grand Rapids	MI	3471	1	520	50

R0076067

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Miller Smith Mfg. Co.	Spring Lake	MI	3471	1	17,247	***
Modern Metal Products Co.	Loves Park	IL	3471	1	163	71
Modern Welding Company	Owensboro	KY	3441, 3443	1	5	*
Modine Manufacturing Company	Racine	WI	3443, 3714	4	488,996	50
Morgan Stanley Leveraged Fund	New York	NY	3724, 3471	2	2,166,420	13
Napco Inc.	Valencia	PA	3499, 3444, 3446, 3442, 3479	1	41,037	60
Nashua Corp.	Nashua	NH	2672, 3572, 3577, 2869, 2821, 3479	2	1,818,504	**
National Forge Company	Irvine	PA	3462	1	3,100	*
National Semiconductor Corp.	Santa Clara	CA	3679, 3674, 3471	1	23,173	6
New Dimension Plating Inc.	Hutchinson	MN	3471	1	17,300	35
Newell Co.	Freeport	IL	3471, 3496	5	324,283	23
Norandal USA	Brentwood	TN	3353, 3479	1	627,740	6
North American Investment Prop	Hawthorne	NY	3443	1	11,755	70
Northland Stainless Inc.	Tomahawk	WI	3443	1	7,570	***
Norton Company	Worcester	MA	3425	1	40,831	63
Oak Industries Inc.	Waltham	MA	3451, 3471, 3398	1	34,128	16
Oberg Industries Inc.	Freeport	PA	3469, 3471, 3089	1	18,435	85
Oregon Sand Blasting & Coating	Tualatin	OR	3479	1	14,660	*
Owens-Illinois Inc.	Toledo	OH	3469	2	412,573	***
Pace Industries Inc.	New York	NY	3639, 3444, 3469	1	14,530	**
Parker Hannifin Corporation	Cleveland	OH	3451, 3492, 3494	9	244,966	50
Pechiney Corporation	Greenwich	CT	3479, 3724	1	216,177	***
Penn Engineering & Mfg	Danboro	PA	3452	1	111,897	100
Philip Morris Companies Inc.	New York	NY	3479, 3468	1	259,053	**
Photocircuits Corporation	Glen Cove	NY	3672, 3471	1	292,178	92
PMF Ind. Inc.	Williamsport	PA	3499, 3471	1	13,015	34
Precision Plating Inc.	Minneapolis	MN	3471	1	10,155	***
Precision Products Group Inc.	Rockford	IL	3398, 3469, 3495, 3493, 3499	1	149,834	***
Premark International Inc.	Deerfield	IL	3556, 3325, 3444	2	140,313	***
Process Engineering Co. Inc.	Jackson	MS	3471	1	10,305	50
Production Paint Finishers	Bradford	OH	3479	1	11,584	60
Prospect Purchasing Co. Inc.	N Brunswick	NJ	3412	1	47,275	50

R0076068

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Protective Coatings Inc.	Kent	WA	3471, 3479	1	41,137	***
Providence Metallizing Co. Inc.	Pawtucket	RI	3479, 3471	1	35,347	70
Quality Rolling & Deburring Co.	Thomaston	CT	3471	1	287,324	***
R P Adams Company Inc.	Tonawanda	NY	3469	1	20	***
Raytheon Company	Lexington	MA	3672, 3471, 3674	1	706,045	50
Rehrig International Inc.	Richmond	VA	3471	1	2,261	***
Reilly Plating Co.	Nanticoke	PA	3471	1	750	2
Reliance Finishing Co.	Grand Rapids	MI	3479	1	11,400	**
Reynolds Metals Company	Richmond	VA	3479	1	2,055,294	38
S. K. Williams Co.	Wauwatosa	WI	3471	1	126	*
Schuller Corporation	Denver	CO	3444	1	24,694	***
Seneca Foods Corporation	Pittsford	NY	3411	1	19,717	50
Siebe Industries Inc.	Richmond	VA	3400, 3471	2	849,335	2
Skills Inc.	Seattle	WA	3479	1	7,650	***
Smith Everett Investment Co.	Milwaukee	WI	3444	1	240,445	89
Smith System Manufacturing Co.	Plano	TX	3444, 2531	1	499	*
Sommer Metalcraft Corp	Crawfordsville	IN	3471	1	1,500	*
Sonoco Products Company	Hartsville	SC	2655, 3469	2	621,380	1
Southline Metal Products Co.	Houston	TX	3412	1	77,552	***
Spx Corporation	Muskegon	MI	3479	1	554,822	2
Stanley Works	New Britain	CT	3471	10	508,199	50
Sunset Fireplace Fixtures	City Of Industry	CA	3429	1	12,800	25
Super Radiator Coils Ltd	Minneapolis	MN	3400	1	139,235	82
Superior Plating Inc.	Minneapolis	MN	3471	1	39,406	***
Surftech Finishes Company	Kent	WA	3471	1	20,270	*
Swva Inc.	Huntington	WV	3441	1	43,405	27
Tawas Plating Company	Tawas City	MI	3471	1	3,265	50
Tech Industries Inc.	Woonsocket	RI	3089, 3471	1	27,003	64
Techmetals Inc.	Dayton	OH	3471	1	10,645	50
Tektronix Inc.	Beaverton	OR	3663, 3444	1	12,393	*
Tenneco Inc.	Houston	TX	3441	1	1,272,423	8
Texas Instruments Incorporated	Dallas	TX	3822, 2812, 3356, 3471, 3714, 3341	1	344,225	25
Therma-Tru Corp	Sylvania	OH	3442, 3089	1	17,255	41
Thiokol Corporation	Ogden	UT	3452	2	1,001,162	40
Thomas Steel Strip Corp	Warren	OH	3471, 3316	1	6,839	50
Trinova Corporation	Maumee	OH	3451, 3498	1	488,879	50
U T I Corporation	Collegeville	PA	3469	1	473,872	50
United States Can Company Del	Hinsdale	IL	3412, 3411	1	5,299	*
United Technologies Corp	Hartford	CT	3086, 3471	2	2,393,252	50
US Can Corporation (Del)	Oak Brook	IL	3411	7	573,088	37

Exhibit 40 (cont'd)
33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Valley Plating Works	Los Angeles	CA	3471	1	130	75
Valley Technologies Inc.	Valley Park	MO	3398, 3463	1	0	**
Van Der Horst Usa Corporation	Terrell	TX	3471	1	20,623	**
Veba Corporation	Houston	TX	3471, 3599	1	24,254	10
W W Custom Clad Inc.	Canajoharie	NY	3471	1	8,595	50
W. J. Roscoe Co.	Akron	OH	2851, 2891, 2517, 3479	1	40,051	50
Walter Industries Inc.	Tampa	FL	3321, 3479	1	859,751	***
Warner-Lambert Company	Morris Plains	NJ	3421	1	146,333	40
Weiss-Aug Co. Inc.	East Hanover	NJ	3465, 3469	1	15,834	**
Wheeling-Pittsburgh Corp	Wheeling	WV	3479	1	560,055	66
Whirlpool Corporation	Benton Harbor	MI	3450, 3471, 3490	1	1,540,866	50
Whyco Chromium Company Inc.	Thomaston	CT	3471	1	88,737	50
Winona Corporation	Winona Lake	IN	3479	1	47,260	50
Wisconsin Tool & Stamping Co.	Schiller Park	IL	3469	1	42,000	**
WNA Inc.	Wilmington	DE	3449	2	248,148	***
Worldwide Cryogenics Holdings	Minneapolis	MN	3443	1	133,810	*
Wright Products Corp	Minneapolis	MN	3429	1	45,287	***
York Metal Finishing Co.	Philadelphia	PA	3471	1	5	*
Zippo Manufacturing Company	Bradford	PA	3421	2	189,929	50

*** = not quantifiable against 1988 data.**
**** = use reduction goal only.**
***** = no numerical goal.**

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. At present, no metal finishing or fabricating facilities are carrying out ELP pilot projects. (Contact: Tai-ming

Chang, ELP Director, (202) 564-5081 or Robert Fentress, (202) 564-7023)

Gillette ELP Project

The objective of the Gillette Environmental Leadership Program is the development and implementation of a third party compliance and management systems audit and verification process. The project will involve the development of environmental compliance and environmental management systems audit protocol criteria that can be adopted and easily implemented by other facilities to assess compliance with relevant regulations. The three Gillette facilities that are participating are: South Boston Manufacturing Center, blade and razor manufacturing; North Chicago Manufacturing Center, batch chemical manufacturing; and Santa Monica, CA, stationary products manufacturing. (Contact: Scott Throwe, (202) 564-7013).

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. Contact Jon Kessler, Office of Policy Analysis, (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard, (202) 233-9065 or the Green Light/Energy Star Hotline at (202) 775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, (202) 260-0700 or the WasteWi$e Hotline at (800) 372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, (202) 260-4407)

NICE3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, (303) 275-4729)

VIII.C. Trade Association/Industry Sponsored Activity

Associations, universities, and the industry are currently working with EPA to make the Agency aware of issues that relate to metal fabricating and finishing industries. As a result of these relationships and overall interest in achieving compliance and reducing pollution, additional research relating to process techniques and pollution prevention alternatives is being conducted. Various workshops and training opportunities have resulted from these efforts. A summary of some trade association and industry activities is presented below, along with some associations related to this industry.

VIII.C.1. Environmental Programs

Several trade and professional associations are working with EPA to make the Agency aware of issues that relate to metal fabricating industries. For example, the Copper and Brass Fabricators Council (CBFC) has been assisting EPA's Office of Solid Waste regarding recycling issues as it develops or redrafts RCRA regulations. CBFC is communicating its experiences with metal fabricating to EPA, in terms of materials used and possible recycling options, in hopes that future regulations might complement the industry's processes.

Additionally, several organizations have sponsored workshops focusing on waste minimization and pollution prevention in several fabricated metal related industries. Three workshops, the

Hazardous Waste Management for Small Business Workshop, the Environmentally Conscious Painting Workshop, and the Pollution Prevention Workshop for the Electroplating Industry, are discussed below.

Hazardous Waste Management for Small Business Workshop

The University of Northern Iowa, with support from EPA, Des Moines Area Community College, Northeast Iowa Community College, Scott Community College, and Indiana Hills Community College, sponsored a *Hazardous Waste Management for Small Business* workshop. This workshop was geared towards small businesses and was intended to provide practical answers to environmental regulatory questions. Small businesses covered by the workshop include: manufacturers, vehicle maintenance and repair shops, printers, machine shops, and other businesses that generate potentially hazardous waste. Topics covered include: hazardous waste determination, waste generator categories, management of specific common waste streams, including used oil and solvents, and pollution prevention. (Contact: Duane McDonald, (319) 273-6899)

Environmentally Conscious Painting Workshop

Kansas State University, NIST/Mid-America Manufacturing Technology Center, Kansas Department of Health & Environment, EPA Region 7, Allied Signal, Inc., Kansas City Plant, and the U.S. Department of Energy sponsored the *Environmentally Conscious Painting* workshop. This workshop covered topics such as upcoming regulations and the current regulatory climate, methods to cost-effectively reduce painting wastes and emissions, and alternative painting processes. (Contact: the Kansas State University Division of Continuing Education, (913) 532-5566)

Pollution Prevention Workshop for the Electroplating Industry

Kansas State University Engineering Extension, EPA Region 7, Kansas Department of Health and Environment, and the University of Kansas sponsored the *Pollution Prevention Workshop for the Electroplating Industry.* The workshop described simple techniques for waste reduction in the electroplating industry, including: plating, rinsing processes and wastewater, wastewater management options, metals recovery options, waste treatment and management, and product substitutions and plating alternatives. (Contact: the Kansas State University Division of Continuing Education, (800) 432-8222)

VIII.C.2. Summary of Trade Associations

Various trade associations represent the interests of metal fabricator workers and the industry itself. Some of these organizations are discussed in greater detail below.

American Electroplaters and Surface Finishers Society (AESF) 12644 Research Parkway Orlando, FL 32826 Phone: (407) 281-6441 Fax: (407) 281-6446	Members: 10,000 Staff: 21 Budget: 2,000,000 Contact: Ted Witt, Executive Director

Founded in 1909, AESF is an international professional society of scientists, technicians, job shop operators, and others interested in research in electroplating, surface finishing, and allied arts. AESF offers classroom training courses, home study courses, cooperative programs, and a voluntary certification program. In addition, it bestows awards, conducts research programs, and provides an insurance program for job shop owners. AESF also publishes *Plating and Surface Finishing* (monthly), *AESF Shop Guide*, books, symposia proceedings, research reports, and training booklets with slide presentations; and makes available films and videotapes.

ASM International (ASM) 9639 Kinsman Materials Park, OH 44073 Phone: (216) 338-5151	Members: 54,000 Staff: 145 Budget: $19,500,000 Contact: Edward L. Langer

Founded in 1920, ASM represents metallurgists; materials engineers; executives in materials producing and consuming industries; and teachers and students. This association disseminates technical information about the manufacture, use, and treatment of engineered materials. It offers in-plant, home study, and intensive courses through the Materials Engineering Institute; conducts conferences, seminars, and lectures; presents awards to teachers of materials science and for achievements in the field; and grants scholarships and fellowships. Additionally, it maintains a library of 10,000 volumes on metals and other materials.

Copper and Brass Fabricators Council (CBFC) 1050 17th Street, NW, Suite 440 Washington, DC 20036 Phone: (202) 833-8575	Contact: Joseph L. Mayer

Founded in 1966, CBFC represents copper and brass fabricators. Its activities involve foreign trade in copper and brass fabricated products, and Federal regulatory matters including legislation, regulations, rules, controls, stockpiling, and other similar measures affecting domestic fabricators of copper and brass products. CBFC holds an annual convention.

Metal Construction Association (MCA) 1101 14th Street, NW, Suite 1100 Washington, DC 20005 Phone: (202) 371-1243 Fax: (202) 371-1090	Members: 100 Staff: 5 Contact: David W. Barrack

Founded in 1983, MCA represents individuals engaged in the manufacture, design, engineering, sale, or installation of metal used in construction, and others interested in the metal construction industry. It promotes the use of metal in all construction applications. Additionally, MCA represents all sectors of the metal construction industry; fosters better trade practices and improved communication within the industry; serves as liaison between members and other industry organizations. The association collects and disseminates information; maintains the Merit Award Program to acknowledge outstanding buildings, products, and systems in the industry; plans programs in institutional advertising, voluntary standards, and statistics; proposed educational programs including structure erection, estimating, and bookkeeping; compiles statistics; and bestows scholarships. MCA also prepares and distributes two publications: the *Metal Construction Association-Membership Directory* (annually) and the *Metal Construction Association-Newsletter* (quarterly). Its newsletter includes technical articles, meeting reviews, committee reports, minutes, and a calendar of events. MCA holds a semiannual meeting and Metalcon International Trade Show and an annual meeting.

Metal Fabricating Institute (FMI) PO Box 1178 Rockford, IL 61105 Phone: (815) 965-4031	Staff: 4 Contact: Ronald L. Fowler

Founded in 1968, MFI conducts technical seminars for structural and sheet metal fabricators to update management on the latest manufacturing techniques. MFI also presents a Fabricating Engineer of the Year Award. In addition, it publishes *Metal Fabricating News* (bimonthly), which contains a calendar of events, new products and literature, book reviews, and a buyers guide. The association also holds a semiannual conference in West Lafayette, Indiana.

Metal Finishers Suppliers Association (MFSA) 801 North Cass, Ste. 300 Westmont, IL 60559 Phone: (708) 887-0797	Members: 180 Companies Staff: 2-4 Budget: $400,000 Contact: Richard Crain

Incorporated in 1951, MFSA is the only trade association representing companies that supply chemicals and equipment to the metal finishing industry. MFSA works closely with organizations that represent the metal finishing industry, such as AESF (see above) and the National Association of Metal Finishers (see below), and is involved in several joint programs, including an annual conference. In addition, MFSA publishes a monthly newsletter and has published a dozen technical papers to inform and assist its members.

National Association of Metal Finishers (NAMF) 401 N. Michigan Avenue Chicago, IL 60611-4267 Phone: (312) 644-6610	Members: 940 Staff: 6 Budget: $750,000 Contact: Brad Parcells

Founded in 1955, NAMF represents management executives of firms engaged in plating, hard chroming, galvanizing, electroforming, metalizing, organic coating, phosphating, rust proofing, polishing, buffing, anodizing, and other forms of metal finishing. NAMF is concerned primarily with management education, development of finishing standards, and legislative issues. In addition, it publishes *Finishers' Management*, a trade magazine of the plating and finishing industry. NAMF also produces *Finishing Line* (monthly), *Legislative Line* (bi-monthly), and *NAMF Regulatory Compliance Manual.* NAMF holds an annual trade show.

Precision Metalforming Association (PMA) 27027 Chardon Road Richmond Heights, OH 44143 Phone: (216) 585-8800 Fax: (216) 585-3126	Members: 1,000 Staff: 20 Budget: $3,000,000 Contact: Jon E. Jenson

Founded in 1942, PMA represents manufacturers of metal stampings, precision metal fabrications, and metal spinnings, and their suppliers. PMA provides information and technical services to members. It also presents numerous awards and publishes *Metalforming*, a monthly magazine that addresses: materials and equipment, electronics in metal forming and assembly, taxes, legal issues, and management.

Society for Mining, Metallurgy, and Exploration, Inc. (SME) PO Box 625005 Littleton, CO 80162 Phone: (303) 973-9550	Members: 20,000 Staff: 31 Budget: $3,700,000 Contact: Gary D. Howell

Founded in 1871, SME represents individuals engaged in the finding, exploitation, treatment, and marketing of all classes of minerals (metal ores, industrial minerals, and solid fuel) except petroleum. Additionally, it offers specialized education programs; and compiles enrollment and graduation statistics from schools offering engineering degrees in mining, mineral, mineral processing/metallurgical, geological, geophysical technology.

United Steelworkers of America (USWA) 5 Gateway Center Pittsburgh, PA 15222 Phone: (412) 562-2400 Fax: (412) 562-2445	Members: 675,000 Staff: 475 Contact: George Becker

Founded in 1936, this association has absorbed numerous associations for steel workers. Currently, this agency publishes *Steelabor* ten times a year. This news magazine reports on legislation and regulation affecting the union, union activities at the national and chapter levels, economic developments, pension news, and information on safety and health. USWA also publishes the *Steelworker Old Time*, quarterly; and holds a biennial convention.

IX. Contacts/Acknowledgments/Resource Materials/Bibliography and Other References

General Profile

Construction Materials, DOC, U.S. Industrial Outlook 1994.

Industry Profile for the Metal Finishing Industry, Meridian Research Inc., U.S. EPA/OPPT, June 24, 1994.

1987 Census of Manufacturers Industry Series 34A: Metal Cans, Cutlery, Handtools, U.S. Department of Commerce, Bureau of the Census, April 1990. (MC87-I-34A)

1987 Census of Manufacturers Industry Series 34B: Heating Apparatus and Plumbing Fixtures, Bureau of the Census, April 1990. (MC87-I-34B)

1987 Census of Manufacturers Industry Series 34C: Fabricated Structural Metal Products, Bureau of the Census, April 1990. (MC87-I-34C)

1987 Census of Manufacturers Industry Series 34D: Screw Machine Products, Bureau of the Census, April 1990. (MC87-I-34D)

Process Description

Emissions From Metal Finishing Operations, Draft Report, U.S. EPA, Office of Research and Development, March 31, 1995.

Hot Dip Galvanized Coatings, American Society for Metals Committee on Hot Dip Galvanized Coatings, Metals Handbook, 9th Edition, Volume 5.

Machining, American Society for Metals, Metals Handbook: 9th Edition, Volume 16, 1989.

McGraw Hill Encyclopedia of Science and Technology, Volume 6, 1987.

Metals Handbook, Ninth Edition; Volume 5, Surface Cleaning, Finishing, and Coating, 1982, American Society for Metals.

Properties and Selection: Stainless Steels, Tool Materials and Special Purpose Materials, American Society for Metals, Metals Handbook, 9th Edition, Volume 3, 1980.

Selection of Cleaning Process Metals, American Society for Metals Committee on Selection of Cleaning Process, Handbook, 9th Edition.

Surface Cleaning, Finishing, and Coating, American Society for Metals, Metals Handbook: 9th Edition, Volume 5, 1982.

Regulatory Profile

U.S. EPA OPPTS Title III Section 313 Release Reporting Guidance: Estimating Chemical Releases from Electroplating Operations, 1988.

Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards, U.S. EPA/Effluent Guidelines Division and Permits Division, 1984.

Listing of Hazardous Waste (40 CFR 261.31 and 261.32): Identification and Listing of Hazardous Waste Under RCRA, Subtitle C, Section 3001, U.S. EPA, May 1980.

Pollution Prevention

Guides to Pollution Prevention: The Metal Finishing Industry, U.S. EPA, ORD, October 1992.

Minnesota Technical Assistance Program Checklists for Identifying Waste Reduction Opportunities.

Pollution Prevention In Metal Manufacturing: Saving Money Through Pollution Prevention, U.S. EPA, OSW, October 1989.

Pollution Prevention Options In Metal Fabricated Products Industries: A Bibliographic Report, U.S. EPA, OPPT, January 1992.

Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, OPPE, June 1994.

Toxic Chemical Release Inventory: Clarification and Guidance for the Metal Fabrication Industry, U.S. EPA, OTS, 1990.

Contacts*

Name	Organization	Telephone
Paul Beatty	U.S. EPA Region VII	(913) 551-5089
Bob Benson	U.S. EPA, Office of Policy, Planning and Evaluation	(202) 260-8668
Marty Borruso	American Electroplaters and Surface Finishers Society	(718) 720-6646
Jim Callier	U.S. EPA Region VII	(913) 551-7646
Doug Fine	Massachusetts Department of Environmental Protection	(617) 556-1049
Marilyn Goode	U.S. EPA Office of Solid Waste	(202) 260-6299
Kris Goschen	U.S. EPA Region VII, Southeast Michigan Initiative	(913) 551-5078
Mardi Klevs	U.S. EPA SEMI Coordinator	(312) 353-5490
Larry Lins	U.S. EPA Region V	(216) 835-5200
John Robison	U.S. EPA, Office of Pollution Prevention and Toxics	(202) 260-3590
William Saas	Taskem, Inc., Metal Finishers Suppliers' Association	(216) 351-1500
Paul Shapiro	U.S. EPA, Office of Research and Development	(202) 260-4969
William Sonntag	National Association of Metal Finishers, American Electroplaters and Surface Finishers Society	(202) 965-5190

* Many of the contacts listed above provided valuable information and comments during the development of this doucment. EPA appreciated this support and acknowledges that the indivduals listed do not necessarily endorse all statements made within this notebook.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators. the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

R0076082

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy!

Order Processing Code:
* 3212

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Qty.	Stock Number	Published in 1995 Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wooo Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	Published in 1997 Title	Price Each	Total Price
	055-000-00570-2	Air Transportation Industry, 90 pages	$ 7.50	
	055-000-00571-1	Ground Transportation Industry, 130 pages	10.00	
	055-000-00572-9	Water Transportation Industry, 90 pages	7.50	
	055-000-00573-7	Metal Casting Industry, 150 pages	13.00	
	055-000-00574-5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055-000-00575-3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055-000-00576-1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055-000-00577-0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055-000-00578-8	Textile Industry, 130 pages	10.00	
	055-000-00579-6	Sector Notebook Data Refresh -1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account ________ – __

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

________ (expiration date) ***Thank you for your order!***

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250-7954

Important: Please include this completed order form with your remittance.

R0076083

EPA

United States
Environmental Protection Agency
(2221A)
Washington DC 20460

United States Environmental Protection Agency
Enforcement And Compliance Assurance (2221A)
EPA 310-R-95-008
September 1995

EPA

Profile Of The Metal Mining Industry

EPA Office Of Compliance Sector Notebook Project

SECTOR NOTEBOOKS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-008

EPA Office of Compliance Sector Notebook Project

Profile of the Metal Mining Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048275-5

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Dan Cabrera, U.S. Department of The Interior.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

METAL MINING
(SIC 10)
TABLE OF CONTENTS

Page

R0076090

METAL MINING
(SIC 10)
TABLE OF CONTENTS (CONT'D)

Page

R0076091

METAL MINING
(SIC 10)
LIST OF EXHIBITS

METAL MINING
(SIC 10)
LIST OF EXHIBITS (CONT'D)

METAL MINING
(SIC 10)
LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants

METAL MINING
(SIC 10)
LIST OF ACRONYMS (CONT'D)

NO_X - Nitrogen Oxide
NOV - Notice of Violation
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)
OAR - Office of Air and Radiation
OECA - Office of Enforcement and Compliance Assurance
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
SX/EW - Solvent Extraction/Electrowinning
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

METAL MINING
(SIC 10)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

Because this profile was not intended to be a stand-alone document concerning the metal mining industry, appended is a full reference of additional EPA documents and reports on this subject, as listed in the March edition of the Federal Register.

II. INTRODUCTION TO THE METAL MINING INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the metal mining industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

The metal mining industry includes facilities engaged primarily in exploring for metallic minerals, developing mines, and ore mining. These ores are valued chiefly for the metals they contain, which are recovered for use as constituents of alloys, chemicals, pigments, or other products. The industry sector also includes ore dressing and beneficiating operations. The categorization corresponds to the Standard Industrial Classification (SIC) code 10, published by the Department of Commerce to track the flow of goods and services within the economy.

The SIC 10 group consists of the following three-digit breakout of industries:

SIC 101 - Iron Ores
SIC 102 - Copper Ores
SIC 103 - Lead and Zinc Ores
SIC 104 - Gold and Silver Ores
SIC 106 - Ferroalloy Ores, Except Vanadium
SIC 108 - Metal Mining Services
SIC 109 - Miscellaneous Metal Ores.

Although the group includes all metal ore mining, the scope of mining industries with a significant domestic presence is concentrated in iron, copper, lead, zinc, gold, and silver. These represent the most common hardrock minerals mined domestically, and comprise an essential sector of the nation's economy by providing basic raw materials for major sectors of the U.S. economy. In addition, the extraction and beneficiation of these minerals generate large amounts of wastes. For these reasons, this profile's focus is limited to the above-stated sectors of the SIC 10 metal mining industry.

While such metals as molybdenum, platinum, and uranium are also included in SIC code 10, mining for these metals does not constitute a significant portion of the overall metal mining industry, nor of the

R0076099

waste generation in mining processes; these metals are therefore excluded from this profile.

In the global market, the U.S. is a major producer of iron, copper, lead, zinc, gold, and silver. In 1993, domestic mines were responsible for six percent of iron ore production, 13 percent of copper ore production, 13 percent of lead production, eight percent of zinc production, 14 percent of gold production, and 11 percent of silver production. Despite an extraordinary wealth of domestic metal sources, with the exception of gold, the U.S. is a net importer of all the above-mentioned metals.

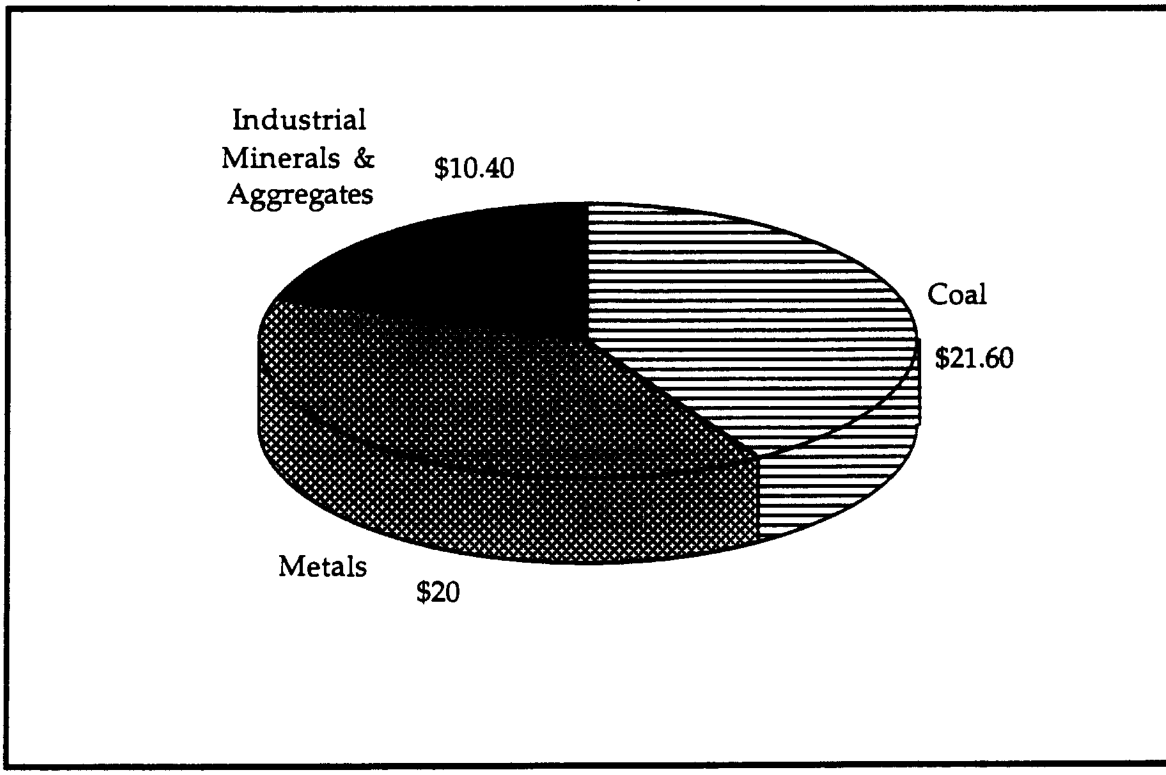
Regulations pertaining to the industry are numerous, but an emphasis is placed on point source discharges to waters, regulated by the Clean Water Act. These industries also face existing and future regulation under the Clean Water Act, Comprehensive Environmental Response, Compensation and Liability Act, and the Clean Air Act. Unlike manufacturing facilities, facilities involved in mining metals are not currently required to report chemical releases and transfers to the Toxic Release Inventory (TRI) Public Release Database under the Emergency Planning and Community Right-To-Know Act of 1986. As a result, TRI data is not available as a source of information on chemical releases in the metal mining industry; alternative sources of data have been identified for purposes of this profile.

II.B. Characterization of the Metal Mining Industry

The metal mining industry is predominantly located in the Western States, where most copper, silver, and gold mining occurs. Iron ore production is centered in the Great Lakes region, while zinc mining occurs in Tennessee and lead mining in Missouri. Large companies tend to dominate mining of such metals as copper, silver, and gold, while more diverse mine operators may be involved in mining lead, zinc, and iron metals. Metals generated from U.S. mining operations are used domestically in a wide range of products, including automobiles, electrical and industrial equipment, jewelry, and photographic materials. Metal mine production has remained somewhat stagnant over recent years, and metals exploration has declined, although future production is expected to climb as a result of continued industrial manufacturing and a growing economy.

The following exhibit depicts the proportion of metal mining production within the entire mining industry.

Exhibit 1
Total Mine Production - USA, in Billions of Dollars



Source: Randol Mining Directory 1994/95.

II.B.1. Industry Size and Distribution

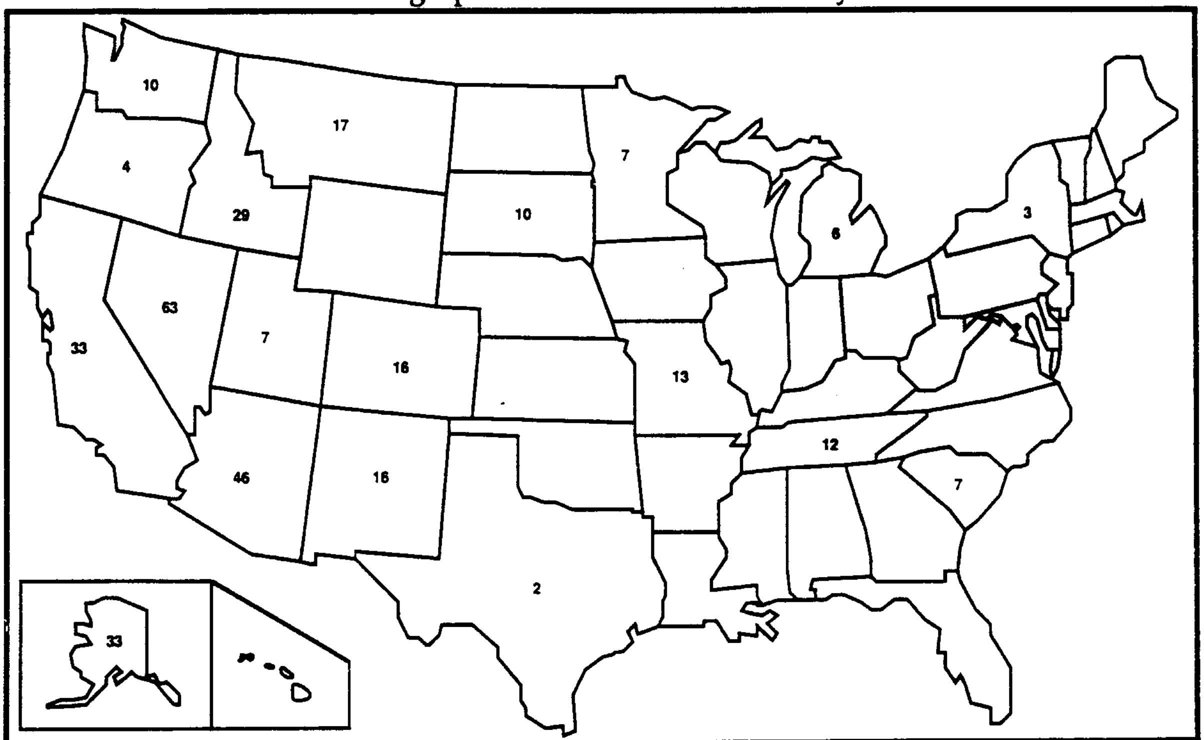
Variation in facility counts occur across data sources due to many factors, including reporting and definition differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Geographic Distribution

Though mining operations are performed throughout the U.S., the concentration of metal mining is located in the Western region of the country. Copper, gold, and silver deposits are primarily found in Utah, Montana, Nevada, California, and Arizona. Zinc is mined primarily in Alaska, Missouri, New York, and Tennessee. Lead deposits are mined primarily in Missouri, Alaska, Colorado, Idaho, and Montana, while Minnesota and Michigan are the primary sources of domestic iron ore production. The U.S. Bureau of Mines lists 482 active mines in its 1994 Mineral Commodity Summaries. (See Exhibits 2, 3, and 4). Exhibit 5 illustrates the number of facilities performing metal-specific operations by State.

R0076101

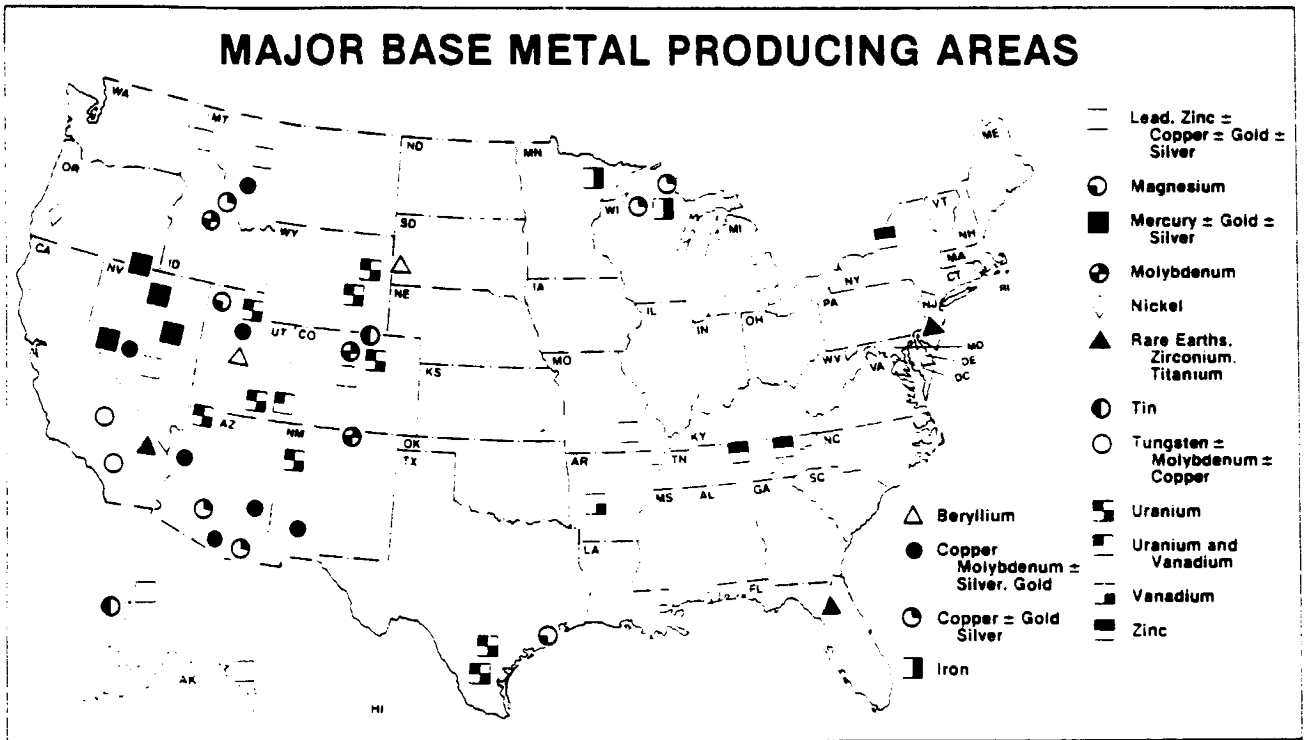
Exhibit 2
Geographic Distribution of Industry

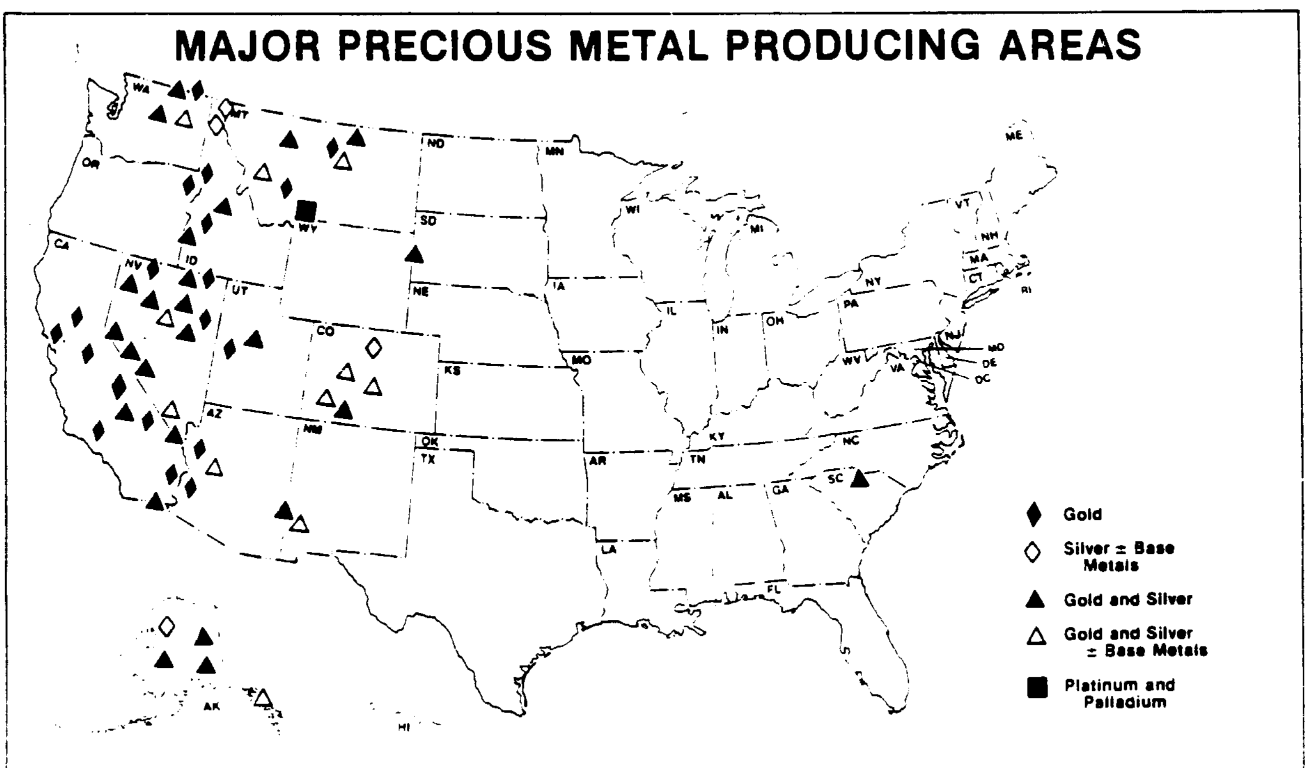


Source: Based on U.S. Bureau of Mines 1992 and 1994 Data.

R0076102

Exhibits 3 & 4
Metal-Producing Areas





R0076103

Exhibit 5
Number of Facilities per State

Type of Facility/ Total Number	States and Number of Mines
Iron Ore (22)	MI-2; MN-7; MT-1; SD-1; TX -2; UT-2
Silver (150)	AK-15; AZ-15; CA-14; CO-4; ID-12; MI-1; MT-9; NV-1; NY-1; OR-1; SC-3; SD-4; UT-4; WA-4
Gold (212)	AK-13; AZ-14; CA-19; CO-7; ID-11; MT-9; NM-5; NV-61; OR-2; SC-4; SD-5; WA-4; UT-2
Lead (23)	AK-2; AZ-1; CO-2; ID-1; IL-1; MO-7; MT-2; NM-2; NY-2; TN-2; WA-1
Zinc (25)	AK-3; CO-1; ID-2; MO-4; MT-1; NY-2; TN-10; WA-1
Copper (50)	AZ-16; CO-2; ID-3; MI-3; MO-2; MT-3; NM-9; NV-1; OR-1; UT-1

Source: U.S. Bureau of Mines 1992 and 1994 Data.

Metals mined under SIC 10 are used for a wide variety of products, and are the primary raw materials used in many industrial applications. As noted in a series of Technical Resource Documents prepared by EPA's Office of Solid Waste, copper is essential to the electronics and construction industry; iron ore provides the base material for the steel, automotive, and transportation industries; gold is used primarily in jewelry and the decorative arts, but is also used in the electronics industry and in dentistry. Gold also serves as an important investment vehicle and reserve asset. All of these metals are essential to the operation of a modern economy. Exhibit 6 provides a more detailed list of the uses for these metals.

Exhibit 6
Major Uses for Selected Metal Minerals

Commodity	Number of Mines	Major Uses	Total U.S. Production (metric tons)
Copper	50	Building construction, electrical and electronic products, industrial machinery and equipment, transportation equipment, and consumer and general products	1,765,000
Gold	212+	Jewelry and arts, industrial (mainly electronic), dental	329
Iron Ore	22	Steel	55,593,000
Lead	23	Transportation (batteries, fuel tanks, solder, seals, and bearings); electrical, electronic, and communications uses	398,000
Silver	150	Photographic products, electrical and electronic, electroplated ware, sterling ware, and jewelry	1,800
Zinc	25	Galvanizing, diecast alloys, brass, and bronze	524,000

Source: U.S. Bureau of Mines, Mineral Commodity Summaries 1994, and Minerals Yearbook, Volume I: Metals and Minerals, 1992.

R0076104

II.B.2. Economic Trends

The estimated U.S. metal mine production value for 1993 was $12.15 billion, accounting for less than one percent of gross national product. In 1993, the total employment in the metal mining industry stood at nearly 50,000 according to the National Mining Association (See Exhibit 7 for the distribution of employment by facility size). Motor vehicle manufacturing helped support demand for materials such as steel (an iron alloy), copper, lead, and zinc. However, mining production volumes remained relatively stagnant. In some cases, ore production was down (lead - four percent; iron ore - one percent; zinc - four percent; silver - six percent). The other principal metal ore industries, copper and gold, remained even with 1992 production levels. Metals production in general is expected to increase, due to anticipated continued growth in the motor vehicle industry.

Exhibit 7
Facility Size Distribution

Type of Facility*	Facilities w/ 1 - 9 employees	Facilities w/ 10 - 99 employees	Facilities w/ 100 + employees	Total
SIC 1021 - Copper	102	30	24	156
SIC 1031 - Lead and Zinc	40	8	16	64
SIC 1041 - Gold	586	122	53	761
SIC 1011 - Iron	81	14	11	106
SIC 1044 - Silver	73	9	2	84

Source: Dun and Bradstreet, 1993.

**Note: Sources define the term "facility" differently, which causes the apparent disparity between those totals cited above and those accounted for by the U.S. Bureau of Mines. Represented in these facility numbers are recreational mine operators predominantly located in Alaska, California, and Montana.*

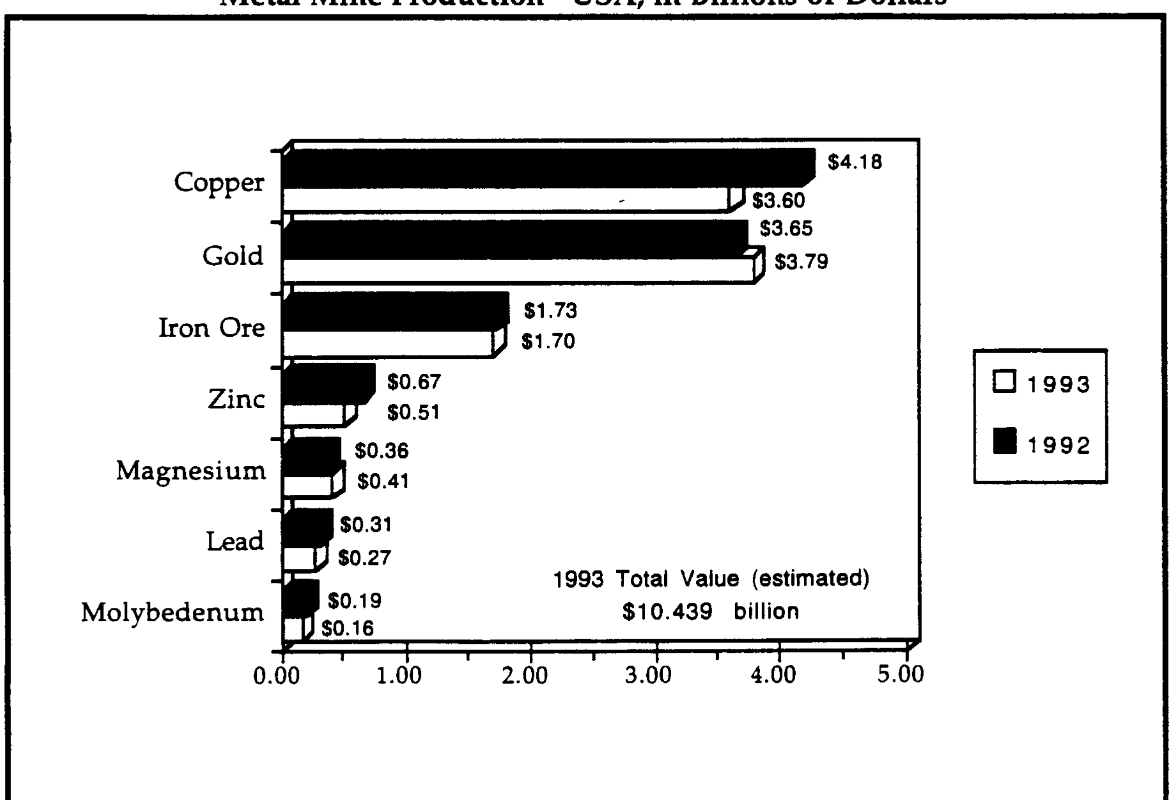
A preliminary evaluation of 1992 survey responses from 36 Canadian and 25 U.S. mineral companies operating in the U.S. suggests that the average corporate exploration budget was reduced by more than one-half from 1991 levels. Metal exploration in the U.S. during 1992 appears to have declined on an average company basis by more than 60 percent. Although specific gold and copper deposits continue to command attention, most U.S. programs have been curtailed. The BLM estimated that 75 percent of company claims were dropped during 1993 (Federal mining law grants sole mineral rights to a prospector if there is a discovery of economic value; prior to such a discovery, a "claim" is honored if the prospector maintains an actual presence on site and completes a progressive amount of developmental work per year).

The number of companies that have shifted portions of their exploration budgets to Latin America is growing. More than 250 companies, about 10 percent of the North American mining exploration industry, are now active in Latin America, especially Mexico and Chile. Among the forces driving U.S. companies abroad is the recent privatization of world-class mineral deposits, the presence of rich overseas ore deposits, depletion of prime domestic ore sources, labor costs, and the lack of significant regulatory pressure in the developing world.

The U.S. economy's slow but steady growth rate of the last several years is expected to spur demand in major domestic materials-consuming industries, such as the auto industry. In addition, developing economies in South America and Asia have had higher consumption of mineral materials as political regimes have liberalized their economies to meet demands for higher standards of living.

The following exhibit illustrates production values in 1993 for various metal mining industry sectors.

Exhibit 8
Metal Mine Production - USA, in Billions of Dollars



Source: Randol Mining Directory 1994/95.

R0076106

Following is a brief summary of current trends in domestic mining industries. Much of the information presented is based on a report prepared by EPA's Office of Research and Development.

Iron

In 1993, domestic production of iron ore remained at approximately the same level as that of 1992. The value of usable ore shipped from mines in Minnesota, Michigan, and six other States in 1993 was estimated at $1.7 billion. Iron ore was produced domestically by 16 companies operating 22 mines, 16 concentration plants, and 10 pelletizing plants. The mines included 19 open pits and one underground operation. Nine of these mines, operated by six companies, accounted for the vast majority of the output.

The U.S. steel industry was the primary consumer of iron ore, accounting for 98 percent of domestic iron ore consumption in 1992. Domestic demand for iron ore has fallen behind that for iron and steel due to changes in industrial processes, including the increased use of scrap (especially by mini-mills) and the use of imported semi-finished steel. Twelve percent of domestic iron consumption in 1993 was imported. While world consumption of iron ore increased slightly, prices declined for the third consecutive year.

Copper

World copper production remained at approximately the same level in 1993 as in 1992, while world consumption of refined copper declined. However, refined copper demand in the U.S. and Canada ran counter to the world trend. Domestic demand for copper rose by approximately eight percent in 1993; the U.S. imported six percent of its copper needs in 1993. Consumption was expected to increase in 1994 to more than 2.4 million tons, up from the previous year's 2.3 million tons. Domestic brass mills (a mixture of copper and zinc) ran at capacity.

Copper was recovered at 50 mines in 1993, and the top 15 mines accounted for more than 95 percent of production. The primary end uses for copper are building construction (42 percent), electrical and electronic products (24 percent), industrial machinery and equipment (13 percent), transportation equipment (11 percent), and consumer and general products (10 percent).

According to Standard & Poor's, the copper mining industry is dominated by three producers (ASARCO Incorporated, Cyprus Amax Mining Company, and Phelps Dodge), which are financially viable operations. However, not all copper mining firms are as healthy financially. From 1989 to 1992, the industry was characterized by decreasing operating revenues and net income, while short and long-term liabilities increased for some companies. With the recent economic recovery, however, the overall outlook for the copper industry is financially secure.

Lead

The U.S. imported 15 percent of its lead needs in 1993. Transportation is the major end use for lead, with approximately 83 percent being used to produce batteries, fuel tanks, solder, seals, and bearings. Electrical, electronic, and communications uses, ammunition, TV glass, construction, and protective coatings accounted for more than nine percent of lead consumption.

According to the U.S. Bureau of Mines, U.S. lead production has remained relatively constant through 1994, while prices for lead continued an upward trend that began in 1993. Consumption of lead in the U.S. increased in 1994, due to greater demand for original equipment batteries in the automotive industry. This trend is expected to continue.

Zinc

In 1993, the U.S. imported 26 percent of its zinc needs. Domestically, 25 zinc mines produced 99 percent of the output; Alaska's Red Dog Mine accounted for nearly one-half of the total. Zinc's main use has traditionally been to provide corrosion protection through galvanization for iron and steel. In 1991, the largest consumers of zinc were the construction (43 percent), transportation (20 percent), machinery (12 percent), and electrical (12 percent) sectors.

Domestic mine production increased substantially in 1994 in response to domestic demand, according to the U.S. Bureau of Mines. The largest growth occurred in the galvanizing and brass and bronze industries, due to increased automobile production. Exports of zinc concentrates were up slightly in 1994.

Gold

Domestic gold mines continue to produce at record levels, maintaining the U.S. position as the world's second largest gold-producing nation (12 percent of world resources), after the Republic of South Africa. The U.S was a net exporter of gold in 1993. Gold was produced at 200 lode mines and numerous placer mines (see discussion below for definition of lode and placer mines). Twenty-five mines yielded 75 percent of the gold produced. Estimated end-uses for 1993 were as follows: jewelry and arts (70 percent); industrial (mainly electronic; 23 percent); and dental (seven percent).

The gold mining industry is dominated by a few firms that are gaining an increasing portion of the market share and that remain financially strong. Smaller firms have seen decreasing operating revenues and net incomes, and may have greater difficulty in the future meeting short-term debt. The trend in gold exploration activities continues to be toward Latin American nations, where favorable geology and liberalized mining regulations hold the promise for greater long-term success and reduced risk to investment capital.

Silver

Continuing the trend begun in 1991, several large domestic silver producers halted mining operations in 1993 due to the continuing low price of silver. As a result, U.S. mine production of silver declined for the fourth consecutive year, and three major silver producers had negative net income. Silver prices have recently begun to rise, however; with the prospect of continued higher prices, some companies are considering resuming operations at currently inactive mines.

The U.S. is a net importer of silver. One hundred and fifty mines in 14 States mined silver in 1993. However, Nevada, Idaho, Arizona, and Montana accounted for 74 percent of all domestic production. Estimated end-uses for 1993 were as follows: photographic products (50 percent); and electrical and electronic products (20 percent).

III. Industrial Process Description

This section describes the major industrial processes within the metal mining industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of available reference documents.

This section describes commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Metal Mining Industry

Much of the following information has been presented previously in reports and issue papers drafted in support of various EPA offices, including the Office of Solid Waste, the Office of Pollution Prevention and Toxics, and the Office of Enforcement and Compliance Assurance. For a complete listing of reference documents, please see Section IX.

Metals are mined from two types of deposits. The first, lode deposits, are concentrated deposits that are fairly well-defined from surrounding rock. Iron, copper, lead, gold, silver, and zinc are mined mainly from lode deposits. The second type of deposits, placer deposits, occur with sand, gravel, and rock; they are usually deposited by flowing water or ice, and contain metals that were once part of a lode deposit. Only a small percentage of domestic gold and silver is derived from placer deposits.

There are three general approaches to mining metals:

Surface or **open-pit mining** requires extensive blasting, as well as rock, soil, and vegetation removal, to reach lode deposits. Benches are cut into the walls of the mine to provide access to progressively deeper ore, as upper-level ore is depleted. Ore is removed from the mine and transported to milling and beneficiating plants for concentrating the ore, and smelting, and/or refining. Open pit mining is the primary domestic source of iron, copper, gold, and silver.

Underground mining entails sinking a shaft to reach the main body of ore. "Drifts," or passages, are then cut from the shaft at various depths to access the ore, which is removed to the surface, crushed, concentrated, and refined. While underground mines do not create the volume of overburden waste associated with surface mining, some waste rock must still be brought to the surface for disposal. Waste rock may either be returned to the mine as fill or put in a disposal area. In the U.S., only lead, antimony, and zinc are solely underground operations.

Solution or fluid mining entails drilling into intact rock and using chemical solutions to dissolve lode deposits. During solution mining, the leaching solution (usually a dilute acid) penetrates the ore, dissolving soluble metals. This pregnant leach solution is then retrieved for recovery at a solvent extraction and electrowinning (SX/EW) plant. This method of mining is used in some parts of Arizona, Nevada, and New Mexico to recover copper.

Historically, the primary mining method has been underground mining. However, with the advent in recent decades of large earth moving equipment, less expensive energy sources, and improved extraction and beneficiation technologies, surface mining now prevails in most industry sectors. Open-pit mining is generally more economical and safer than underground mining, especially when the ore body is large and the overburden (surface vegetation, soil, and rock) relatively shallow. In fact, the lower cost of surface mining has allowed much lower-grade ores to be exploited economically in some industry sectors.

Metal mining processes include extraction and beneficiation steps during production. Extraction removes the ore from the ground, while beneficiation concentrates the valuable metal in the ore by removing unwanted constituents. Often, more than one metal is targeted in beneficiation processes. For example, silver is often beneficiated and recovered with copper. The beneficiation method selected varies with mining operations and depends on ore characteristics and economic considerations.

The following sections provide more detail on extraction methods and beneficiation processes, as they relate to the mining of each metal.

R0076111

Extraction Processes

As described in a report drafted for EPA's Office of Pollution Prevention and Toxics, extraction involves removing any overburden, then drilling, blasting, and mucking the broken ore and waste rock.

Mobile rigs drill holes in rock, which can then be filled with explosives for blasting waste rock and ore. Potential pollutants involved in this step in the mining process include the fuel, lubricants, and hydraulic oils consumed by the rigs; fuels and oils typically contain such constituents as benzene, ethylbenzene, and toluene.

Explosives (usually a mixture of ammonium nitrate and fuel oil) are used to break up the rock. Other explosives, including trinitrotoluene (TNT) and nitroglycerine, may also be used.

Mucking is the process of removing broken ore from the mine, using a variety of loading and hauling equipment to transport ore to a mill for beneficiation. Depending on ore volume, trucks, rail cars, conveyers, and elevators may all be required to haul ore. Equipment involved in this step of the mining process uses hydraulic fluid (containing glycol ethers); batteries (containing sulfuric acid, lead, antimony, and arsenic); and lubricants and fuel (containing petroleum hydrocarbons).

Beneficiation Methods

Ore beneficiation is the processing of ores to regulate the size of the product, to remove unwanted constituents, or to improve the quality, purity, or grade of a desired product. Under regulations drafted pursuant to the Resource Conservation and Recovery Act (40 CFR §261.4), beneficiation is restricted to the following activities: crushing; grinding; washing; dissolution; crystallization; filtration; sorting; sizing; drying; sintering; pelletizing, briquetting; calcining to remove water and/or carbon dioxide; roasting, autoclaving, and/or chlorination in preparation for leaching; gravity concentration; magnetic separation; electrostatic separation; flotation; ion exchange; solvent extraction; electrowinning; precipitation; amalgamation; and heap, dump, vat, tank, and *in situ* leaching.

The most common beneficiation processes include gravity concentration (used only with placer gold deposits); milling and floating (used for base metal ores); leaching (used for tank and heap leaching); dump leaching (used for low-grade copper); and magnetic separation. Typical beneficiation steps include one or more of the following: milling; washing; filtration; sorting; sizing; magnetic separation; pressure oxidation; flotation; leaching; gravity concentration; and agglomeration (pelletizing, sintering, briquetting, or nodulizing).

Milling extracted ore produces uniform-sized particles, using crushing and grinding processes. As many as three crushing steps may be required to reduce the ore to the desired particle size. Milled ore in the form of a slurry is then pumped to the next beneficiation stage.

Magnetic separation is used to separate iron ores from less magnetic material, and can be classified as either high- or low-intensity (requiring as little as 1,000 gauss or as much as 20,000). Particle size and the solids content of the ore slurry determine which type of magnetic separator system is used.

Flotation uses a chemical reagent to make one or a group of minerals adhere to air bubbles for collection. Chemical reagents include collectors, frothers, antifoams, activators, and depressants; the type of reagent used depends on the characteristics of a given ore. These flotation agents may contain sulfur dioxide, sulfuric acid, cyanide compounds, cresols, petroleum hydrocarbons, hydrochloric acids, copper compounds, and zinc fume or dust.

Gravity concentration separates minerals based on differences in their gravity. The size of the particles being separated is important, thus sizes are kept uniform with classifiers (such as screens and hydrocyclones).

Thickening/filtering removes most of the liquid from both slurried concentrates and mill tailings. Thickened tailings are discharged to a tailings impoundment; the liquid is usually recycled to a holding pond for reuse at the mill. Chemical flocculants, such as aluminum sulfate, lime, iron, calcium salts, and starches, may be added to increase the efficiency of the thickening process.

Leaching is the process of extracting a soluble metallic compound from an ore by selectively dissolving it in a solvent such as water, sulfuric or hydrochloric acid, or cyanide solution. The desired metal is then removed from the "pregnant" leach solution by chemical precipitation or another chemical or electrochemical process. Leaching methods include "dump," heap," and "tank" operations. Heap leaching is widely used in the gold industry, and dump leaching in the copper industry.

The following exhibit summarizes the various processes used within each mining sector, and the primary wastes associated with those processes.

Exhibit 9
Sector-Specific Processes and Wastes/Materials

Sector	Mining Type	Beneficiation/Processing	Primary Wastes/Materials
Gold-Silver	• Surface • Underground • *In Situ* (experimental)	• Cyanidation • Elution • Electrowinning/zinc precipitation • Milling • Base metal flotation • Smelting • Amalgamation (historic)	• Mine water * • Overburden/waste rock • Spent process solutions • Tailings • Spent Ore
Gold Placer	• Surface	• Gravity separation •Roughing, cleaning, fine separation • Some magnetic separation	• Mine water* • Overburden/waste rock • Tailings
Lead-Zinc	• Underground (exclusively)	• Milling • Flotation • Sintering • Smelting	• Mine water* • Overburden/waste rock • Tailings • Slag
Copper	• Surface • Underground • *In Situ*	• Milling • Flotation • Smelting • Acid leaching • SX/EW recovery • Iron precipitation/smelting	• Mine water* • Overburden/waste rock • Tailings • Slag • Spent ore • Spent leach solutions
Iron	• Surface (almost exclusively) • Underground	• Milling • Magnetic separation • Gravity separation • Flotation • Agglomeration • Blast furnace	• Mine water* • Overburden/waste rock • Tailings • Slag

* *Note: Mine water is a waste if it is discharged to the environment via a point source*
Source: U.S. EPA, Office of Solid Waste, Technical Document, Background for NEPA Reviewers: Non-Coal Mining Operations.

Below is a more detailed discussion of the various beneficiation methods and processes used for each of the sectors presented in the table above.

Iron Ore

Typical beneficiation steps applied to iron ore include: milling, washing, sorting, sizing, magnetic separation, flotation, and agglomeration. Milling followed by magnetic separation is the most common beneficiation sequence used, according to the American Iron Ore Association. Flotation is primarily used to upgrade the concentrates generated from magnetic separation, using frothers, collectors, and antifoams.

Steel mills generally agglomerate or pelletize the iron ore concentrates to improve blast furnace operations that utilize iron ore. Pelletizing operations produce a moist pellet (often using clay as a binder), which is then hardened through heat treatment. Agglomeration generates by-products in the form of particulates and gases, including compounds such as carbon dioxide, sulfur compounds, chlorides, and fluorides. These emissions are usually treated using cyclones, electrostatic precipitators, and scrubbing equipment. These treatment technologies generate iron-containing effluent, which is recycled into the operation. Agglomeration produces large volumes of sulfur dioxide and nitrogen dioxide.

Copper

Copper is commonly extracted from surface, underground, and, increasingly, from *in situ* operations. According to the U.S. Bureau of Mines, surface mining accounted for 83 percent of copper production in 1992, with underground mining accounting for the remainder. *In situ* mining is the practice of percolating dilute sulfuric acid through ore to extract copper, by pumping copper-laden acid solutions to the surface for solvent extraction/electrowinning (SX/EW). This leaching operation uses both ammonium nitrate and sulfuric acid.

Beneficiation of copper consists of crushing and grinding; washing; filtration; sorting and sizing; gravity concentration; flotation; roasting; autoclaving; chlorination; dump and *in situ* leaching; ion exchange; solvent extraction; electrowinning; and precipitation. The methods selected vary according to ore characteristics and economic factors; approximately half of copper beneficiation occurs through dump leaching, while a combination of solvent extraction/froth flotation/electrowinning is generally used for the other half. Often, more than one metal is the target of beneficiation activities (silver, for example, is often recovered with copper).

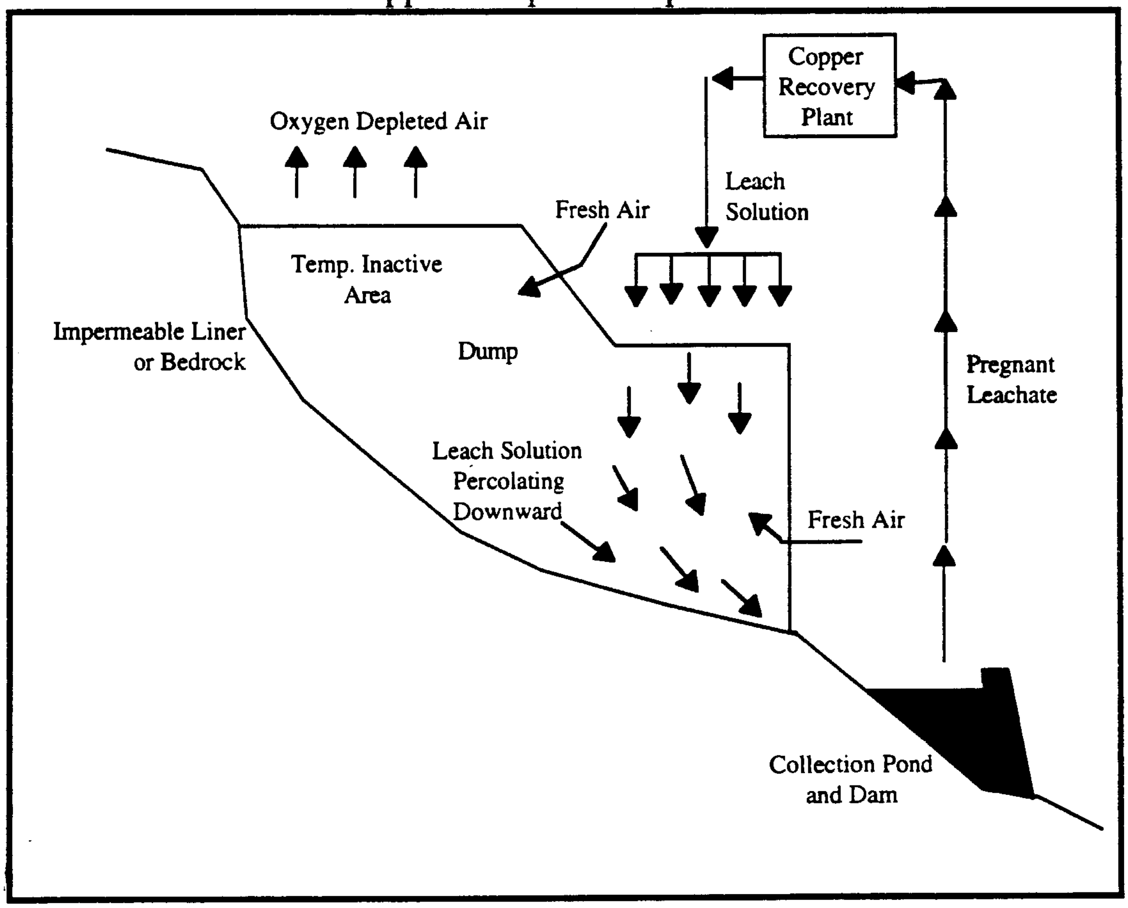
According to EPA's Office of Solid Waste *Technical Resource Document*, copper is increasingly recovered by solution methods, including dump and *in situ* leaching. Because most copper ores are insoluble in water, chemical reactions are required to convert copper into a water-soluble form; copper is recovered from a leaching solution through precipitation or by SX/EW. Solution beneficiation methods account for approximately 30 percent of domestic copper production; two-thirds of all domestic copper mines use some form of solution operations. Typical leaching agents used in solution beneficiation are hydrochloric and sulfuric acids. Microbial (or bacterial) leaching is used for low-grade sulfide ores, however this type of leaching is much slower than standard acid leaching and its use is still being piloted.

Dump leaching is a method of treating copper ore that has been extracted from a deposit, and refers to the leaching of oxide and low-grade sulfide ore on (typically) unlined surfaces. These operations involve the application of leaching solution, collection of pregnant leach solution (PLS), and the extraction of copper by SX/EW or cementation. Natural precipitation or mine water is generally used to leach low grade sulfide ore, while dilute sulfuric acid is commonly used to leach oxide ores. Copper dump leaches are massive, ranging in height from 20 to hundreds of feet, covering hundreds of acres, and containing millions of tons of ore. Dump leaching operations may take place over several years.

The solvent extraction process is a two-stage method; in the first stage, low-grade, impure leach solutions containing copper, iron, and other base-metal ions are fed to the extraction stage mixer-settler. In the mixer, the aqueous solution contacts an active organic extractant in an organic diluent (usually kerosene), forming a copper-organic complex; impurities are left behind in the aqueous phase. The barren aqueous solution, called raffinate, is typically recirculated back to the leaching units while the loaded organic solution is transferred from the extraction section to the stripping section. In the second stage, the loaded organic solution is stripped with concentrated sulfuric acid solution to produce a clean, high-grade solution of copper for electrowinning. Electrowinning is the method used to recover copper from the electrolyte solution produced by solvent extraction.

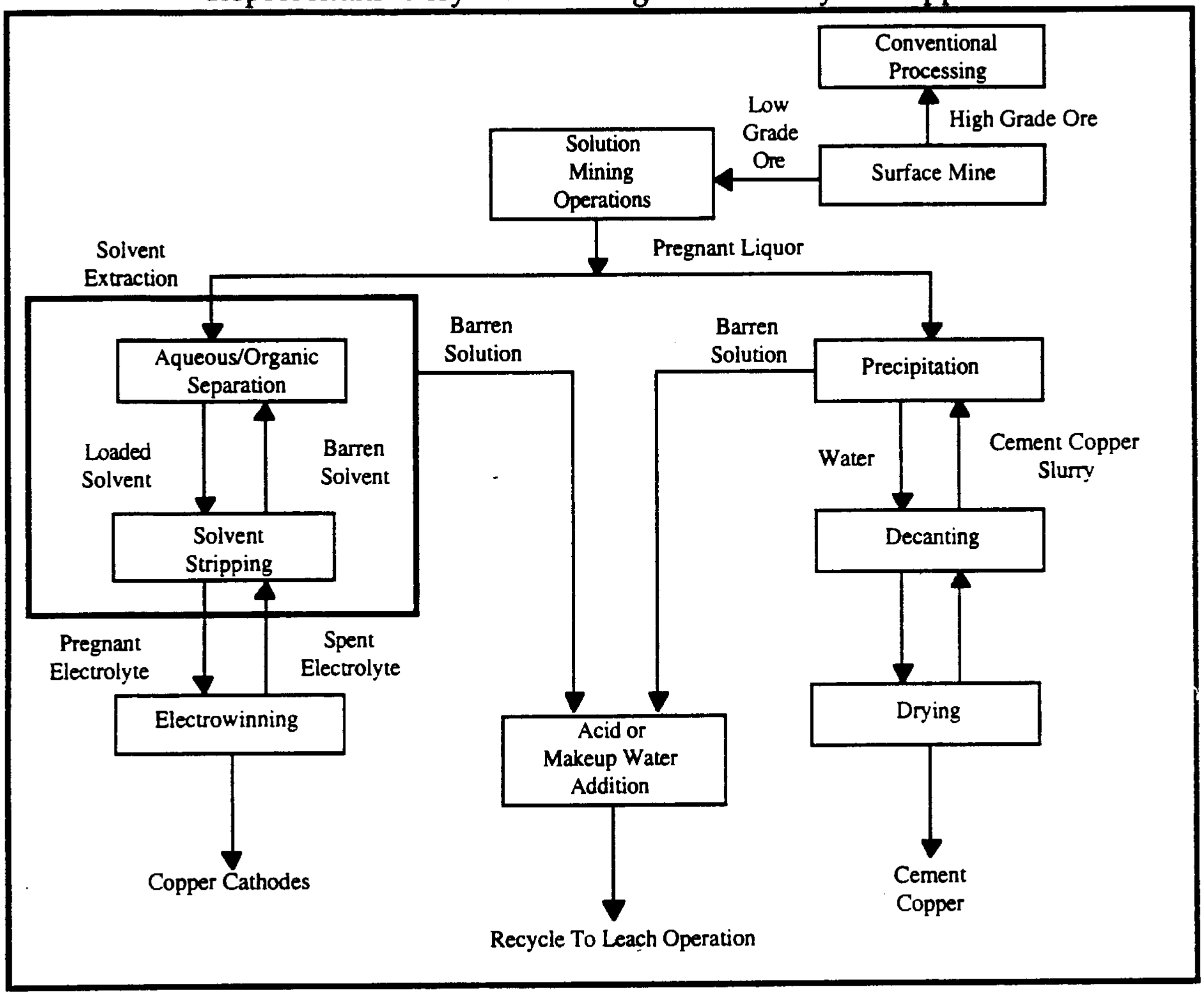
Exhibits 10 and 11 illustrate a typical dump leach operation and a representative solution-based process for recovering copper from ore. Variations exist in exact methods and processes used at each operation.

Exhibit 10
Copper Dump Leach Operation



R0076117

Exhibit 11
Representative Hydrometallurgical Recovery of Copper



Source: Technical Resource Document: Extraction and Beneficiation of Ores and Minerals, Volume 4, Copper, August 1994 U.S. EPA.

Lead and Zinc

Beneficiation of lead and zinc ores includes crushing and grinding; filtration; sizing; flotation; and sintering of concentrates. Flotation is the most common method for concentrating lead-zinc minerals. Ore may be treated with conditioners during or after milling to prepare the ore pulp for flotation. Common conditioners may include lime, soda ash, caustic soda, or sulfuric acid. The conditioned ore is then slurried in fresh or salt water with chemical reagents to beneficiate the ore. Several separate flotation steps may be needed to concentrate individual metal values from the ore. Reagents used in the flotation processes typically include such chemicals as sulfur dioxide, zinc sulfate, coal tar, copper sulfate, and sodium or calcium cyanide.

Lead and zinc mineral concentrates that will be smelted and refined may require sintering, typically performed at the smelter site. Sintering partially fuses the ore concentrates into an agglomerated material for processing, and involves several steps. First, ore concentrates are blended with moisture and then fired (sintered) and cooled. During cooling, the sinter is crushed, graded, and further crushed to produce a smaller sinter product. By-products of the roasting and sintering processes include sulfur dioxide, nitrogen dioxide, and carbon monoxide. Residues generated also include dust and primary lead process water.

Gold and Silver

Three principal techniques are used to process gold and silver ore: cyanide leaching, flotation of base metal ores followed by smelting, and gravity concentration. According to the U.S. Bureau of Mines, cyanide leaching generated 88 percent of all domestic lode gold in 1991, and 38 percent of silver. Processing of base metal ores produced 11 percent of the gold; over half of the silver produced in 1991 was from smelting concentrates produced by flotation of silver and base metal ores. Gravity concentration is used primarily by gold and silver placer operations.

Cyanide leaching is a relatively inexpensive method of treating gold ores and is the chief method in use. In this technique, sodium or potassium cyanide solution is either applied directly to ore on open heaps or is mixed with a fine ore slurry in tanks; heap leaching is generally used to recover gold from low-grade ore, while tank leaching is used for higher grade ore.

Compared to tank leaching, **heap leaching** has several advantages, including simplicity of design, lower capital and operating costs, and shorter start-up times. Depending on the local topography, a heap or a valley fill method is typically employed. The size of heaps and valley fills can range from a few acres to several hundred. Heap leaching may involve any or all of the following steps:

- Preparation of a pad with an impervious liner. Some liners may simply be compacted soils and clays, while others may be of more sophisticated design, incorporating clay liners, french drains, and multiple synthetic liners.
- Placement of historic tailings, crushed ore, or other relatively uniform and pervious material on the uppermost liner to

protect it from damage by heavy equipment or other circumstances.

- Crushing and/or agglomerating the ore.
- Placing the ore on the pad(s).
- Applying cyanide solution using drip, spray, or pond irrigation systems, with application rates generally between 0.5 and 1.0 pounds of sodium cyanide per ton of solution. This is known as the barren solution because it contains little or no gold.
- Collecting the solution via piping laid on the liner, ditches on the perimeter of the heap, or pipes/wells laid through the heap into sumps at the liner surface. The recovered pregnant solution, now laden with gold (and silver), may be stored in ponds or routed directly to tanks for gold recovery, or it may be reapplied to the heap for additional leaching.
- Recovering the gold from the pregnant solution (typically containing between 1 and 3 ppm of gold).

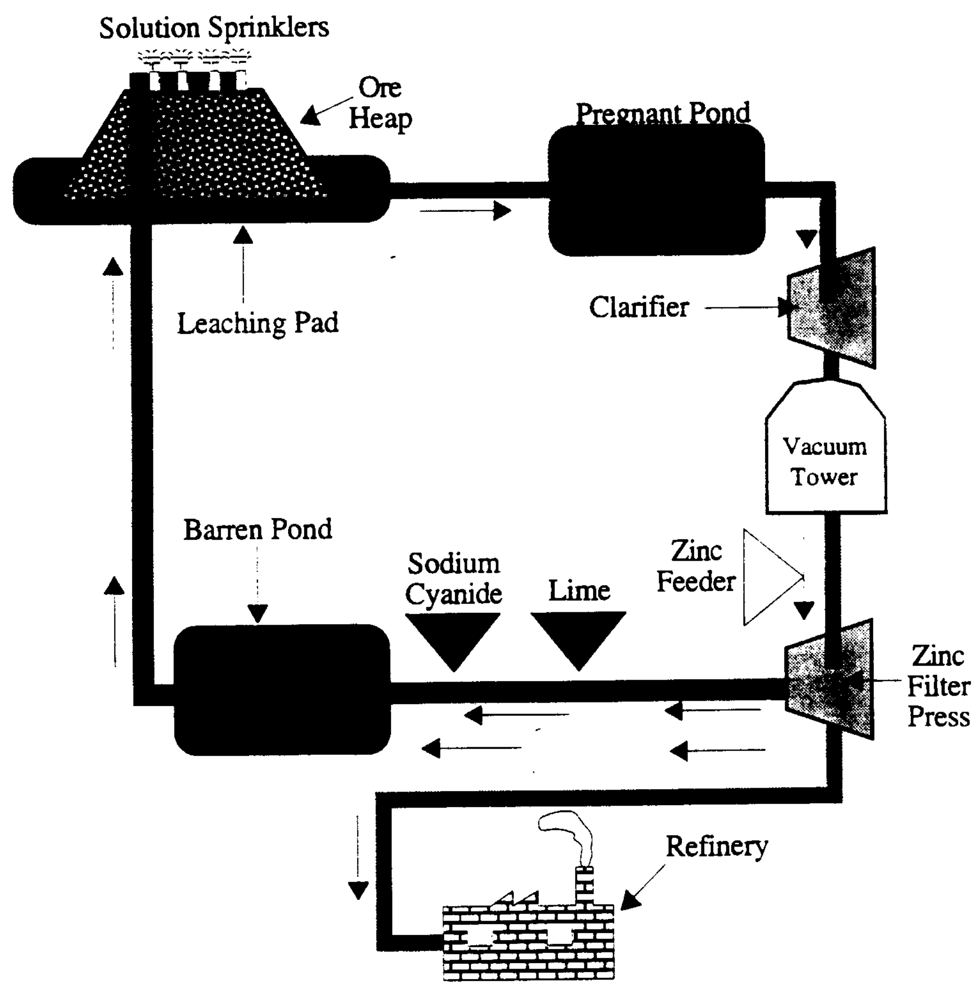
The leaching cycle can range from weeks to several months, depending on permeability, size of the pile, and ore characteristics. The average leach cycle is approximately three months.

Recovery of gold from the pregnant solution is accomplished using carbon adsorption or, less commonly, by direct precipitation with zinc dust. These techniques may be used separately or in a series with carbon adsorption followed by zinc precipitation. Both methods separate the gold-cyanide complex from other remaining wastes. Carbon adsorption involves pumping the pregnant solution into a series of activated carbon columns, which collect gold from the cyanide leachate. The precious metals are then stripped from the carbon by elution with the use of a boiling caustic cyanide stripping solution, or similar solution. Gold in the pregnant eluate solution may be electrowon or zinc precipitated.

Although carbon adsorption/electrowinning is the most common method of gold recovery domestically, zinc precipitation is the most widely used method for gold ore containing large amounts of silver. In zinc precipitation, pregnant solution (or the pregnant eluate stripped from carbon) is filtered and combined with metallic zinc dust resulting in a chemical reaction which generates a gold precipitate. The solution is then forced through a filter that removes the gold.

The following exhibit illustrates a typical gold heap leach operation using zinc precipitation; variations exist in exact processes and methods used at each operation.

Exhibit 12
Gold Heap Leaching Operation



Source: U.S. EPA, Office of Enforcement and Compliance Assurance.

To prepare for **tank leaching**, ore is ground to expose the metal values to the cyanide. Finely ground ore is slurried with the leaching solution in tanks. The resulting gold-cyanide complex is then adsorbed on activated carbon. The pregnant carbon then undergoes elution, followed either by electrowinning or zinc precipitation, as described previously. The recovery efficiencies attained by tank leaching are significantly higher than for heap leaching. The tank leaching process may occur over a series of days, rather than the weeks or months required in heap leaching.

After heap leaching and rinsing, the spent ore becomes waste and is left as is or is deposited in disposal areas similar to those used for waste rock. Spent ore may contain wastewater from rinsing the ore, residual cyanide, metal-cyanide complexes, and small quantities of heavy metals. Tailings produced from tank leaching may contain arsenic, barium, chloride, nitrate, sodium, and sulfate. Cyanide residues may require destruction using alkaline chlorination, ozone, or hydrogen peroxide addition.

Gravity concentration, a beneficiation method used mostly in placer mines, involves passing a slurry of ore and water over a series of riffles to catch heavier gold particles. Amalgamation, or wetting metallic gold with mercury to form an amalgam, is another recovery technique used in placer operations. Its high cost, inefficiency for large-scale mining operations, and environmental and safety considerations have greatly restricted amalgamation's previous widespread use.

Chemical Usage

The following exhibit lists the chemicals used in greatest volume in the metal mining processes for several of the main commodities. While volume does not necessarily correlate with potency, this data indicates which chemicals are present in greatest quantity, and to which chemicals mine workers may be most frequently exposed. Although it does not appear in the chart below, cyanide is also consumed in massive quantities by the gold industry. In 1990 alone, Dow Chemical supplied over 160 million pounds of reagent-grade cyanide for use in gold mining, according to the *Chicago Tribune* (February 2, 1992, p.27).

Exhibit 13
Chemicals Used in High Volume

Type of Mine	Chemical Name	Volume/Mass at Mine Site
Iron Ore	Acetylene	5,577,726 gallons
	Argon	15,892,577 gallons
	Diesel Fuel	3,417,487 gallons
	Nitrogen	9,398,026 gallons
Lead/Zinc	Acetylene	1,021,795 gallons
	Calcium Oxide	932,129 lbs.
	Diesel Fuel No. 2	1,640,271 gallons
	Propane	171,733 lbs.; 1,015,962 gallons
	Sulfur Dioxide*	1,843,080 lbs.

Exhibit 13 (cont'd)
Chemicals Used in High Volume

Type of Mine	Chemical Name	Volume/Mass at Mine Site
Copper	Acetylene	10,909,868 gallons
	Calcium Oxide	512,620,243 lbs.
	Chlorine**	17,242,059 lbs.; 138,015 gallons
	Coal	2,375,684,593 lbs.
	Copper ore concentrate**	24,000,000 lbs.
	Copper Slag	10,833,500 lbs.
	Diesel Fuel No. 2	47,301,433 gallons
	Limestone	154,280,000 lbs.
	Natural Gas	8.6 x 10^12 gallons
	Nitrogen	189,315,331 gallons
	Pyrites	38,400,000 lbs.
	Sulfuric Acid**	82,907,916 lbs.; 5,772 gallons
Gold	Acetylene	829,460 lbs.; 2,033,041 gallons
	Calcium Oxide	58,394,968 lbs.
	Chlorine**	66,090,022 lbs.; 165 gallons
	Diesel Fuel No. 2	13,425,408 gallons
	Propane	1,218 lbs.; 2,743,927 gallons
	Sulfuric Acid**	1,800,501 lbs.

Source: NIOSH 1990/91

* Proposed TRI chemical
** Current TRI chemical

III.B. Mining Process Pollution Outputs

The extraction and beneficiation of metals produce significant amounts of waste and byproducts. Total waste produced can range from 10 percent of the total material mined to well over 99.99 percent. The volume of total waste can be enormous: in 1992, gold mining alone produced over 540 million metric tons of waste. The following exhibit provides further detail on the volume of product and waste material generated from metal mineral mining.

Exhibit 14
Volume of Waste Generated for Selected Metals

Commodity	Number of Mines	Total Commodity Produced (1,000 mt)	Tailings Generated (1,000 mt)	Other Waste Handled (1,000 mt)
Copper	50	1,765	337,733	393,332
Gold	+212	0.329	247,533	293,128
Iron Ore	22	55,593	80,204	106,233
Lead	23	398	6,361	--
Silver	150	1.8	2,822	--
Zinc	25	524	4,227	--

Source: U.S. Bureau of Mines, Mineral Commodity Summaries 1994 and Minerals Yearbook, Volume I: Metals and Minerals, 1992.

The industry (including non-metallic minerals) is estimated to have generated 50 billion metric tons of waste through 1985, and currently generates approximately one billion metric tons annually. It is important to note, however, that virtually none of this annual production related to extraction and beneficiation is classified as RCRA hazardous waste. Exhibit 15 summarizes some of the potential effects of industrial mining on the environment.

Exhibit 15
Steps in the Mining Process and Their Potential Environmental Impacts

Mining Process	Process Wastes	Air Emissions	Other Waste	Land, Habitat, Wildlife
Site Preparation	Erosion due to removal of vegetation	Exhaust from construction vehicles; fugitive dust	Run-off sediment	Deforestation and habitat loss from road and site construction
Blasting/ Excavation	Acid Rock Drainage (ARD); erosion of sediments; petroleum wastes from trucks	Dust blown to surrounding area; exhaust from heavy machinery	Non-reused overburden; waste rock	Loss of habitat; increase in erosion; loss of plant population from dust and water pollution; reduction in localized groundwater recharge resulting from increased runoff; loss of fish population from water pollution; nearby structural damages from vibration and settling; competition for land use
Crushing/ Concentration	Acid Rock Drainage (ARD) from tailings	Dust created during transportation	Additional waste rock; tailings	

Exhibit 15(cont'd)
Steps in the Mining Process and Their Potential Environmental Impacts

Mining Process	Process Wastes	Air Emissions	Other Waste	Land, Habitat, Wildlife
Leaching	ARD; water pollution from ruptures in pipes or ponds holding leach solution		Sludges from neutralization of contaminated water	Loss of plant, fish, and water fowl population from water pollution

Source: Mining Support Package,. Draft, U.S. EPA, April 1994.

Wastes

Several wastes are created when metal ores are extracted from the earth. The first is overburden and waste rock, which is soil and rock removed in order to access an ore or mineral body. Overburden typically includes surface soils and vegetation, while waste rock also includes rock removed while sinking shafts, accessing or exploiting the ore body, and rock embedded within the ore or mineral body.

Most overburden and waste rock are disposed of in piles near the mine site, although approximately nine percent is backfilled in previously excavated areas, and nearly four percent is used off-site for construction. Waste rock dumps are generally constructed on unlined terrain, with underlying soils stripped, graded, or compacted depending on engineering considerations. Drainage systems may be incorporated into dump foundations to prevent instability due to foundation failures from groundwater saturation, and may be constructed of gravel-filled trenches or gravel blankets.

Tailings are a second type of common mining waste. Most beneficiation processes generate tailings, which contain a mixture of impurities, trace metals, and residue of chemicals used in the beneficiation process. Tailings usually leave the mill as a slurry consisting of 40 to 70 percent liquid mill effluent and 30 to 60 percent solids; liquids are commonly re-used in milling processes. Most mine tailings are disposed in on-site impoundments. Design of the impoundment depends on natural topography, site conditions, and economic factors; generally it is economically advantageous to use natural depressions to contain tailings. Impoundments are designed to control the movement of fluids both vertically and horizontally.

In some cases, tailings are dewatered or dried and disposed in piles; this minimizes seepage volumes and the amount of land required for an impoundment. However, dry disposal methods can be prohibitively expensive due to additional equipment and energy costs.

Slurried tailings are sometimes disposed of in underground mines as backfill to provide ground or wall support. This decreases the above-ground surface disturbance and can stabilize mined-out areas. Subaqueous tailings disposal, practiced primarily in Canada, is the placement of tailings below a permanent water surface such as a lake or ocean; it is used primarily to minimize the acid-generating potential of tailings by preventing sulfide ore from oxidizing. This disposal method is not currently practiced commercially in the United Stated.

Water

Water removed from a mine to gain or facilitate access to an ore body is known as mine water. Mine water can originate from precipitation, from flows into pits or underground workings, and/or from groundwater aquifers that are intercepted by the mine. Mine water is only a waste if it is discharged to the environment via a point source. Mine water can be a significant problem at many mines, and enormous quantities may have to be pumped continuously during operations. When a mine closes, removal of mine water generally ends. However, underground mines can then fill and mine water may be released through adits or fractures that reach the surface. Surface mines that extend below the water table fill to that level when pumping ceases, either forming a lake in the pit or inundating and saturating fill material. Pumped mine water is typically managed in on-site impoundments. Collected water may be allowed to infiltrate/evaporate, used as process water or for other on-site applications such as dust control, and/or discharged to surface water, subject to permit requirements.

Acid drainage is a potentially severe pollution hazard associated with mining, and can be difficult to predict. It occurs when pyrite and other sulfide minerals, upon exposure to oxygen and water, oxidize to create ferrous ions and sulfuric acid. Catalyzed by bacteria, the ferrous ions react further with oxygen, producing hydrated iron oxide, known as "yellowboy." This combination of yellowboy and sulfuric acid may contaminate surrounding soil, groundwater, and surface water, producing water with a low pH. When this reaction occurs within a mine it is called Acid Mine Drainage (AMD). When it occurs in waste rock and tailings piles it is often known as Acid Rock Drainage (ARD), although AMD is the most widely used term for both.

AMD is a significant problem at many abandoned mine sites: a 1993 survey by the U.S. Forest Service (*Acid Mine Drainage from Mines on National Forests, A Management Challenge*) estimates that 5,000 to 10,000 miles of domestic streams and rivers are impacted by acid drainage. Acid drainage can lower the pH of surrounding water, making it corrosive and unable to support many forms of aquatic life; vegetation growing along streams can also be affected. Mine water can also carry toxic, metal-bearing sediment into streams, which can kill waterborne plant and animal species. In extreme cases, acid drainage can kill all living organisms in nearby streams. Humans may also increase disease risks by consuming drinking water and fish tissue with a heavy metal content.

According to the 1994 *Technical Document/ Background for NEPA Reviewers: Non-Coal Mining Operations*, prepared by EPA's Office of Solid Waste (OSW), acid drainage can pose significant threats to surface and groundwater quality and resources during active mining and for decades after operations cease. Although mines that began operating after 1978 are required to treat their effluent water, the need for water treatment may persist for decades after mining operations have ceased. Abandoned mines and refuse piles can produce acid damage for over 50 years. According to EPA's hardrock mining strategy framework, for example, "negative changes in geochemistry over time can occur when the materials' environment changes (e.g., going from a reducing environment to an oxidizing one) or buffering capacity is exceeded (such as when the total neutralizing capacity of a rock mass is exceeded by acid generation). When these conditions are present, a facility can close in full environmental compliance, only to have a severe problem show up decades later." Because remediating acid drainage is so damaging and costly, predictive tools, design performance, financial assurance, and monitoring have become increasingly important.

Acid leaching operations are an additional source of water pollution. The leaching process itself resembles acid drainage, but it is conducted using high concentrations of acids to extract metals from ore. Since acid leaching produces large volumes of metal-bearing acid solutions, it is vital that leach dumps and associated extraction areas be designed to prevent releases. Most environmental damage associated with acid leaching is caused by leakage, spillage, or seepage of the leaching solution at various stages of the process. Potential problems include: seepage of acid solutions through soils and liners beneath leach piles; leakage from solution-holding ponds and transfer channels; spills from ruptured pipes and recovery equipment; pond overflow caused by excessive runoff; and ruptures of dams or liners in solution-holding ponds. Cyanide leaching solution processes carry a similar potential for damage as a result of leakages, spills, overflows, and ruptures.

Solution ponds associated with leaching operations are potential sources of acid and metal releases to ground and surface water. Ponds associated with precious metal leaching operations and newer copper facilities are generally lined with synthetic materials (although liners are often susceptible to failure). At older copper sites, solution ponds may be unlined or lined only with natural materials. Leakage, run-off from precipitation, and the like, may cause contamination of ground and surface waters.

Air

Substantial air pollution can occur at mining sites during excavation and transportation. Fugitive dust may be a significant problem at some sites, depending on site conditions and management practices, and is created at many stages of the mining process. The inherent toxicity of the dust depends on the proximity of environmental receptors and type of ore being mined; high levels of arsenic, lead, and radionuclides in windblown dust tend to pose the greatest risk, according to EPA's 1995 hardrock mining framework strategy. Sources of dust may be from road traffic in the mine pit and surrounding areas, rock crushers located in pits and in mills, and tailings ponds.

Dust control methods aim to reduce amounts and concentrations of dust produced and to minimize human exposure to remaining dust. The most important element of dust control at underground mines is a properly designed ventilation system. Water sprays are also used during ore transportation and crushing, and can greatly reduce dust levels at the site. Dust suppressants, such as lignin sulfonates and magnesium chloride, can stabilize solid piles or tailing areas that might otherwise become airborne in windy conditions. After mine closure, revegetation or other stabilizing methods may be used for dust control.

Exhaust fumes from diesel engines and blasting agents may also be serious hazards at underground mines. These exhausts produce carbon monoxide and nitrogen oxide gas, which collect in underground areas. Ventilation and monitoring are important steps taken to reduce the potential harm these fumes may cause workers.

The following exhibit, derived from EPA's OSW 1994 *Technical Document/Background for NEPA Reviewers: Non-Coal Mining Operations*, describes the various measures mining operators may take to mitigate potential environmental impacts of waste products generated through different phases of the extraction and beneficiation processes.

Exhibit 16
Potential Mine Waste Mitigation Measures

Mining Waste Product	Mitigation Measures
Extraction - Mine Workings	• Evaporation and re-use of mine water in processing operations • Run-on and runoff control measures, such as berms and ditches • Neutralization/precipitation or other treatment practices prior to discharges • Clean-up of blasting residuals • Provide for post-closure mine water management • Monitor discharges and surface water quality • Site mine water containment units to minimize potential for surface water recharge
Extraction - Waste Rock/ Overburden	• Backfill into dry mine workings with waste rock • Maximize use of overburden in reclamation • Collect and monitor seepage, drainage, and runoff • Segregate and cover reactive waste rock with non-reactive materials where ARD is observed • Use non-reactive waste rock for on-site construction • Provide for adequate dump drainage to minimize potential for slope failure • Conduct baseline surface water monitoring; continue monitoring throughout operation and post-closure • Use run-on controls to minimize potential for infiltration
Beneficiation - Tailings Impoundments	• Design unit to contain maximum reasonable storm event • Consider natural and/or synthetic liners for units located in drainages; consider liners for any seepage/runoff collection sumps/ditches • Maximize the reclaim/reuse of tailings water • Limit mill reagents to least extent necessary • Provide adequate drainage of berms • Include secondary containment of tailings pipelines • Continue ARD testing throughout operations and closure • Collect and treat runoff/seepage from outer slopes of impoundment

R0076129

Exhibit 16 (cont'd)
Potential Mine Waste Mitigation Measures

Mining Waste Product	Mitigation Measures
Beneficiation - Copper Dump Leach Operations and SX/EW Plants, Gold Heap Leaching	• Design dump leach units to fully drain to collection areas • Ensure that collection, pregnant solution, and raffinate ponds are designed to contain up to the maximum reasonable storm event; line process ponds, heap leach pads, and conveyances • Install leachate detection and collection systems under ponds and heaps; construct seepage ponds downgradient of ponds, heaps, and dumps • Recycle process water • Lime neutralization or wetlands treatment of acid drainage • Provide secondary containment for solution pipes to minimize impacts from pipe failures/spills • Collect and treat drainage that occurs after closure, as necessary • Perform baseline groundwater monitoring and conduct groundwater quality monitoring during operations and post-closure; monitor post-closure discharges and downstream surface water quality • Detoxification of heaps, dumps, and any spent solutions to reduce cyanide, acidity, and metal loadings • Biological treatment for cyanides, nitrates, and heavy metals
Beneficiation - Cyanide Leaching Operations	• Where possible, do not locate leaching operations in or near drainages • Ensure that pregnant and barren ponds and ditches are designed to contain all solution flows and any runoff up to the maximum reasonable storm event • Use double liners and leak detection systems for all heaps, ponds, and drainage ditches • Test detoxified materials prior to disposal or closure to ensure cyanide levels are reduced • Collect and test seepage and runoff from spent ore piles; treat runoff/seepage as necessary; perform downstream water quality monitoring
Beneficiation - *In Situ* Mining	• Ensure proper production well installation/completion to avoid uncontrolled solution releases; provide for adequate well abandonment • Perform a detailed characterization of the site hydrogeology to guide design of recovery systems and determine potential for releases • Carefully monitor pumping pressures of solutions entering and leaving deposits to assure that solutions are not migrating into groundwater • Line surface collection systems and provide for leak detection; design collection systems to contain maximum volumes of leaching solutions and runoff/precipitation/snow melt

R0076130

Because proposed mining activities may also impact aquatic resources, vegetation, and wildlife, EPA suggests the following potential mitigation measures for use at mine sites:

Exhibit 17
Ecosystem Mitigation Measures

- Employ sediment retention structures to minimize amount of sediment migrating off-site
- Employ spill prevention and control plans to minimize discharge of toxic/hazardous materials into water bodies
- Site roads, facilities, and structures to minimize extent of physical disturbance
- Avoid construction or new disturbance during critical life stages
- Reduce the chance of cyanide poisoning of waterfowl and other wildlife by neutralizing cyanide in tailings ponds or by installing fences and netting to keep wildlife out of ponds
- Minimize use of fences or other such obstacles in big game migration corridors; if fences are necessary, use tunnels, gates, or ramps to allow passage of these animals
- Use "raptor proof" designs on power poles to prevent electrocution of raptors
- Use buses to transport employees to and from mine from outer parking areas to minimize animals killed on mine-related roadways
- Limit impacts from habitat fragmentation, minimize number of access roads, and close and restore roads no longer in use
- Prohibit use of firearms on site to minimize poaching

IV. WASTE RELEASE PROFILE

This section provides a general overview of the waste release activities and issues common to the metal mining industry. Unlike facilities covered by SIC codes 20 through 39 (manufacturing facilities), metal mining (extraction and beneficiation) facilities are not required by the Emergency Planning and Community Right-to-Know Act to report to the Toxic Release Inventory (TRI). EPA is considering expanding TRI reporting requirements in the future, including participation of previously exempt industries such as metal mining. Because TRI reporting is not required in the metal mining industry, other sources of waste release data have been identified for this profile.

IV.A. Waste Release Data for the Metal Mining Industry

In 1994 EPA's OSW studied the unpermitted mining waste releases and environmental effects for nine States: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, South Carolina, and South Dakota. Researchers examined State records to document waste release events for various types of mines throughout each State. These releases generally were not authorized under existing permits or regulations, and therefore should not be considered "accepted," "standard," or "typical" waste outputs of metal mining facilities. Rather, the data presented below offer a picture of representative unpermitted mining release events, and of the magnitude of these events in many Western States, where most metal mining facilities are located. It should be noted that most of these releases were properly mitigated by the associated mining companies.

The release information presented below is categorized by mineral type, and is derived from the *Mining Waste Releases and Environmental Effects Summaries* reports prepared for OSW (see "References" for further information). Release data are presented in the units of measurement reported by each State and are therefore not standardized. Iron ore is not represented in the data because all U.S. iron ore mining occurs outside of the States selected for the survey. Note that the common types of waste released pose the greatest potential for polluting water sources, as stated elsewhere in this profile. Breaches of tailings impoundments, and subsequent spills of tailings, are not included in the data.

Copper

As evidenced in the following exhibit, the most prevalent waste release events related to copper mining involve leachate or process wastewater, reflecting the predominant extraction method for this ore.

Acid Mine Drainage is a significant release associated with abandoned copper mines.

Exhibit 18
Copper-Related Waste Releases

Site	Waste Released	Release Event Year
Cyprus Miami Mine, Claypool, AZ	Copper leachate (amount unknown) Waste water (amount unknown) Non-potable water (37,000 gallons) (min 185, 000 gallons)	1990 1980, 85, 86 1990 1989
Magma Copper, Miami Tailings Reprocessing Pit and Copper Cities Pit, Miami, AZ	Pregnant leach (5000-10000 gallons) Slurry (15,600 gallons, 35,000 gallons, 1000-2000 gallons, 216,600 gallons) Recycle (1,320 gallons) Effluent (amount unknown)	1984 1989 1991 1991 1989 1991
Oracle Ridge Mine, Pima County, AZ	Copper concentrate (100 pounds) Process water (5000 gallons)	1991 1991
ASARCO, Ray Mines, Gila County, AZ	Diesel fuel (amount unknown) PCB, dielectric fluid (10 gallons) Sulfuric acid (20 tons) Gasoline (amount unknown) Acidic water (amount unknown) Cooling tower blowdown (4340m^3/day) Sulfur dioxide (amount unknown)	1989 1989 1989 1989 1985 1985 1988
Sierrita Mine and Mill, Cyprus Minerals Corp., Pima County, AZ	Process water (1 gallon/min) Pregnant leachate (amount unknown)	1987 extended
Chino Mines, NM	Heavy metals and sulfuric acid Acidic water (16,200 gallons) (2 million gallons)	extended 1986 1988
Tyearone Mine, NM	TDS and sulfuric acid from tailings (4,270 acre feet per year)	1978-89
Montana Resources, Inc. Butte, MT	Leach (amount unknown)	1986
Bully Hill Mine, Redding, CA	Acid mine drainage (30 gallons/min)	since 1927
Penn Mine, New Penne Mines, Inc., Campo Seco, CA	Acid mine drainage Leaching of heavy metals (no known flow rate)	since 1955
Walker Mine, Calicopia Corp., Plumas County, CA	Acid mine drainage Heavy metals (no known flow rate)	since 1941
Mammoth, Keystone & Stowell Mines, Shasta County, CA	Acid mine drainage (100-275 gallons/min)	extended time period
Red Ledge Mine, NV	See Gold and Silver	
Arimetco Facility, ArimetcoInc./Copper Tek Corp., Lyon County, NV	Acid leach (amount unknown) Pregnant solution (2000 gallons)	1989-91 1990
Nevada Moly Project, Cyprus Tononpah Mining, Tononpah, NV	Process solution (amount unknown) Mercury (5.783 kg)	1989 1990
Rio Tinto Mine, US Forest Service, Elko County, NV	Acid (amount unknown)	extended

R0076133

Lead and Zinc

Because lead and zinc are often mined as a byproduct of other primary ores (copper or silver, for example), less data is available concerning releases specific to lead and zinc mining processes. Unless a mine operates exclusively as a lead/zinc operation, waste releases associated with these minerals are generally subsumed in the primary ore category and is included in the "Gold and Silver" data.

Exhibit 19
Lead and Zinc - Related Waste Releases

Site	Waste Released	Release Event Year
Black Cloud Mine, Res-ASARCO Joint Venture, Lake County, CO	Copper sulfate (2 gallons, 10 gallons, 50 gallons, amount unknown) Water and sediments (amount unknown) Acid leak (amount unknown)	1987 1987 1983 extended
Taylor/Ward Project ,White Pine County, NV	Lead only, see gold and silver	
Central Valley of CA	Zinc only, see gold and silver	
Red Ledge Mine, ID	Zinc only, see gold and silver	
Montana Tunnels Mine, MT	See gold and silver	
Lucky Friday Mine, Mullan, ID	See gold and silver	
Taylor/Ward Project, Alta Gold Co., White Pine County, NV	Lead only, see gold and silver	

Gold and Silver

As might be expected from the predominant beneficiation methods associated with gold and silver mining, release of leachate solutions (pregnant, process, barren, etc.) is by far the most common type of release for these ores, followed by release of cyanide, a common treatment solution. Release of cyanide is reported as presented in State files and is presumed to be released in solution form. Acid Mine Drainage is also problematic for gold and silver ore mining.

R0076134

Exhibit 20
Gold- and Silver -Related Waste Releases

Site	Waste Released	Release Event Year
American Girl Mine, American Girl Mining Co., Imperial County, CA	Pregnant solution (1700 gallons) Process solution (4320-8640 gallons) Barren solution (5000 gallons)	1987 1988 1989
Carson Hill Gold Mine, Western Mining Co., Calaveras County, CA	Pregnant leach solution (91,450 gallons)	1989
Goldfields Operating Co., Mesquite, CA	Leaching solution (amount unknown) (770, 50, 2520, 33, 26 gallons) Pregnant solution (4000 gallons) (52 gallons)	1986 1990 1989 1990
Goldstripe Project, Plumas County, CA	Leaching solution (amount unknown) Residue solution (amount unknown)	1986 1986-87
Gray Eagle Mine, Noranda, Siskiyou County, CA	Slurry (15 and 30 gallons/min) (1000-1500 gallons) (19,100 gallons) Untreated water (2-3 gallons/min for hours)	1983 1983 1986 1989
Jamestown Mine, Sonora Mining Corp., Tuolumne County, CA	Flotation solution (500 gallons) Reagents (2,700 gallons) Process water (1000 and 1500 gallons) Soda ash solution (3000 gallons) Supernatant (20 gallons/min) Concentrate (amount unknown, 10 tons, amount unknown)	1987 1987 1989, 90 1990 1987 1988, 90, 91
Kanaka Creek Joint Venture, Alleghany, CA	Effluent with arsenic (28 gpm)	1989
McLaughlin Mine, Homestake Mining Co., Napa & Yolo Counties, CA	Ore slurry (amount unknown)	1989
Morning Star Mine, Vanderbilt Gold Corp., San Bernardino, CA	Pregnant solution (2500 gallons)	1988
Mt. Gaines Mine, Texas Hill Mining Co., Mariposa, CA	Leaching solution (308,000 gallons)	1991
Central Valley of CA, numerous closed mines	Acid mine drainage Copper, zinc, cadmium (2 tons/year) Iron (22 tons/year)	extended
Picacho Mine, Chemgold Inc., Imperial County, CA	Cyanide solution (min 1200 gallons)	since 1987
Snow Caps Mine, Sunshine Mining Co., Independence, CA	Leaching solution (6000 gallons and amount unknown)	1989 1988
Yellow Aster Mine, Rand Mining Co., Randsburg, CA	Leaching solution (amount unknown)	1989
Atlantic and Pacific Mine, 2900 Development Corp., Madison County, MT	Effluent (amount unknown)	1988

Exhibit 20 (cont'd)
Gold- and Silver-Related Waste Releases

Site	Waste Released	Release Event Year
Basin Creek Mine, Lewis & Clark, Jefferson Counties, MT	Acid mine drainage (amount unknown) Cyanide (amount unknown, amount unknown)	extended 1988 1989
Cable Creek Project, Deer Lodge County, MT	Effluent from main sediment pond (amount unknown)	1989
Golden Sunlight Mine, Placer Amex, Inc., Whitehall, MT	Pregnant solution (2000 gallons) Acidic water (amount unknown) Waste rock (amount unknown)	1986 1980 1987
Mineral Hill Mine/Jardine Joint Venture, Jardine, MT	Seepage return solution (20-50 gallons) Cyanide (200 gallons)	1990 1990
Landusky Mine, Zortman, MT	Cyanide (few gallons/hour) Pregnant solution (amount unknown)	1987 1988
Montana Tunnels Mine, Jefferson County, MT	Cyanide (amount unknown)	1987, 88
Pony Custom Gold Mill, Chicago Mining Corp., Pony, MT	Slurry (20 gallons/day, max 15 gallons/day, amount unknown)	1990 1990 1990
Copperstone Project, Parker, AZ	Leaching solution (2000 gallons, 5 gallons) Process solution(150-200 gallons) Process water (500 gallons) Slurry (300-400 gallons, 200 gallons)	1987, 88 1989 1990 1988 1990, 92
Portland Mine, Bullhead City, AZ	Heap slide (amount unknown)	1986
Bullger Basin Mine, Pennsylvania Mining Inc., Park City, CO	Sediment (amount unknown) Oil (amount unknown)	1986 1986
Cross Gold Mine, Hendricks Mining Co., Caribou, CO	Mine water with cadmium, zinc, copper, lead (amount unknown)	1985, 1990
Jerry Johnson Group Cyanide Leach, El Paso County, CO	Fresh ore (amount unknown)	1986
Rubie Heap Leach, American Rare Minerals Inc., Teller County, CO	Cyanide (amount unknown)	1985-92
Gilt Edge Project, Brohm Mining Co., Deadwood, SD	Cyanide (amount unknown, amount unknown) Process solution (300 gallons) Neutralization solution (1,329 gallons) Pregnant solution (47.05 gpd) Leaching solution (amount unknown)	1991 1991 1990 1990 1989 1988-90

Exhibit 20 (cont'd)

Gold and Silver- Related Waste Releases

Site	Waste Released	Release Event Year
Annie Creek Mine, Wharf Resources, Lawrence County, SD	Process water (1 gallons/hr, amount unknown) Leachate (100 gallons, 10,000 gallons, amount unknown) Cyanide (500 gallons, amount unknown, 200 gallons, amount unknown, 1000 gallons, amount unknown, 50-60 gallons, 1317 gpd, 1288 gpd) Pregnant solution (5 gallons, amount unknown, amount unknown) Neutralization solution (amount unknown) Sedimentation pond (amount unknown) Diesel fuel (4000 gallons) Carbon slimes (amount unknown) Diesel free product (amount unknown)	1986 1989 1988, 90 1987 1988, 84, 84, 85, 90, 90, 84, 91, 91 1984, 89 1990 1989 1990-91 1987 1990 1991
Golden Reward Mine, Lead, SD	Barren solution (500 gallons) Leach heap (300 gallons/cell) Surge pond solution (500 gpd) Cyanide (120 gallons, 125 gallons, 1000-2000 gallons, 400 gallons, 50 gallons, 29 gallons, 25-50 gallons, 25-50 gallons, 200 gallons) Hydraulic oil (150 gallons)	1990 1990 1990 1989 90, 90, 91 1991 1990
Homestake Gold Mine, Lead, SD	Cyanide (amount unknown) Waste bench run-off (amount unknown)	1988 1988
Richmond Hill Mine, Bond Gold Co., Lawrence County, SD	Cyanide (200 gallons, 1350 gallons, 150 gallons) Ore (40 tons)	1989, 90 1990 1990
Brewer Gold Mine, Westmont Mining Inc., Jefferson, Chesterfield Counties, SC	Process water (amount unknown) Cyanide (1,800 gallons, 1683 gallons, 10-12 million gallons) Partially leached ore (500 tons) Barren solution (750 gallons, 1000 gallons, 1000 gallons, 150 gallons) Pregnant solution (500-600 gallons, 8741 gallons) Emergency pond solution (300-2250 gallons/day for 14 days) Ore (100 tons, amount unknown) Rinse solution (2250 gallons) Spent ore (125 ft^3)	1987 1988, 89 1990 1987 1990, 87 1988 1988 1990 1989 1989, 90 1989 1989
Luck Friday Mine, Hecla Mining Co., Mullan, ID	Copper sulfate (100 gallons)	1988
Marigold II Mine, Powell & Micro Gold II, Florence, ID	Mercury (12 pounds.)	1983
Princess Blue Ribbon Mine, Precious Metals Technology, Camas County, ID	Cyanide (amount unknown) Sediment (amount unknown)	1988-90 1990

Exhibit 20 (cont'd)
Gold and Silver- Related Waste Releases

Site	Waste Released	Release Event Year
Red Ledge Mine, Alta Gold Co., Adams County, ID	Acid mine drainage (.2 cfs)	since 1973
Stibnite Mine Project, Valley County, ID	Diesel oil (900 gallons) Cyanide (amount unknown)	1989-90 1989
Yellow Jacket Mine, Glen Martin, Cobalt, ID	Cyanide (amount unknown)	1983
ACH-Dayton Project, American Eagle Resources, Lyon County, NV	Cyanide (amount unknown) Barren pond (amount unknown)	1986 1989
Alligator Ridge Mine, USMX Inc., Ely, NV	Cyanide (100,000-200,000 gallons, 32,000-34,000 gallons, amount unknown) Pregnant solution (amount unknown) Process water (amount unknown, amount unknown)	1983 1986 1986 1985-89 1990 1990
Aurora Gold Project, Aurora Partnership, Mineral County, NV	Pregnant solution (4500 gallons)	1988
Bald Mountain Mine, Placer Dome U.S. Inc., White Plain County, NV	Barren solution (9,000 gallons, 5,000 gallons)	1989 1991
Big Springs Project, Independence Mining Co., Elko County, NV	Tails liquor (23,000 gallons) Cyanide (amount unknown)	1989 1990
Borealis Gold Project, Tenneco Mining, Mineral County, NV	Cyanide (2,000 gallons, 1,000 gallons)	1988
Buckhorn Mine, Cominco American Inc., Eureka County, NV	Process solution (3,000-5,000 gallons)	1990
Candelaria Mine, Necro Metals Inc., Hawthorne, Esmeralda, and Mineral Counties, NV	Pregnant solution (20,000-25,000 gallons)	1986
Chimney Creek Project, Gold Fields Mining Corp., Humboldt County, NV	Ammonium nitrate (4940 pounds.) Cyanide (1 gallons, 400 gallons, 360 gallons, 80 L, 80 gallons) Descalant solution (10 gallons) Diesel fuel (125 gallons) Hydraulic oil (78 gallons)	1991 1991 1991 1991 1991 1991
Coeur Rochester, Love Lock, Pershing County, NV	Barren solution (90,000-130,000 gallons) Pregnant solution (5,000-10,000 gallons)	1987 1987
Cortez Gold Mines, Cortez Joint Venture, Cortez, NV	Process solution (600 gallons)	1991
Crofoot & Lewis Projects, Hycroft Resources & Development, Humboldt County, NV	Pregnant solution (5000 gallons, 17,000 gallons, 228,000 gallons, 72,000 gallons)	1990, 91 1990 1990
Dee Gold Mine, Dee Gold Mining Co., Elko, NV	Tailings reclaim water (142,968 gallons) Cyanide (58 pounds, amount unknown)	1986 1990, 91

R0076138

Exhibit 20 (cont'd)
Gold and Silver-Related Waste Releases

Site	Waste Released	Release Event Year
Denton-Rawhide Project, Kennecott Rawhide Mining Co., Mineral County, NV	Safety pond solution (167 gpd)	1990
Easy Junior Mine, Alta Gold Co., White Pine County, NV	Used oil (13 barrels, 3000 gallons)	????
Elder Creek Mine, Alta Gold Co., Lander County, NV	Barren solution (4000 gallons, small amount, amount unknown) Pregnant solution (10,000 gallons)	1989, 90 1990 1990
Florida Canyon Mine, Pegasus Gold Corp., Pershing County, NV	Barren solution (1200 gallons, 500 gallons) Pregnant solution (30 gallons) Leaching solution (112 gallons)	1991 1990 1991
Flowery Project, American Eagle Resources, Virginia City, NV	Cyanide (amount unknown) Leaching solution (160-290 ml/min, amount unknown)	1988 1991 1991
Gretchell Mine, First Miss Gold Inc., Winnemucca, NV	Laboratory samples (8-16 gpd) Sulfuric acid (20 gallons)	1989-90 1991
Gold Bar Project, Atlas Gold Mining Inc., Eureka County, NV	Process fluid (amount unknown) Cyanide (amount unknown)	1989 1988
Golden Butte Project, Alta Gold Co., White Pine County, NV	Cyanide (75 gallons, 50-55 gallons, amount unknown) Pregnant solution (2.4 gpm, 6,500-17,500 gallons, 1000 gallons)	1990 1990 1989, 89 1990
Gooseberry Tailings Pond, Asamera Minerals Inc., Storey County, NV	Barren solution (300 gallons)	1990
Haywood Leach Facility, Oliver Hills Mining, Co., Lyon County, NV	Cyanide (amount unknown)	1989
Hog Ranch Mine, Western Mining Co., Valmy, NV	Cyanide (250,000 gallons) Barren solution (3,500 gallons)	1989 1990
Jerritt Canyon Project, Elko County, NV	Cyanide (20,000 gallons)	1989
Marigold Mine, Marigold Mining Co., Valmy, NV	Leaching solution (amount unknown)	1991
Mother Lode Project, US Nevada Gold Search Joint Venture, Beatty, NV	Pregnant solution (228 gpd, 640 gpd) Cyanide (.4 pounds)	1989 1990 1990
Nevada Mineral Processing Mill, Nevada Mineral Processing, Mineral County, NV	Cyanide (amount unknown)	1991
North Area Leach Project, Newmont Gold Co., Eureka County, NV	Pregnant solution (2500 gallons)	1988
Northumberland Mine, Western Minerals Corp., Nye County, NV	Pregnant solution (555,000 gallons) Leaching solution (8-100 gallons, 400 gallons)	1983 1989 1985

R0076139

Exhibit 20 (cont'd)
Gold and Silver-Related Waste Releases

Site	Waste Released	Release Event Year
Paradise Peak Project, FMC Gold Co., Nye County, NV	Cyanide (275 pounds, 48 pounds)	1989, 91
Rain Facility, Newmont Mining Co., Carlin, NV	Acid drainage (3 gpm)	1990
Santa Fe Project, Corona Gold Inc., Hawthorne, NV	Leaching solution (5 gpm) Barren solution (amount unknown) Waste oil (amount unknown)	1989 1990 1989
Silver Peak Project, Homestead Minerals Corp., Esmeralda County, NV	Cyanide (20-25 gallons, 8,000-10,000 gallons) Leach thickener (15, 750 gallons)	1988 1986 1991
6-Mile Canyon Project, Gold Canyon Placer Inc., Dayton, NV	Cyanide (amount unknown, 10 tons)	1986, 90
Sleeper Mine, Amax Gold Inc.	Reclaimed seepage pond solution (610 gallons) Barren solution (3,000 gallons, 2,000 gallons 300 gallons, 3600 gallons, 2000 gallons, 4000 gallons) Cyanide (149 pounds, 7.66 pounds, 265 pounds) Pregnant solution (amount unknown) Process water (4100 gallons, 6240 gallons, 45,000 gallons) Ore processing evaporation pond (1 gpm) Mill make-up water (3000 gallons)	1989 1989, 89 1989, 89 1990 1989, 90 1990 1990 1991 1991, 90 1990 1990
South Leach Project, Newmont GoldInc., Eureka County, NV	Pregnant solution (amount unknown, amount unknown)	1991 1991
Tonkin Springs Gold Mining Co., Eureka County, NV	Pregnant solution (500,000 gallons) Leach seepage solution (amount unknown, amount unknown)	1988 1988 1990
USX Project, Ivanhoe Gold Co., Elko County, NV	Leaching solution (150 gpd, amount unknown)	1990 1991
Willard Project, Western States Mineral Corp., Pershing County, NV	Pregnant solution (450 gallons) Barren solution (100 gallons, 600 gallons) Strip solution (450 gallons, 6000 gallons)	1989 1989, 90 1989, 90
Wind Mountain Project, Washoe, NV	Cyanide (385,000 gallons, 1.7 pounds, 300 gallons, 30 gallons)	1989, 90 1991

IV.B Other Data Sources

AIRS Data

The Aerometric Information Retrieval System (AIRS) is an air pollution data delivery system managed by the Technical Support Division in EPA's Office of Air Quality Planning and Standards, located in Research Triangle Park, North Carolina. AIRS is a national repository of data related to air pollution monitoring and control. It contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. States are the primary suppliers of data to AIRS. Data are used to support monitoring, planning, tracking, and enforcement related to implementation of the Clean Air Act. AIRS users include State environmental agency staff, EPA staff, the scientific community, other countries, and the general public.

Exhibit 21 summarizes AIRS annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). This information is compared across industry sectors.

Exhibit 22 lists the air emissions of particular chemicals reported for the metal mining industry in the Air Facility Subsystem (AFS) of AIRS, presented in a "SIC Code Profile, Metal Mining," prepared by EPA's Office of Pollution Prevention and Toxics in April, 1992. The release data are expressed in pounds released per year, per facility. Most of the chemicals released in the highest quantities and those released by the largest number of facilities are metals. In total, 17,654,112 pounds of the chemicals listed in Exhibit 22 were released by the mines covered.

R0076141

Exhibit 21
Pollutant Releases (Short Tons/Years)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97.208.000	23,402.000	45,489,000	7,836,000	21.888.000	23,312.000
Metal Mining	**5,391**	**28,583**	**39,359**	**140,052**	**84,222**	**1,283**
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108.575	4,107	39,082	182,189	52.091
Organic Chemicals	146,947	236.826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1.518,642	138.985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

R0076142

Exhibit 22
AIRS Releases

Chemical	Facilities	Med. Releases (lbs/Year/ Facility)	Total Releases (lbs/Year/ Facility)
Acetaldehyde	3	200	546
Acetone	8	147	19,366
Acrolein	3	136	381
Acrylic acid	2	72	143
Acrylonitrile	2	92	185
Aniline	2	126	251
Antimony	38	1.568	1,499,719
Arsenic	60	636	2,189,992
Barium	62	77	54,284
Benzene	15	226	9,929
Benzyl chloride	2	67	134
Beryllium	2	1	3
Biphenyl	2	2	3
1,3-Butadiene	4	108	380
Butyl acrylate	2	68	137
sec-Butyl alcohol	2	54	108
tert-Butyl alcohol	2	67	134
Butyraldehyde	3	72	212
Cadmium	60	166	613,554
Carbon disulfide	2	14	29
Chlorine	64	3,450	3,197,210
Chlorobenzene	2	113	226
Chloroethane	2	46	92
Chloroform	2	81	162
Chloroprene	2	54	108
Chromium	64	292	227,682
Cobalt	56	119	93,723
Copper	63	1,625	1,887,139
Creosote	2	59	118
Cresol (mixed isomers)	2	60	121
Cumene	2	60	121
Cyclohexane	13	34	1,032
1,2-Dibromoethane	2	67	134
Dibutyl phthalate	2	6	13
1,2-Dichlorobenzene	2	64	127
1,4-Dichlorobenzene	2	115	229
Dichlorodifluoromethane CFC-1	2	56	111
1,2-Dichoroethane	2	92	185
Dichloromethane	2	119	239

R0076143

Exhibit 22 (cont'd)
AIRS Releases

Chemical	Facilities	Med. Releases (lbs/Year/ Facility)	Total Releases (lbs/Year/ Facility)
Dichlorotetrafluoroethane	2	2	3
Dimethyl phthalate	2	10	19
Epichlorohydrin	2	67	134
2-Ethoxyethanol	2	57	115
Ethyl acrylate	2	80	159
Ethylbenzene	5	52	333
Ethylene	9	192	7,160
Ethylene glycol	2	59	118
Ethylene oxide	2	60	121
Formaldehyde	154	256	36,290
Formic acid	2	67	134
Freon	2	64	127
Glycol Ethers	2	70	140
HCFC-22	2	25	51
Hydrogen sulfide	1	3	3
Isobutyraldehyde	2	67	134
Lead	64	2,218	4,065,664
Maleic anhydride	2	11	22
Manganese	64	451	572,225
Mercury	36	14	8,365
Methanol	2	223	446
2-Methoxyethanol	2	62	124
Methyl acrylate	2	60	121
Methyl ethyl ketone	2	194	388
Methyl isobutyl ketone	2	89	178
Methyl methacrylate	2	73	146
Methylene bromide	2	5	10
Monochloropenta-fluoroethane	2	3	6
Naphthalene	7	48	1,716
n-Butyl alcohol	2	110	220
Nickel	62	164	132,525
Nitrobenzene	2	53	105
Phenol	3	35	154
Phosphorus (yellow or white)	62	190	142,058
Phthalic anhydride	2	32	64
Propionaldehyde	3	57	191
Propylene oxide	2	80	159

Exhibit 22 (cont'd)
AIRS Releases

Chemical	Facilities	Med. Releases (lbs/Year/ Facility)	Total Releases (lbs/Year/ Facility)
Propylene (Propene)	9	201	3,067
Selenium	56	78	54,673
Silver	35	59	41,069
Styrene	3	96	405
Tetrachloroethylene	2	111	223
Toluene	15	125	3,323
1,1,1-Trichloroethane	2	68	137
1,1,2-Trichloroethane	2	56	111
Trichloroethylene	2	68	137
Trichlorofluoromethane CFC-11	2	97	194
1,2,4-Trimethylbenzene	2	2	3
Vinyl acetate	2	88	175
Vinyl chloride	2	67	134
m-Xylene	2	91	181
o-Xylene	5	47	252
p-Xylene	2	64	127
Xylene (mixed isomers)	2	111	223
Zinc (fume or dust)	64	1,694	2,781,488

National Priorities List

Presented in Exhibit 23 is a table of mining sites listed on the National Priorities List (NPL) for environmental remediation. These sites have been involved primarily in the extraction and beneficiation of those metal ores covered in this profile and represent only a small fraction of the total number of sites on the NPL, currently numbering over 1,200. The total number of mining-related sites on the NPL is far greater, and includes smelting and other metal processing facilities, and a wider range of metal and non-metal mining facilities.

Exhibit 23
Selected NPL Mining Sites

Site Name/Location	Type of Mine	Contaminant of Concern	Environmental Damage
Silver Bow Creek, Butte, MT	Copper	Arsenic, heavy metals	Contaminated surface soils and sediments; contamination of primary drinking water sources
Clear Creek/Central City Site, Clear Creek, CO	Gold, silver, copper, lead, zinc, molybdenum	AMD, aluminum, arsenic, cadmium, chromium, lead, manganese, nickel, silver, copper, fluoride, zinc	Surface water contamination from AMD; contaminated sediments and groundwater; potential air-borne contamination from tailings
Silver Mountain Mine, Loomis, WA	Silver, gold, copper	Arsenic, antimony, cyanide	Soil, groundwater, and surface water contamination
Summitville Mine, South Fork, CO	Gold, copper, silver	AMD, heavy metals, cyanide	Surface water contamination; fishkills
Whitewood Creek, Lawrence/Meade/Butte Co's., SD	Gold	Arsenic, cadmium, copper, manganese, other metals	Contaminated alluvial groundwater, surface water, surface soils, and vegetation
Cherokee County-Galena Subsite, Cherokee Co., KS	Lead and Zinc	Cadmium, lead, zinc, AMD	Ground and surface water contamination; contaminated soils
Oronogo-Duenweg Mining Belt, Jasper Co., MO	Lead and Zinc	Cadmium, lead, zinc	Contaminated ground and surface water, and sediments; contamination of primary drinking water supplies
Tar Creek, Ottawa Co., OK/Cherokee Co., KS	Lead and Zinc	AMD, heavy metals	Contaminated aquifer serving approx. 21,000 residents; acute surface water contamination; high mortality rate of most surface water biota
California Gulch, Leadville, CO	Gold, silver, lead, zinc, copper	AMD, cadmium, copper, lead, zinc	Contaminated surface water, groundwater, and sediments
Eagle Mine, Gilman, CO	Zinc, copper, silver	AMD, antimony, arsenic, cadmium, chromium, copper, lead, manganese, nickel, silver, thallium, uranium, zinc	Contaminated surface water and groundwater; contaminated soils and sediments
Iron Mountain Mine, Redding, CA	Gold, silver, copper, zinc, pyrite	AMD, cadmium, copper, zinc	Contamination of surface water; elimination of aquatic life; fishkills
Richardson Flat Tailings	Multiple	Arsenic, cadmium, copper, lead, selenium, zinc	Surface water contamination; possible contamination of wetlands
Smuggler Mountain, Pitkin County, CO	Silver, lead, zinc	Lead, cadmium, zinc, arsenic, barium, copper, manganese, silver, mercury	Soil contamination; potential air, ground and surface water contamination

V. POLLUTION PREVENTION OPPORTUNITIES

As a national policy, the Pollution Prevention Act of 1990 (PPA) and the Resource Conservation and Recovery Act (RCRA) encourage the reduction in volume, quantity, and toxicity of waste. While RCRA focuses primarily on the reduction in volume and/or toxicity of hazardous waste, the PPA encourages maximum possible elimination of all waste through source reduction.

In the PPA, Congress defined source reduction as any practice that reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise releases into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants. Source reduction includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways, such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, employee awareness and education, and employing substitutions for toxic chemicals.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the metal mining industry. While the list is not exhaustive, it does provide core information that can be used as a starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can or are being implemented by this sector. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

Much of the information presented is drawn from EPA's OSW report on *Innovative Methods of Managing Environmental Releases at Mine sites, April 1994.*

V.A. Controlling and Mitigating Mining Wastes

Mining Water Control

As discussed previously, acid drainage is an environmental concern at many mining sites. There are no widely-applicable technologies to stop a fully-developed acid drainage situation. This makes it particularly important to prevent acid drainage before it starts. Prevention of acid drainage requires control of oxygen, water, bacteria, and sulfide minerals. Within a mine, oxygen levels cannot be controlled, so AMD prevention measures focus on control of the other three parameters, particularly on water flows.

The primary strategy for minimizing acid drainage focuses on water control. A comprehensive water control strategy works both to limit contact between water and exposed mine rock and to control the flow of water that has been contaminated by mineral-bearing rock. Development of systems for water control at mine sites requires consideration of rainfall runoff as well as process water used or produced when mine dewatering is required in excavation, concentration, and leaching. Although the type of water controls used varies widely according to topography, rock type, and climactic conditions, efforts are typically aimed at directing water flows to containment ponds for treatment or evaporation. The five principal technologies used to control water flow at mine sites are: diversion systems, containment ponds, groundwater pumping systems, subsurface drainage systems, and subsurface barriers.

Surface water is controlled by diversion systems, made up primarily of drainage ditches. Some drainage ditches channel water away from mining sites before runoff reaches exposed minerals, while others direct contaminated water into holding ponds for evaporation or treatment. The ponds used to hold leaching solutions are more sophisticated than holding ponds for mine runoff because of environmental concerns and the valuable nature of the metal-rich solutions in leaching holding ponds.

Groundwater sources can also be protected with water control systems. Groundwater pumping systems are used to control or reduce underground seepage of contaminated water from collection ponds and waste piles. Wells are drilled where underground water movement is detected, and pumps are then used to move the water out of the ground to holding ponds and/or to a treatment plant. Subsurface drainage systems are also used to control seepage in mining areas. These systems use a drain channel and wells to collect contaminated water that has seeped underground and move it to a

R0076149

treatment plant. Subsurface barriers are used to divert groundwater away from mining operations. The most common forms are slurry walls and grouting. Slurry walls are made of low-permeability materials that are sunk into the ground around mining operations.

Grouting involves the injection of a liquid solution, which then solidifies, into rock crevices and joints to reduce water flow. The EPA and DOE-sponsored Mining Waste Technology Program (MWTP) in Butte, Montana is conducting a clay-based grouting demonstration project at the Mike Horse Mine in Lincoln. Researchers have found that clay-based grouts retain their plasticity throughout stabilization, unlike cement-based grouts; clay grouts are not easily eroded; and clay grouts generally penetrate mine fractures better than cement-based grouts. Through this project, researchers hope to use a clay grout, developed specifically for the site's geological characteristics, to isolate specific mineralized structures within the mine. This grouting barrier will lower the groundwater flow entering the mine, reducing contact with the mine's sulfide minerals. Consequently, acid generation will decrease and lower quantities of acid and dissolved metals will be delivered to area surface water sources.

MWTP is also demonstrating a sulfate-reducing bacteria project at the nearby abandoned Lilly/Orphan Boy mine, where acid production is a continuing problem. This technology uses bacteria to reduce contamination in mine wastewater by reducing sulfates to hydrogen sulfide. This hydrogen sulfide reacts with dissolved metals, resulting in the formation of insoluble metal sulfides. Finally, the sulfate reduction produces bicarbonate, which increases the pH of the water. This biotechnology also acts as a source control by slowing or reversing the process of acid generation. Because biological sulfate reduction is an anaerobic process, it reduces the quantity of dissolved oxygen in the mine water and increases the pH, thereby slowing or stopping the production of acid. Final reporting on this demonstration project is expected after the three-year trial ends in late 1997.

Waste Rock Disposal Area and Tailing Impoundment Design

In addition to controlling water flow, acid drainage minimization also requires that waste rock disposal areas and tailings impoundments be properly designed and sited. When selecting a site for waste disposal areas, mine operators should consider the topography of the site and the proximity to groundwater, streams, and rivers. Waste rock can be sloped to minimize uncontrolled runoff and to control the velocity of water that flows into containment ponds.

Wetlands

One promising technique for treating AMD is the use of constructed wetlands. There are currently approximately 400 such systems in operation, mostly as a result of U.S. Bureau of Mines research programs. Constructed wetlands systems have been particularly effective at removing iron from acid mine water. These wetlands rely on bacterial sulfate reduction (the opposite of bacterial oxidation, the formation of acid) to remove iron and other minerals and to reduce the acidity of contaminated water. The iron is precipitated out, deposited in the substrate, and eventually accumulated by plants. Although a few wetland systems have been built to treat large flows of acid mine drainage, the technique seems best suited to handling seeps and small flows. Their effectiveness is also limited when there are large seasonal changes in flow rates, or high concentrations of nonferrous metals, as occurs in some metal mining areas.

The Dunka mine site, an iron ore mine operated by LTV Steel Mining Company (LTV SMCo) is currently using wetlands treatment methods to mitigate an existing seepage problem. The facility has experienced seepage from a specific type of acid generating waste rock found at the site. Seepage from the waste rock piles has flowed to a creek, which enters Birch Lake; a previous study estimated 50 million gallons a year of discharge. Studies conducted at the mine's active wetlands site indicate 30 percent removal of nickel and 100 percent removal of copper by peat sequestration. Overall mass analyses indicate more than 80 percent of copper entering the wetlands were retained. Other technologies currently being used at the site include pile capping to reduce infiltration; diverting the creek away from the waste rock stockpiles; and a lime neutralization treatment system for removing metals from collected waste rock seepage.

Pump and Treat

The conventional approach to treating contaminated ground or surface water produced through acid drainage involves an expensive, multi-step process that pumps polluted water to a treatment facility, neutralizes the contaminants in the water, and turns these neutralized wastes into sludge for disposal. The first step in the process, equalization, involves pumping polluted water into a holding basin. The holding basin may be the containment pond at the base of the waste rock disposal area or tailings impoundment, or may be an additional basin constructed for this purpose. A steady "equalized" flow of water is then pumped out of the holding basin to a treatment plant for neutralization. Lime is commonly added to the water in the treatment plant to neutralize the acid. The next step, aeration, involves moving the treated water to another basin where it is exposed to air. The metals precipitate typically as hydroxides, forming a gelatinous sludge. The floc then settles to the bottom of the pond as sediment. This sediment contains most of the contaminants that had previously been mixed with the water, as well as unreacted neutralizing reagents. The accumulated sludge at the bottom of the basin can then be removed for disposal.

MWTP is exploring a variety of options for improving mine wastewater treatment technologies. Among its projects is an effort to use photoassisted electron transfer to remove toxic substances, specifically nitrate and cyanide, from wastewater. Researchers are also developing new treatment technologies involving chemical precipitation, with or without aeration, to neutralize acid waters and precipitate contaminants from a nearby abandoned open-pit mine that contains over 20 billion gallons of wastewater. Final study results for this project will be published in early 1996.

Sludge Disposal

Sludge disposal is the most expensive and difficult part of acid drainage treatment. The easiest method for final disposal is to pump the sludge into abandoned mines. The long-term environmental impact of this method is undetermined. While the mine is still active, the sludge may be placed in a basin next to the sediment pond. The sludge is left in this second pond until evaporation takes place and the sludge dries. The sludge can then be transferred to an appropriate location for long-term storage or disposal.

MWTP is currently completing a research project on sludge stabilization. The research team, led by faculty at University of Montana's Montana Tech, is studying the properties and stability of sludges generated through water treatment techniques for acid-polluted water from sulfide mines. Researchers are analyzing the chemical properties of sludges, and will propose various storage environments to optimize long-term sludge stability.

Mine Planning

One way to mitigate the problems caused by acid water draining from underground and surface mines is to carefully consider a site's topography, geology, hydrogeology, geochemistry, and the like in determining approaches to ore production and the siting of such process wastes as waste rock piles, tailings impoundments, and solution ponds. Proper planning of operations can greatly reduce such environmental hazards as potential releases to ground and surface waters and AMD production.

Acid Zone Isolation

An alternative to removing acid producing zones, which may be neither feasible nor economical, is to isolate them by using a mining sequence that avoids extracting material that will create AMD-producing wastes and exposing "hot" zones. This is accomplished by leaving rock barriers between mining operations and the potential acid-producing zone, and, if necessary, grouting or otherwise sealing off the flow of water into the "hot" zone.

V.B. Innovative Waste Management Practices

New techniques for recovering metal resources that may have less of an environmental impact include *in-situ* leaching, use of robotic systems, and underground leaching. These techniques could reduce surface disturbances and eliminate waste piles and impoundments, but may have serious impacts on groundwater. Alternatively, existing waste piles may be remined to meet environmental standards, if economically feasible. Another possibility is the development of techniques to extract metals more economically from common rocks. Waste from these common rocks may not contain the hazardous components common in the sulfide ore that are the source of many metals. Industry groups suggest, however, that metals in common rock may not be present in recoverable form and amounts.

The Bureau of Mines has developed a froth flotation process to remove heavy-metal-bearing minerals from tailings. This process recovers not only the desired mineral components of the tailings, but also the acid-forming minerals, and renders the wastes less susceptible to AMD. A combination of conventional and non-conventional flotation reagents lowers the metal content of tailings by as much as 95 percent. Two other possibilities for dealing with wastes created during processing is to concentrate potential contaminants, which would then require a smaller disposal area, or to treat contaminants with a chemical or physical coating, which reduces the rate of release.

Following is an exhibit that describes some of the waste minimization/prevention opportunities for different steps of the mining process.

Exhibit 24
Waste Minimization and Prevention Opportunities

Activity	Waste	Waste Minimization Options
Flotation	Sodium cyanide	• Non-toxic reagents may be substituted for cyanide compounds in copper beneficiation; sodium sulfide/ bisulfide may be used as alternatives to sodium cyanide
	Zinc sulfate, sodium cyanide	• Flotation process control equipment w/sensors, computing elements, and control units may be installed to reduce amount of flotation reagents necessary and to improve separation of waste from product
	Ammonia	• Alkalinity in the beneficiation circuits may be maintained by reagents less toxic than ammonia, such as lime
Tailings Management	Sulfuric acid	• Pyrites could be segregated from other gangue material before discharge to tailings impoundments to reduce the potential for sulfuric acid formation after closure • Thin Layer (TL) process for copper reduces water use by as much as 75 percent as the amount needed for agitation leaching; also reduces fugitive dust generation • Up to 90 percent of metals and cyanide can be removed through use of ion exchange, heavy metal removal systems and cyanide destruction systems, precipitation of heavy metals using lime, oxidization of cyanide using sodium hypochlorite, then electrolysis, and filtration through a high flow rate sand filter
	Water (and associated pollutants)	• Water may be removed from the tailings slurry for reuse in the milling circuit
Leaching	Trace metals	• A Pachuca reactor reduces the elution time for recovering cobalt from spent copper leach solutions • Substitute thiourea, thiosulfate, malononitriles, bromine, and chlorine compounds for cyanide under certain conditions
Metal Parts Cleaning	Miscellaneous chlorinated solvents	• Switching to semi-aqueous cleaners such as terpene and hydrocarbon cleaners or aqueous cleaners which are water-based cleaning solutions would reduce or eliminate solvent emission and liquid waste generation
Blasting	Ammonium nitrate	• Maintain storage containers properly • Use used oil instead of new oil in the preparation of ANFO (if allowed by MSHA)
Crushing	Zinc liners	• Zinc mantle liner pieces in the secondary crushers may be recycled

Source: Draft Report to U.S. EPA Office of Pollution Prevention and Toxics, September 1994.

Metals Recovery

In cooperation with domestic steel makers, the Bureau of Mines has developed an innovative, efficient, and cost-effective recycling process to treat the estimated 1.8 million annual tons of iron-rich dusts and sludges that are contaminated with heavy metals, by mixing various dusts and wastes to produce recyclable metal pellets. The process has been proven on a 1,000 lb/hour pilot scale, and full scale industrial tests are being scheduled. In addition, the Bureau of Mines has worked with DOE and industry representatives to develop a 1,000 lb/hour electric arc furnace suitable for demonstrating the vitrification of mineral wastes and/or the recovery of heavy-metal-rich fume products for recycling. If the contaminated mineral wastes cannot be easily treated, furnace treatment is possible. This treatment has been shown to be effective in rendering unleachable and safe for discarding any unrecoverable trace metals left in the resulting slag.

Cyanide Removal

Bureau of Mines scientists are also investigating new methods of rinsing heaps to remove cyanide. Researchers have determined that interrupted or pulsed water rinsing, as opposed to continuous washing, more efficiently rinses cyanide from heaps and produces less liquid waste to be chemically neutralized or destroyed. Chemical neutralization methods are also being studied for a suite of cyanide complexes typically found in mining waste. In addition, an alternative to destroying cyanide or preventing its escape is the development of leaching agents other than cyanide. Several reagents such as thiourea are effective for recovering gold under certain circumstances. Thiosulfate, malononitriles, bromine, and chlorine compounds also have been shown to leach gold under specific conditions.

Reclamation

Bureau of Mines researchers are currently developing methods for reclamation and closure of mining operations. The focus of this work is on controlling hydrology at sites, decontaminating wastes when necessary, and stabilizing wastes for closure. For example, the current practice for sealing mine shafts is to install a concrete plug. This practice is difficult and expensive because it requires drilling into rock walls to provide support for the plug; access to remote shafts and portals is also a problem. One possible solution being investigated is the use of low-density foaming plastics and/or cements. The cost of the foaming plastic closure is about one-half that of concrete plugs, and the expansion characteristic of the foaming materials may eliminate the need for drilling into intact rock. Another important advantage of using foamed plastic or cement plugs is that these materials may provide a resistant seal to acidic mine waters.

Flotation Technology

Flotation mills separate metalliferrous minerals from waste rock, using surfactants to cause air bubbles to attach themselves to mineral particles and to float to the top of a frothing bath of ore slurry. The goal of flotation mill operators is to maximize the amount of valuable material floated, while minimizing the ore concentrate's gangue content. In order to also improve environmental quality, operators must minimize the amount of surfactants and heavy metals in the waste stream fed to the tailings pond. Reliable on-line measurements of metals content at various points throughout the mill is thus necessary to effect control of the operation.

X-Ray Fluorescence (XRF) is an analytical technique designed to rapidly measure the metals content of a flotation slurry sample. In mills with on-line X-ray analyzers, operators can base their responses to process changes on absolute determinations of the metals content of each stream sampled. In its simplest form the operator uses output information from the analyzer to adjust surfactant addition rates to meet quality goals. Some mills are moving toward a more advanced system of incorporating XRF technology, using central computers to store historical data and/or a detailed model of the total process to establish automatic control setpoints.

This technology is now in use at the Doe Run Fletcher mill, which beneficiates a mixed sulfide ore. During the flotation process, assay data from the XRF unit is sent to a process control computer. Flowmeter readings from all of the reagent addition lines are also sent to the computer, as are the outputs from a variety of process monitors. The computer displays most of this data on an operator console in the mill control room. Based on the data presented, the operator can vary the reagent addition rates to obtain better mineral separation. The computer maintains an archive of the historical behavior of the mill, enabling mill managers to specify empirical formulae relating reagent needs to assay results.

Use of an on-line X-ray analyzer, coupled with a process control computer, greatly simplifies the operation of a mill. One mill required 24 operators, three engineers, and three supervisors before this technology was introduced; it now requires about eight staff to operate. Benefits associated with this process control technology may include a decrease in reagent consumption, a significant environmental benefit; a stabilized process, increasing metal recovery rates; and more effective grinding control, allowing an increase in mill tonnage throughput. Doe Run estimates its cost savings to approach $785,000 per year, including a 14 percent reduction in reagent costs per year and improved metallurgy resulting from higher purity concentrates. In addition, the technology has resulted in a reduction of 4,500 to 5,000 pounds of metal entering the tailings pond per day.

Pyrite Flotation

At the Superior Mine in Arizona, Magma Copper Company is currently producing a high grade pyrite product by subjecting copper tailings to an additional flotation circuit. Instead of generating a tailings high in sulfide, the facility produces less reactive tailings and two marketable pyrite products.

Pyrite easily oxidizes to form sulfuric acid and, at many mine sites, is associated with acid generation from tailings piles and other mining activities. Removing pyrite prior to discharging the tailings will decrease the potential for acid generation from tailings, which may in turn minimize possible waste treatment and remediation costs.

Magma's pyrite flotation circuit is similar to its copper flotation circuit and uses existing flotation equipment. Operators use reagents to float pyrite from copper tailings, producing a 99 percent pure pyrite concentrate. This concentrate is pumped to a settling pond for dewatering after exiting the flotation circuit. As the pyrite dries, it is excavated from the pond and sent to the plant to package for sale.

Currently, the operation of pyrite flotation circuit is demand-driven, with the circuit used only as needed to meet the demand for the pyrite product. At other times, the pyrite is discharged with the tailings to the tailings impoundment. According to Magma's facility personnel, "breaking even" financially with the pyrite flotation project is a satisfactory result because of the resultant savings or avoidance of waste treatment costs associated with acid generation caused by pyrite in the tailings.

Possible limitations to widespread application of this technology are related to the Superior Mine's unique ore, in which pyrite concentration reaches 25 percent (concentration at most copper mines is closer to five percent). Lower pyrite concentrations in other ore may make pyrite flotation more difficult and/or expensive. In addition, because the operation is demand-driven and operates only when needed, pyrite is removed from only a portion of the copper tailings.

Tailings Reprocessing

Magma Copper is also recovering additional copper from a tailings pile at its Pinto Valley operation. The tailings pile covers 210 acres and contains 38 million tons of tailings; it was deposited between 1911 and 1932. Pinto Valley hydraulically mines the tailings pile, leaches the tailings, and produces copper by using a SX/EW facility. After leaching and washing of the slurried tailings, the remaining slurry is piped overland approximately five miles to an abandoned open copper pit mine for final disposal.

The pile's oldest tailings contain .72 percent copper, while those deposited most recently contain .11 percent copper; Magma thus pre-strips the top layer in order to get to an economically recoverable zone. Magma still reprocesses this pre-stripped layer, although the copper recovered is extremely low.

The hydraulic mining system's water jets and vacuum pumps break down clay aggregates, allowing more efficient tailings separation, and renders the tailings into a slurry for beneficiation processes. The slurry first enters a leach tank, then goes to the first of two thickeners. Overflow from this thickener becomes the pregnant leach solution (PLS), which is sent to the solvent extraction circuit. The underflow from the first thickener is pumped to a second thickener. Overflow from this thickener is returned to the mining circuit as feed for the hydraulic operations; the underflow is pumped into a tailings disposal area. Magma uses the same SX/EW operation for reprocessed tailings and its in situ leach operation; there is no difference between the SX/EW operation for the reprocessed tailings and other SX/EW plants in use at other copper sites.

According to facility personnel, the operation has recently been financially profitable due to the increase of copper prices and is expected to continue to be profitable in the future. Environmentally, the benefit derived from the operation results from the removal of the tailings pile located in a drainage adjacent to a town and redepositing the tailings in an abandoned open pit in a relatively remote location. Magma credits the success of this operation to the high concentration of copper present in the tailings; other sites may have a lower percentage of copper in the tailings, which may make reprocessing less economical.

Pipe Recycling/Reuse

IMC operates phosphate rock mines in West Central Florida, and has implemented a waste minimization program involving the reuse and recycling of steel pipe used to transport slurry, water, tailings, and other materials. IMC obtains maximum use from its pipe in several ways:

- Pipe used for matrix and clay transport is periodically rotated to ensure that wear is evenly spaced over the full diameter of the pipe
- To the extent possible, pipe no longer suitable for the most demanding use is used in other, less demanding pipelines
- Pipe no longer suitable for use in pipelines is either used for other purposes (such as culverts) or is sold for off-site reuse or scrap.

IMC has developed a computerized model to predict how long a section of pipe can remain in each position and when it needs to be turned. When pipe can no longer be used for materials transport, any undamaged portions of pipe are removed for onsite reuse as culvert or sold to a local scrap dealer as usable pipe. Damaged pipe is sold to a scrap dealer. By reusing pipe onsite, IMC estimates that it saves approximately $1.5 million each year. In 1991, $316,000 was received for pipe that could be reused offsite, and 4,200 tons of scrap piping was sold for an estimated total of $42,000 - $84,000. IMC's program reduces capital expenditures by reducing the amount of new pipe that must be purchased, as well as saving operating costs by avoiding costly shutdowns when pipes fail.

Mine Tire Recycling

Mine representatives have estimated the price of one large tire to range from $10,000 to $16,000, or over $100,000 to fit one large piece of equipment. Several options exist for recycling or reusing whole large tires. One alternative is retreading the tires for reuse; retreading reduces the demand for new tires and conserves resources (retreading a used tire requires less than 40 percent of the fossil fuel to make a new tire). The purchase price for retreaded tires is less than for new tires, providing an additional savings incentive. In addition to retreading, whole scrap tires are used in civil engineering applications, including construction, erosion control, and agriculture (feeding troughs, for example).

Processing scrap tires involves shearing, cutting and/or shredding tires into smaller pieces. The major markets for processed tires are as tire derived fuel and in civil engineering applications. Scrap tires are an excellent fuel source, generating about 80 percent as much energy as crude oil per pound. In recent years, there have been major increases in the use of scrap tires as fuel by a number of industries, including power plants, cement kilns, pulp and paper mills, and tire manufacturing facilities.

Mining companies may be able to access the tire retreading market through their current tire vendors. Depending on their condition and suitability, some vendors may offer reimbursement for used tires. Cobre, a tire vendor for the Dee Gold Mine, performs on-site evaluations of used tires to determine each tire's potential for retreading. If a tire is retreadable, Dee Gold Mine is reimbursed $500 per tire; if it isn't, Cobre will remove the tire free of charge.

Two major impediments to recycling mine vehicle tires are the distance to existing resource recovery markets and the size of these large scrap tires. Large mining operations are not usually located near their potential markets in larger cities. For remote mine locations, some added effort may be necessary to find or develop markets. In order to reduce size and handling difficulties associated with used mine tires, shredders or shears may be used to cut large tires into pieces more suited to handling.

Mine Water Management

One of the major concerns regarding runoff from mining activities is the potential for acid generation and metal mobilization in waste associated with mining. Sources of potentially contaminated non-process waters at a mine site include: seepage from underground mine workings; runoff from abandoned/inactive mines; runoff from waste rock, overburden, and tailings piles; overflow from ponds or pits, especially during high precipitation or snow melt events; runoff from chemical storage areas; former mining and processing areas with contaminated residue; leaks from liquid/slurry transport lines; and runoff from other areas disturbed by mining operations.

Effective practices for managing and controlling runon/runoff are also known as best management practices, or BMPs. BMPs can be measures or practices used to reduce the amount of pollution entering surface or groundwater, air, or land, and may take the form of a process, activity, or physical structure. BMPs include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, waste disposal, drainage from raw material storage or other disturbed areas. BMPs applicable to mine site discharges can be divided into three general areas: 1) construction/reclamation; 2) management and housekeeping; and 3) treatment. The following table provides examples of specific techniques used within each of these areas.

Exhibit 25
Mine Water Management Techniques

Construction/Reclamation Techniques	Management & Housekeeping Techniques	Treatment Techniques
Diversion ditches and drainage systems	Comprehensive pollution prevention plan	Sedimentation basins Oil/water separators
Rip-rap	Immediate spill clean-up	Neutralization
Dikes and berms	Inspection	Artificial wetlands
Grading or terracing	Training and education	
Collection basins	Routine maintenance	
Capping or sealing	Proper handling procedures	
Vegetation and mulching	Periodic systems reviews	
Silt fences		

The following cases illustrate how some facilities are approaching water management at their operations. First, the Hayden Hill Project is operated in Lassen County, California by Lassen Gold Mining, Inc., a subsidiary of Amax Gold Inc.. Amax Gold won a California Mining Association award for its facility reclamation plan, and the 1992 DuPont/Conoco Environmental Leadership Award for environmental excellence in the precious metals industry. Mining operations include an open pit mine, waste rock disposal area, a heap leach pad, and mill processing facilities.

Storm water control measures undertaken at Hayden Hill include:

- Baseline and continual monitoring of ground and surface water
- Double liner and leak detection for heap leach pad and processing ponds
- Lined tailings impoundment, with a surrounding freeboard berm to protect against runon and overflow
- Erosion control measures, such as retention ponds to intercept runoff and stream crossing constructed during low flow periods
- Protection of stream bank to prevent grazing impacts
- Groundwater springs near the open pit will be rerouted

- Diversion of natural drainage around the heap leach pad
- Solution pipes located in lined ditches.

In addition, all runoff from the shops and warehouse areas is collected in a storm water collection ditch; above the mill area are storm water diversion ditches to route storm water around the mill to avoid potential contact with material at the mill. The waste rock dump basin is designed with interior benches that slope towards the inside of the basin to allow storm water to be captured as it flows across the bench. These "V" ditches will drain the runoff to a heap toe drain.

Revegetation will be an important step in the mine's reclamation. To aid this effort, various erosion controls will be used, including rip-rap in shallow interception ditches, sediment collection basins, rock dikes, and straw bales as check dams around culverts. Expectations are to return the site to livestock grazing, watershed protection, wildlife habitat, and recreational use after mining is complete.

The Cyprus Bagdad Mine, operated by the Cyprus Bagdad Copper Corporation in Baghdad, Arizona, is another facility using an integrated approach to water management as part of its pollution prevention plan. Cyprus' pollution prevention plan was prepared in response to Arizona Department of Environmental Quality requirements, and addresses many areas of the facility, including non-mining activities such as vehicle fueling.

Examples of Cyprus' pollution prevention controls include:

- Diversion ditches to carry runoff away from the solvent exchange leach and tailings disposal areas; regular ditch inspections and repairs
- Runoff and spills channeled to collection basins and surge ponds; planned upgrades for many existing ponds with double liners and leak detection systems
- Earthen berms around petroleum tanks to prevent runon from contacting the tank and surrounding areas
- Visual leak/spill inspections of tailing disposal, reclaim water, seepage return, and leaching systems
- Redirection and control of water from mine shop parking lot
- Collection and recycling of spilled fuel and oil; monitor equipment areas for spilled fuel and oil

R0076162

- Cover copper-concentrate trucks with heavy tarps to prevent in transit losses; store concentrate on concrete and asphalt pads
- Construction of a lined impoundment and oil/water separator at truck wash area; chlorinated solvents no longer used at the truck wash, eliminating a contaminant source.

A notable feature of Cyprus' pollution prevention and control plan is its comprehensiveness. All facets of facility operation are addressed, including frequency of routine maintenance and inspections; employee training; supervisor maintenance of monitoring logs; emergency backup systems testing, inspection of piping, sumps, and liners; and monitoring pump rates and pond and dam elevations.

Lastly, the Valdez Creek Mine in Cantwell, Alaska is using stream diversion to both improve access to ore and prevent stream discharges. In order to access ore sources beneath an active stream channel, the Valdez Creek was diverted by constructing a diversion dam upstream of the active pit; the dam impounds water, which then flows through the diversion channel approximately one mile before rejoining the stream. The diversion channel is lined with a synthetic liner and riprap to prevent erosion and incision of the channel. To aid water management in the active pit, the facility uses two diversion ditches on either side of the valley above the mined area to intercept runoff before it reaches the pit.

The lined diversion channel for Valdez Creek and the diversion ditches minimize impact to the downstream environment by reducing turbidity and sedimentation caused by mining operations. Stream diversion not only prevents stream discharges, but also improves access to the ore and has lowered operating costs by reducing pit dewatering requirements.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities

R0076164

that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties

that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the

Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The

Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

R0076174

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry-Specific Requirements

Three types of laws govern and/or regulate the mining of metal resources. The first type, (i.e., the Mining in National Parks Act and the Wild and Scenic Rivers Act), define areas that are off-limits to metal mining. The second type of law, (i.e., the General Mining Law of 1872), defines methods for allocating metal deposits for extraction. The third type of law, those governing the extraction process and establishing restrictions on the types and amounts of wastes that may be generated, comprises most of the following discussion.

General Mining Law of 1872

The General Mining Law of 1872 is one of the major statutes that direct the Federal government's land management policy. The Mining Law grants free access to individuals and corporations to prospect for minerals in public domain lands, and allows them, on discovery, to stake a claim on that deposit. According to staff in EPA's Office of Solid Waste, roughly 40 percent of U.S. mines operate under this provision.

The Bureau of Land Management (BLM), under the Department of the Interior, has authority to regulate these mining claim operations under the Federal Land Policy and Management Act (FLPMA) of 1976. FLPMA established BLM's general land management and planning authority (43 CFR Part 3809), and requires that mining operations on Federal lands are regulated to prevent "unnecessary and undue degradation."

While mining operations are subject to varying levels of scrutiny, all operations must be reclaimed and must comply with all applicable State and Federal laws, including air and water quality standards such as those established under the CAA and CWA, and standards for the disposal of solid waste under RCRA.

In addition to requiring reclamation bond posting, BLM requires mining operations that involve cyanide leaching to meet the following standards:

- Fencing must be used to ensure protection of the public, livestock, and wildlife
- Facilities must be designed to contain the maximum operating water balance in addition to the water from a 100-year, 24-hour storm event; containment ponds must be included in all containment systems
- Leakage detection and recovery systems must be designed for heap and solution containment structures; monitoring of ground and surface water through closure and final reclamation is required
- Cyanide solution and heaps must be neutralized or detoxified.

Although BLM has general management authority for the mineral resources on Federal lands, the Forest Service (FS) also regulates mining activities on Forest Service land, with a similar mandate to minimize adverse environmental impacts. The National Forest Management Act of 1976 provides the Forest Service with authorities and responsibilities similar to those provided to BLM by FLPMA. Like BLM's regulations, they require compliance with the Clean Water Act and other environmental statutes and regulations. FS generally consults with appropriate agencies of the Department of the Interior, including BLM, in reviewing technical aspects of proposed mining operations. FS also conducts environmental assessments of proposed plans and, if necessary, prepares EISs pursuant to the National

Environmental Policy Act. FS also specifies standards for reclamation and may require bond posting.

EPA is currently pursuing a Memorandum of Understanding (MOU) with the Department of the Interior to formally coordinate regulatory and enforcement efforts concerning mining operations on Federal lands. Ongoing enforcement efforts are commonly coordinated with BLM State offices, as part of a broader strategy to simplify and coordinate oversight of mining operations at the State and Federal level.

Clean Water Act (CWA)

Under the Clean Water Act, National Pollution Discharge Elimination System (NPDES) permits must be acquired before any pollutant can be discharged from a point source into U.S. waters. EPA has established national technology-based effluent limitation guidelines for ore mining and dressing operations (40 CFR Part 440). These include new source performance standards based on Best Available Demonstrated Technology (BADT). For mine and mill point source discharges, 40 CFR Part 440 establishes the maximum levels of pollutants that can be released daily and monthly. The discharger must not exceed the daily allowance nor the average allowed over an entire month in order to comply with regulations. For most metals, the monthly averages are one-half the daily maximums for metal pollutants.

Contaminated storm water runoff from some mining operations has been documented as causing water quality degradation, according to a Technical Resource Document on extraction and beneficiation of copper by EPA's OSW. In the past, point source storm water discharges have received limited emphasis under the NDPES program. However, EPA has promulgated regulations that specifically address point source discharges of storm water from industrial facilities, including active and inactive/abandoned mine sites (55 FR 47990; November 16, 1990). These regulations require NPDES permits for all discharges of contaminated storm water. The Water Quality Act of 1987 added §402(p)(2)(B), requiring that point source discharges of storm water associated with industrial activity (including active and inactive mining operations) be permitted by October, 1992. This provision includes discharges from "areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water." The storm water permitting regulations address discharges from mine sites that occur as a result of precipitation events where the runoff from those sites is contaminated by exposed overburden, raw material, intermediate products, finished products, byproducts, or waste materials resulting from present or past mining activities.

In the case of active mine sites, the storm water regulations apply to both storm water discharges from mining operations as well as to areas used for the storage and maintenance of material handling equipment, shipping and receiving areas, and haul roads. For inactive or abandoned mines, all point source discharges of contaminated storm water (i.e., storm water that has come into contact with mine facilities, materials or wastes) must be covered under an NPDES storm water permit. Some storm water discharges from mine sites are not subject to NPDES permitting, including storm water that is not contaminated by contact with overburden, raw material, or waste materials located on the site of the operation.

The following exhibit highlights examples of discharges from ore mining and dressing facilities that are subject to 40 CFR Part 440 or to storm water permitting.

Exhibit 26
Mine Discharges Subject to Permitting

Runoff/drainage discharges subject to 40 CFR Part 440 effluent limitation guidelines	Subject to storm water permitting (not subject to 40 CFR Part 440)
Land application area Crusher area Spent ore piles, surge piles, ore stockpiles, waste rock/overburden piles Pumped and unpumped drainage and mine water from pits/underground mines Seeps/French drains On-site haul roads, if constructed of waste rock or spent ore or if wastewater subject to mine drainage limits is used for dust control Tailings dams/dikes when constructed of waste rock/tailings Unreclaimed disturbed areas	Topsoil piles Haul roads not on active mining area On-site haul roads not constructed of waste rock or spent ore (unless wastewater subject to mine drainage limits is used for dust control) Tailings dams, dikes when not constructed of waste rock/tailings Concentration/mill building/site (if discharge is storm water only, with no contact with piles) Reclaimed areas released from reclamation bonds prior to 12/17/90 Partially, inadequately reclaimed areas or areas not released from reclamation bond Most ancillary areas (e.g., chemical and explosives storage, power plant, equipment/truck maintenance and wash areas, etc.)

The concentration of pollutants discharged in mine drainage from mines operated to obtain copper bearing ores, lead bearing ores, zinc bearing ores, gold bearing ores, silver bearing ores, or any combination of these ores in open-pit or underground operations other than placer deposits shall not exceed:

Exhibit 27
Mine Discharge Limitations

Effluent Characteristic	Maximum of any 1 day (mg/l)	Average of daily values for 30 days (mg/l)
TSS	30	20
Cu	30	15
Zn	15	7.5
Pb	6	3
Hg	2	1
pH	*	*
*Within the range 6.0 to 9.0		

Source: 40 CFR 440.102(a).

Beneficiation is regulated by the same effluent limitation guidelines as extraction processes.

The concentration of pollutants discharged from mills that employ the froth flotation process alone or in conjunction with other processes, for the beneficiation of copper ores, lead ores, zinc ores, gold ores, or silver ores, or any combination of these ores shall not exceed:

Exhibit 28
Mill Discharge Limitations

Effluent Characteristic	Maximum for any 1 day	Average of daily values for 30 consecutive days
TSS	30	20
Cu	30	15
Zn	10	5
Pb	6	3
Hg	0.002	0.001
Cd	10	0.05
pH	*	*
*Within the range 6.0 to 9.0		

Source: 40 CFR 440.102(b).

Safe Drinking Water Act (SDWA)

The Safe Drinking Water Act may also apply to mine operations if primary drinking water sources and Class 3 wells are affected by mine wastewater releases. EPA regulates cadmium, lead, and arsenic under its primary drinking water standards (40 CFR 141.11(b)), and regulates copper, iron, manganese, and zinc under its secondary drinking water standards (40 CFR 143.3).

Resource Conservation and Recovery Act (RCRA)

The Bevill Amendment

In 1980, Congress amended RCRA in the Solid Waste Disposal Act Amendments, adopting what has been dubbed the Bevill Amendment, after Representative Tom Bevill of Alabama. The amendment temporarily exempted from Subtitle C regulation solid waste from ore and mineral extraction, beneficiation, and processing. The Amendment directed EPA either to develop Subtitle C regulations for the waste or determine that the exemption should continue, and to present its findings in a report to Congress.

EPA modified its hazardous waste regulations to reflect the Bevill exclusion and issued a preliminary, and quite broad, interpretation of the exclusion's scope. In particular, it interpreted the exclusion as covering "solid waste from the exploration, mining, milling, smelting and refining of ores and minerals." Based on this broad interpretation of the Bevill Amendment, EPA suspended its Subtitle C listing of six hazardous smelter wastes.

In 1985 the U.S. District Court for the District of Columbia awarded judgment to the Environmental Defense Fund and two public interest groups that had sued EPA for failing to submit the required report to Congress and make the regulatory determination by the statutory deadline. The court imposed two schedules, one for completing studies of extraction and beneficiation wastes and submitting them in a report to Congress, and the second for proposing reinterpretation of mineral-processing wastes. In so doing, the court effectively split the wastes that might be eligible for exclusion from regulation into two groups: mineral extraction and beneficiation wastes; and mineral processing wastes.

In December 1985 EPA submitted a report to Congress on mining wastes (*1985 Report to Congress: Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale*) in which EPA found that some mining wastes exhibit hazardous characteristics, that waste management practices have caused environmental damage, and that the range of risk from mining waste is broad. In July 1986 EPA published a regulatory determination, upheld in subsequent court challenges, that RCRA Subtitle C regulation of extraction and beneficiation wastes was unwarranted because mining wastes tend to be disposed of in arid climates, facilities and wastes are located in sparsely populated areas where human contact is minimal, and waste volumes are high. It also determined that it should develop a risk-based, State-run mining waste program under RCRA Subtitle D.

In keeping with its court-ordered directive to reinterpret the Mining Waste exclusion for mineral processing wastes, EPA proposed to narrow the scope of the exclusion for mineral-processing wastes to include only a few specific waste streams. Unable to articulate criteria for selecting these wastes, EPA later withdrew this proposal and was subsequently sued by the Environmental Defense Fund. The courts ruled against EPA, holding that the Agency's interpretation of Bevill exclusions was overbroad. The court ordered EPA to restrict the scope of the exclusion as it applied to mineral-processing wastes to include only "large volume, low hazard" wastes.

In a series of rulemaking notices, EPA reinterpreted the exclusion for mineral-processing wastes and defined which mineral-processing wastes met the high-volume, low-hazard criteria. The vast majority of mineral-processing wastes did not meet both criteria. EPA published its final regulatory determination in 1991, in compliance with a court-ordered deadline. The final rule permanently retains the Bevill exemption for 20 mineral-processing wastes. EPA determined that regulation under RCRA Subtitle C was inappropriate for these wastes because of the extremely high cost to industry and the technical infeasibility of managing them under Subtitle C requirements; 18 of the wastes are subject to applicable State requirements, while the remaining two (phosphogypsum and phosphoric acid process waste water) are currently being evaluated by EPA.

Wastes from the extraction and beneficiation of ores and minerals remain exempt from Subtitle C requirements, irrespective of their chemical characteristics; EPA may, in the future, evaluate the appropriateness of regulating these wastes under RCRA Subtitle D as an industrial waste. Wastes from mineral processing, however, are not exempt from Subtitle C unless they are one of the 20 specific wastes identified in EPA's final ruling.

In addition, only wastes that are uniquely associated with the extraction and beneficiation of ores and minerals (or one of the 20 listed mineral processing wastes) are excluded from hazardous waste regulation. Non-uniquely associated wastes are typically generated as a result of maintaining mining machinery or as a result of other facility activities, and continue to be subject to Subtitle C regulation. These non-uniquely associated wastes may include used oil, polychlorinated biphenyls, discarded commercial chemicals, cleaning solvents, filters, empty drums, laboratory wastes, and general refuse.

Determining how and under what circumstances the Bevill Amendment exclusions should be interpreted in regulating mining wastes continues to be a subject of discussion and study, at least in part because many beneficiation terms are used to describe activities common to a wide range of nonexempt industries and to describe mineral-processing operations that occur at the same location as the beneficiation operations. Beneficiation and mineral-processing operations are often closely linked; in order to apply Subtitle C regulations at a mine site, a regulator often must prove that the waste is not a beneficiation waste. Because a variety of regulators, at both Federal and State levels, are independently interpreting the Bevill rules, the potential for inconsistent interpretations is significant. Staff in EPA's OSW have suggested the following guidelines for regulators and the regulated community in distinguishing between exempt and nonexempt wastes at mines and mineral-processing sites:

- Determine whether the material is considered a solid waste under RCRA.
- Determine whether the facility is using a primary ore or mineral to produce a final or intermediate product and also whether 50 percent of the feedstocks are from secondary sources.
- Establish whether the material and the operation that generates it are uniquely associated with mineral production.
- Determine where in the sequence of operations beneficiation ends and mineral processing begins.
- If the material is a mineral-processing waste, determine whether it is one of the 20 special wastes from mineral processing.

This sequence will result in one of three determinations: 1) the material is not a solid waste and therefore not subject to RCRA; 2) the material is a solid waste but is exempt from RCRA Subtitle C because of the Mining Waste Exclusion; or 3) the material is a solid waste that is not exempt from RCRA Subtitle C and is subject to regulation.

R0076182

Comprehensive Response Compensation and Liability Act (CERCLA)

Although Bevill wastes are excluded from regulation under RCRA Subtitle C, they can be addressed under CERCLA. Mining companies may be liable under CERCLA for the release or threat of release of hazardous substances, covering releases to air, surface water, groundwater and soils. Many mines, where practices did not incorporate the safeguards now required under the CWA, allowed runoff from mine and tailings sites to flow into nearby streams and lakes. Even newer mines, which have been subject to CWA regulations, have been targeted for CERCLA enforcement. Some of these mines, such as Colorado's Summitville Mine, have been listed on the National Priorities List (NPL). Mine owners may also be liable for damages to natural resources as a result of mining activity.

Clean Air Act (CAA)

Under §111 of CAA, New Source Performance Standards (NSPS) applicable to metallic mineral-processing plants have been established (40 CFR 60 Subpart LL). These standards regulate emissions of particulate matter in metal mining operations in crushers, conveyor belt transfer points, thermal dryers, product packaging stations, storage bins, truck loading and unloading stations, and rail car loading and unloading. Although all underground mining facilities are exempt from these provisions, fugitive dust emissions from mining activities may be regulated (usually by requiring dust suppression management activities) through State permit programs established to meet Federal NAAQSs.

National Environmental Policy Act (NEPA)

NEPA requires that all Federal agencies prepare detailed statements assessing the environmental impact of, and alternatives to, major Federal actions that may "significantly affect" the environment. An environmental impact statement (EIS) must provide a fair and full discussion of significant environmental impacts and inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts on the environment; EISs must explore and evaluate all reasonable alternatives, even if they are not within the authority of the lead agency. NEPA authorities are solely procedural; NEPA cannot compel selection of the environmentally preferred alternative.

Federal actions specifically related to mining that may require EISs include Federal land management agency (e.g. BLM and Forest Service) approval of plans of operations for hardrock mining on

Federally-managed lands. All effected media (e.g., air, water, soil, geologic, cultural, economic resources, etc.) must be addressed. The EIS provides the basis for the permit decision; for example, an NPDES permit may be issued or denied based on EPA's review of the overall impacts, not just discharge-related impacts, of the proposed project and alternatives. Issues may include the potential for acid rock drainage, aquatic and terrestrial habitat value and losses, sediment production, mitigation, and reclamation.

Endangered Species Act (ESA)

The ESA provides a means to protect threatened or endangered species and the ecosystems that support them. It requires Federal agencies to ensure that activities undertaken on either Federal or non-Federal property do not have adverse impacts on threatened or endangered species or their habitat. In a June 1995 ruling, the U.S. Supreme Court upheld interpretations of the Act that allow agencies to consider impact on habitat as a potential form of prohibited "harm" to endangered species. Agencies undertaking a Federal action (such as a BLM review of proposed mining operations) must consult with the U.S. Fish and Wildlife Service (USFWS); an EIS must be prepared if "any major part of a new source will have significant adverse effect on the habitat" of a Federally or State-listed threatened or endangered species.

State Statutes

In addition to Federal laws, State and common laws also affect waste generation from mining activities. State law generally requires that permits be obtained prior to commencement of mining activities; permits may require design, performance, closure, and reclamation standards, and may impose monitoring requirements. Under common law, a mine owner may be liable for trespassing if wastes migrate into and damage another's property, or if the waste impacts the community as a whole, a miner may be liable for creating a public nuisance. Over the last five years several States have substantially altered their mining regulations to prevent the damage caused by past mining operations. Considerable disagreement remains, however, between mining industry groups and the environmental community regarding the effectiveness of these State regulations in preventing damage to the environment.

Many Western States require mining operations to obtain reclamation bonds and mining permits that are designed to regulate and monitor mining activity. States that require bonding and/or permitting include Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming. To regulate mining activity in the State of Colorado, for example, the State requires mining operations to obtain: 1) a performance bond, 2) a reclamation bond, and 3) a permit. The performance bond outlines what the mining operation intends to do on the land, and is simply a promise from the mining operation that it will reclaim the land. This bond gives Colorado the authority to pursue reclamation costs from mining operations that fail to properly reclaim the land. The reclamation bond, also known as a financial warranty, equals the cost the State would incur if it were to hire someone to reclaim the site should the mining operation fail to do so. Although performance bonds are updated periodically, the bonds have not always been adequate to cover closure costs.

VI.C. Pending and Proposed Regulatory Requirements

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA) Section 313 mandates that owners and operators of facilities that manufacture, process, or otherwise use a listed chemical report to EPA their annual releases of these chemicals to any environmental medium. EPA makes this information available to the public in the form of the Toxics Release Inventory (TRI). TRI currently requires reporting from facilities in SIC codes 20-39 that meet various threshold requirements.

EPCRA Section 313 gives EPA discretionary authority to modify the coverage of facilities required to report to EPA for inclusion in the TRI. EPA is considering expanding the TRI through the development of reporting requirements for additional facilities. These additional facilities include a list of 25 SIC codes that contribute 99 percent of the non-manufacturing TRI chemical loadings to the environment. SIC code 10 is among these 25 SIC codes. EPA anticipates publication of a proposed rule in late 1995 or early 1996 requiring additional facilities to report the use, release, and transfer of TRI chemicals.

Clean Water Act (CWA)

A comprehensive bill was introduced in Congress in 1995 to reauthorize the Clean Water Act. The bill may affect EPA's authority to require changes in production processes, products, or raw materials to control emissions of toxins; may require risk assessments for water quality standards, effluent limitations or other regulatory requirements; and may require social, economic, and environmental benefits to be weighed in establishing regulations. Potentially large sectors of the mining industry could be affected by this legislation.

Clean Air Act (CAA)

EPA continues to prepare rules for industry sources subject to hazardous air pollutant standards under the CAA, as amended. The sources are those that emit one or more of the 189 substances defined as hazardous air pollutants (HAPs) under the CAA. The EPA published a list of these sources in 1992 and has begun to define Maximum Achievable Control Standards that will apply to them. Although the timetable for issuing regulatory controls varies, proposed standards for most mineral industries are due by November 15, 1997.

EPA is also reviewing and updating national ambient air quality standards (NAAQS) for particulate matter, ozone, and sulfur dioxide to incorporate new scientific and technical information that has become available since the last reviews. Based on these revised data, EPA will determine whether revisions to the standards are appropriate. The metal mining sector will be affected by any revisions to these standards.

Resource Conservation and Recovery Act (RCRA)

The Hazardous and Solid Waste Amendments of 1984 require EPA to promulgate regulations establishing treatment standards that must be met before hazardous waste may be disposed on land. An announcement of new proposed rulemaking was made on October 24, 1991 in 56 CFR 55160. The proposed rulemaking established treatment standards for certain mineral processing waste and toxicity characteristic metals. Proposed rulemaking is expected mid-1995 and final action is expected mid-1996.

In a July 1986 Regulatory Determination, EPA stated that it was not appropriate to regulate the extraction and beneficiation wastes covered in the 1985 *Report to Congress: Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale*. Among the reasons cited by EPA for the special treatment of mining wastes were: 1) mining waste is generated in much larger volumes than industrial wastes (the average mining waste facility produces 3,000,000 metric tons of waste annually, while the average RCRA Subtitle C regulated waste producer produces 50,000 metric tons annually); 2) mining waste sites are usually much larger than traditional waste producers. The average tailings pile covers 494 acres and the average mining waste piles cover 126 acres, while the average Subtitle C hazardous waste impoundment of landfill is six to ten acres; 3) mining waste streams are believed to have lower human exposure and risk potential.

As a result, EPA determined that RCRA Subtitle C controls may be neither technically nor economically feasible, nor at times necessary to protect human health and the environment. EPA recommended development of a primarily State-implemented, site-specific, and risk-based regulatory approach under Subtitle D of RCRA. The result was the preparation of *Strawman I* and *II* proposals, which would regulate material uniquely associated with mining that the regulatory authority determines could pose a threat to human health and the environment, including mill tailings, stockpiled ores, leaching solutions, and water that may accumulate hazardous constituents.

While the Strawman proposals no longer represent a viable and current Agency approach to the mining industry, EPA may in the future evaluate the appropriateness of regulating mining waste under RCRA Subtitle D as an industrial waste.

VII. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multi-media indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consist only of records from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS), which tracks facilities in all media databases. Please note that in this section EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well-defined within EPA databases.

R0076188

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within EPA databases may be small compared to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single-media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[1] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS

[1] EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources, such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Section VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action

R0076190

within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or

Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Metal Mining Compliance History

The following exhibit provides a summary of five-year enforcement and compliance data for the metal mining industry. Consistent with information presented in previous sections, the greatest concentration of metal mining activity occurs in the Western States, where the greatest number of inspections and enforcement actions also occur.

Exhibit 29
Five Year Enforcement and Compliance Summary for the Metal Mining Industry

A	B	C	D	E	F	G	H	I	J
Metal Mining SIC 10	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	2	1	1	120	1	1	0%	100%	1.00
Region II	15	11	74	12	2	14	100%	0%	0.19
Region III	9	8	47	11	1	1	100%	0%	0.02
Region IV	28	20	209	8	5	7	86%	14%	0.03
Region V	27	17	129	13	5	15	67%	33%	0.12
Region VI	40	14	56	43	6	17	0%	100%	0.30
Region VII	14	10	91	9	4	12	42%	58%	0.13
Region VIII	135	62	284	29	13	32	100%	0%	0.11
Region IX	54	42	346	9	11	13	31%	69%	0.04
Region X	549	154	282	117	19	43	2%	98%	0.15
Total/Average	873	339	1,519	34	67	155	47%	53%	0.10

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibit 30 highlights enforcement and compliance information across selected industries. The metal mining industry had one of the lowest numbers of inspections among those industries represented, as well as the highest average number of months between inspections.

Exhibit 31 provides enforcement and compliance summary data for one year for selected industries. Over half of the facilities inspected were cited for a violation. The metal mining industry also represented the greatest percentage of facilities with enforcement actions taken, at 19 percent.

Exhibit 32 presents inspection and enforcement data by statute for selected industries. As discussed previously, water pollution represents the most common problem associated with the metal mining industry, followed by air. Thirty-four percent of total enforcement actions taken were under the Clean Water Act, while 11 percent were under the Clean Air Act.

Exhibit 33 provides a one-year summary of inspection and enforcement data by statute for selected industries. Again emphasizing the weight given to water pollution in the metal mining industry, inspections under the Clean Water Act represented over 50 percent of total metal mining inspections.

Exhibit 30
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	**873**	**339**	**1,519**	**34**	**67**	**155**	**47%**	**53%**	**0.10**
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 31
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 32
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

Exhibit 33
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

VII.C. Review of Major Legal Actions

This section provides a listing of major legal cases and supplemental enforcement projects that pertain to the Metal Mining Industry. Information in this section is provided by EPA's *Enforcement Accomplishments Reports FY 1991, FY 1992, FY 1993* and the Office of Enforcement and Compliance Assurance. As indicated in the EPA's *Enforcement Accomplishments Report,* publications, nine significant enforcement actions were resolved between 1991 and 1993 for the metal mining industry. CERCLA violations comprised three of these actions, the most of any statute. The remaining cases were distributed fairly evenly with CWA and RCRA cited twice, and CAA, EPCRA, and TSCA each cited once.

Two of the cases involved cyanide contamination from heap leaching of gold ores. Each of the settlements, one under CERCLA and one under the CAA, resulted in monetary penalties. The CERCLA settlement provided for company reimbursement of the Superfund for $250,000 in past response costs. Two other CERCLA settlements resulted in penalties: a penalty for failure to notify authorities of a release resulted in a $75,000 fine; a judgment in U.S. vs. Smuggler-Durant Mining Corporation resulted in a $3.4 million award in favor of the EPA.

Both of the CWA actions cited Section 404 for destruction of wetlands. Both instances involved placer mining and resulted in monetary penalties; one of the actions involved a Supplemental Environmental Project (SEP) requiring stream/wetland restoration. Another SEP involved a TSCA violation by Kennecott Utah Copper. In addition to a monetary penalty, Kennecott agreed to upgrade an emergency computer system at an estimated cost of $70,000.

VII.C.1. Supplemental Environmental Projects

This section provides a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. The following chart contains a representative sample of the Regional responses addressing the metal mining industry. The information contained in the chart is not comprehensive and provides only a sample of the types of SEPs developed for the metal mining industry. (See Exhibit 34)

Exhibit 34
Supplemental Environmental Projects

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Sunshine Precious Metals, Inc. Kellogg, ID	X	TSCA	Pollution Reduction	$6,588	Early disposal of PCB equipment	$6,588	$3,294

VII.D. EPA Hardrock Mining Framework

EPA is currently developing a multi-media, multi-statute hardrock mining strategy for existing EPA authorities, resources, and expertise in order to address the environmental problems posed by mining activities in the U.S., in concert with other Federal, State, tribal and local agencies. Some of the driving issues behind the strategy's development are concerns about overlapping and poorly coordinated regulatory authorities and actions; liability under CERCLA and other statutes, which may create a recurring barrier to voluntary remediation of mine sites; and rapid changes in mining practices that are leading to new environmental challenges.

The strategy establishes **environmental goals**, to protect human health and ecological resources through pollution prevention, control, and remediation at active, inactive, and/or abandoned mine sites on both Federal and non-Federal lands; **administrative goals**, to use available resources and authorities most efficiently and to focus on the highest priority concerns; and **fiscal responsibility goals**, to promote inter- and intra-governmental efficiency and fiscal responsibility in control of mining sites, as well as to prevent future unfunded public burdens.

Several objectives have been defined in support of these goals, including the following:

- Facilitate coordination with co-regulators: employ a range of approaches to ensure coordination and communication
- Use innovative approaches to foster efficiency: wherever possible, innovative tools (particularly non-regulatory) will be employed to help achieve efficient and timely action

- Consolidate priority-setting: establish multi-agency priorities to maximize scarce resources, help ensure benefits for costs incurred, and address the most problematic sites first
- Promote fiscal/personal responsibility: promote responsibility to help owners reflect true costs of activities and to avoid incurring unnecessary and unfunded environmental and financial burdens for the public
- Enhance capabilities of existing tools: use current administrative authorities to improve environmental problem-solving capabilities
- Be proactive and preventative: ensure that environmental performance standards are quantified to the maximum extent, and that assumptions, risks, and uncertainties are identified
- Promote protective closure standards and adequate financial assurances: establish closure performance standards and bonding requirements that will ensure mines are properly closed and that adequate post-closure care is performed
- Perform timely and environmentally sound clean-up of abandoned mines: ensure that priority inactive and abandoned mines are cleaned up in a timely manner, addressing worst sites first, while avoiding costly efforts addressing mines with little or no environmental effects.

In compliance and enforcement issues, the strategy promotes multi-agency compliance approaches, developing a ranking system for determining inspection priorities, and developing a multi-media inspection protocol for mine sites. Other compliance and enforcement measures include:

- Promoting use of environmental audits within the regulated community
- Conducting an enforcement initiative to target mine owners and operators who violate requirements to obtain and comply with storm water permits
- Compiling and circulating within EPA brief descriptions of successful mining-related enforcement actions brought by the Agency
- Prioritizing action based on the extent of actual human health and environmental impacts; the potential for additional

impacts; the likely success, technical feasibility, and cost effectiveness of response actions; and the availability of staff, equipment, and funding

- Developing enforcement MOAs with other Federal agencies to facilitate consultations and joint actions
- Improving consultation between EPA and the States to determine whether violations of Federal and State law warrant joint enforcement action.

As noted above, however, EPA seeks to strengthen its use of non-regulatory tools to encourage environmental compliance and clean-up at mining sites. These tools are intended to complement existing regulatory programs in addressing mining impacts. Common themes of most non-regulatory approaches include: active participation by principal stakeholders, creative use of funding resources, site-specific flexibility, prioritization of clean-up projects, and regulatory discretion to promote creative problem-solving and early implementation of clean-up projects.

Most non-regulatory approaches have one or more of the following characteristics:

- **Financial** - Financial support often comes from a variety of sources when non-regulatory approaches are used; funds are often leveraged and budgets are typically tight. Other Federal agency funds are often used to supplement EPA funds; State/local partnerships can fill financial holes; and voluntary efforts by private parties can contribute significantly to clean-up of inactive or abandoned mine sites.
- **Institutional** - Interagency Agreements (MOUs, MOAs, and IAGs) are tools that can be used to streamline the mining permitting and regulatory processes; more informally, interagency groups are often used to focus attention on certain projects or issues. Agreements to encourage consistent Federal positions are particularly important for siting criteria, operating criteria, and reclamation and bonding standards.
- **Technical Assistance and Outreach** - Forms of technical assistance vary and may include dedicating either EPA staff or contractor hours to directly help a stakeholder; developing analytic methodologies, such as monitoring and testing standards; providing education and training; and providing materials to small business assistance centers.

EPA has identified several examples of existing approaches to using non-regulatory tools. Site-specific examples include the Coeur D'Alene Basin Restoration Project, the Clear Creek Watershed Project, and the Arizona Copper Mine Initiative. Non-site specific examples include the CWA non-point source funding approaches; RCRA Subtitle D Strawman guidelines; Mining Headwaters Initiative; technology demonstration programs; and the Western Governors' Association Mine Waste Task Force.

As part of its hardrock mining strategy, EPA is developing detailed guidance for regulatory personnel who must apply various regulatory tools to specific mine sites. This matrix will highlight areas of overlap, gaps, unused but available authorities, and synergy among the various regulatory authorities. Envisioned is a document that will present various sources of pollution, a range of possible associated problems/concerns/threats, and a short description of the tools applicable to each situation.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

Compliance Projects

Region VIII has introduced "The Mining Initiative," whose goal is to obtain compliance with the Clean Water Act at active metal mines and metal mining exploration sites. The Regional NPDES program is in the process of determining the compliance status of the active metal mines located in the Region. Most of the mines (98 percent) are located in Colorado, Montana, and Utah. The States are trying to achieve deterrence through high profile enforcement actions which remove the economic advantage of noncompliance by assessing financial penalties.

The Region VIII Water Division is taking an active role in monitoring State enforcement actions against mining facilities and State-issued NPDES permits for mines, encouraging States to apply consistent requirements to all metal mining facilities. EPA has requested that each State appoint a contact to work with EPA on this initiative.

The Bureau of Mines Waste Research Program

In 1988 the debate over the Bevill exclusion wastes and other environmental issues led the Bureau of Mines to initiate a new, comprehensive research program to investigate the environmental problems posed by the mining and minerals processing industry in managing waste. The new research program was named the "Environmental Technology Program" and was established to develop mining technologies that would ameliorate environmental damage caused by mining activities.

The program's main elements are "Control of Mine Drainage and Liquid Wastes" and "Solid Waste Management and Subsidence." Control of Mine Drainage and Liquid Wastes examines acid mine drainage and migration of toxic waters from mines and waste disposal piles that threaten the quality of surface and groundwater. The Solid Waste Management and Subsidence program has two objectives: to investigate management and disposal methods for the solid waste produced by mining and minerals processing; and to develop new technology to mitigate the effects of subsidence and other environmental hazards caused by underground mining. Under ETP, National Mine Land Reclamation Centers have also been established in several regions to investigate the surface effects of mining and the problems associated with reclaiming abandoned, as well as active, mine lands. An important element of the program is cooperation with universities, industry, labor, State and Federal government agencies, and international institutions.

The Bureau of Mines has also established an Environmental Health Research Program to focus on monitoring and controlling airborne dusts and emissions from diesel engines that are inhaled deep into the lungs, and which can cause respiratory diseases. Under this program, a dust monitor is being developed that will continuously evaluate dust conditions during the mineral ore extraction process and will alert workers to hazardous dust concentrations. Dust control techniques are primarily directed at reducing concentrations through use of water sprays, more effective use of ventilation, and modification of mining machine operations. Current Federal regulatory efforts for mining operations seek to limit the amount of diesel soot in the mine environment, while researchers are developing instruments that will allow diesel soot particulate to be sampled and measured in the underground atmosphere. The Bureau of Mines is also conducting research to reduce diesel soot emissions by filtration, ventilation, fuel modifications, and catalytic conversion techniques. Because of the confined, dusty, humid, and often hot conditions in the mine environment, this research will be widely applicable to the most difficult industrial and environmental dust problems.

Mine Safety and Health Administration (MSHA) Mines Initiative

Electrical transformers or capacitors containing polychlorinated biphenyls (PCBs) are often used as power sources in underground mines. This equipment is regulated by EPA to prevent environmental release of PCBs, chemicals classified as probable human carcinogens. Abandoned mines often fill with groundwater, which can cause PCB-containing equipment, if left in place, to corrode and leak chemicals into the water; EPA regulations currently require removal of this equipment prior to mine closure.

EPA and MSHA launched a joint effort in early 1993 to identify all underground mines using electrical transformers or capacitors that contain PCBs. During 1993, MSHA inspectors conducted PCB surveys to identify mines using PCB- or other liquid-filled equipment underground. Inspectors also identified any violations of EPA regulations governing PCB use, marking, storage, or disposal. A total of 85 underground mines that may use PCB-containing equipment were identified. EPA has since used the PCB surveys in its enforcement efforts, resulting in four mining companies being cited for PCB mismanagement and facing Federal penalties of up to $317,575. EPA has settled one of these cases, while filing three additional complaints.

Mine Waste Technology Program (MWTP)

In 1991 Congress allocated $3.5 million to establish a pilot program for treating mine wastes in Butte, Montana. Both bench-scale research and field demonstrations are conducted through the MWTP. Sponsored by EPA's Risk Reduction Engineering Laboratory and the Department of Energy (DOE), the program is implemented by DOE's Western Environmental Technology Office (WETO) contractor, MSE, and the University of Montana's Montana Tech. MWTP program goals include the following:

- Identify mine waste problems that are most severely affecting human health and the environment
- Evaluate engineering and economic factors for selected technologies
- Prioritize the most promising mine waste treatment technologies based on their engineering and economic value
- Demonstrate, test, and evaluate the most promising mine waste treatment technologies
- Accelerate the commercialization of selected mine waste treatment technologies
- Transfer knowledge gained from the above through systematic training of user communities, and the use of workshops, short courses, video outreach, and graduate study support.

The program focuses on developing and proving technologies that offer solutions to the remedial problems facing abandoned mines and the ongoing compliance problems associated with active mines. Other Federal agencies, such as USBM, BLM, and the Forest Service, are also participating in various phases of the research. Within EPA, the Butte program is coordinated and teamed with the Superfund Innovative Technology Evaluation (SITE) program, and is coordinated with the DOIT (Demonstration of Innovative Technologies) Committee of the

Western Governor's Association to assist in technology outreach and coordination among the States most affected by mining activities.

The priority areas for research are:

1) *Source controls, including in situ treatments and predictive techniques.* Such at-source control technologies as sulfate-reducing bacteria, biocyanide oxidation, transport control/pathway interruption techniques, and AMD production prediction techniques will help generate permanent solutions to mining waste problems.

2) *Treatment technologies.* Technologies such as unique reagent utilization and use of natural and enhanced wetlands are high priorities for research to protect the environment from immediate damage until long-range solutions can be developed.

3) *Resource recovery.* Much of the mining wastes represent a potential resource, since they contain significant quantities of heavy metals. Membrane technologies, ion exchange systems, electrochemical separation processes, selective precipitation, enhanced magnetic separation, biological treatment/recovery schemes, and advanced metallurgical processes are techniques that might provide effective and efficient separation and recovery of the metal values in both liquid and solid waste streams.

In addition to those cited previously in the profile, specific MWTP projects include the following:

- *Nitrate Removal Demonstration Project* focuses on developing innovative technologies to remove nitrates from effluent and drinking water through ion exchange, biological denitrification, and electrochemical ion exchange.
- *Neutral Chelating Polymers Research Project* focuses on treating acid mine wastewater by using chelates (chemical substances with more than one binding site on the molecule) to remove metal ions from wastewater.
- *Photoassisted Electron Transfer Reactions Research Project* focuses on treating mine wastewaters by using dissolved and solid photocatalysts to remove toxic cyanide and nitrate anions.
- *Science and Technology Information Retrieval System (STIRS)* facilitates centralized access to various databases developed by EPA, DOE, Bureau of Mines, and others, including CD ROM databases.

- *Remote Mine Site Demonstration Project* seeks to operate a water-powered remote treatment facility for acidic metal-laden mine wastewater, using the Crystal Mine near Basin, Montana. The facility treats 10-25 gallons of wastewater per minute, using a series of rip-rap channels, water wheel-powered feeders, and settling ponds to conduct oxidation, adjust pH levels, and separate solids and liquids for ultimate disposal.
- *Biocyanide Demonstration Project* focuses on using bacteria to degrade cyanide and cyanide complexes in mining wastewater.

Western Governors' Association

Over the past few years, EPA has enlisted the assistance of the States in developing an approach to regulating mining activities under RCRA. In order to facilitate the States' involvement in this effort, EPA has provided funding to the Western Governors' Association (WGA), an independent non-partisan organization of 21 member governors. In 1988, WGA formed a Mine Waste Task Force to coordinate the views of member States and to work with the EPA, the mining industry, the environmental community, and the public to develop workable mine waste management programs.

Kansas State University

Kansas State University's Hazardous Substance Research Center (HSRC) is an EPA-funded center that provides research and technology transfer services for pollution prevention and other waste management techniques, including mining waste. HSRC programs include outreach for industry, assistance to government, education materials, and workshops on pollution prevention and hazardous waste remediation.

VIII.B. EPA Voluntary Programs

EPA sponsors a variety of programs aimed at waste reduction and pollution prevention. Some research-oriented programs, such as the Mining Waste Technology Program, are funded through other Federal and State agencies and are described in previous sections of this profile. Other programs that may serve the metal mining industry are highlighted below.

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations to demonstrate the ELP program principles. These principles include: environmental management systems, multi-media compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In exchange for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek change in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

NICE^3

DOE and EPA's Office of Pollution Prevention are jointly administering a grant program called the "National Industrial Competitiveness through Energy, Environment, and Economics" (NICE^3). By providing grants of up to 50 percent of total project cost, the program encourages industry to reduce industrial waste at its source and to become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries, however priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, 303-275-4729)

VIII.C. Trade Association Activity

The metal mining industry's many associations have been active participants in exploring new avenues of pollution prevention. As noted above, some are participating in Bureau of Mines or MSHA research. A description of various industry associations is provided in the following section.

The trade and professional organizations serving the metal mining industries are primarily organized according to commodity. In light of the controversy over mining law and the possible legislative reform of current mining practices, there are also several associations whose sole intent is to influence the reform process.

National Mining Association 1130 17th St. Washington, D.C. 20036 Phone: (202) 861-2800 Fax: (202) 861-7535	Members: 400 Contact: Richard Lawson

Founded in 1995 with the merger between the American Mining Congress and the National Coal Association, the National Mining Association represents producers of domestic coal, metals, and industrial and agricultural minerals; manufacturers of mining and mineral processing machinery, equipment, and supplies; engineering/consulting firms; and financial institutions that serve the mining industry. The Association also offers tax, communications, and technical workshops.

Coalition for Responsible Mining Law c/o Coeur D'Alene Mines Corp. PO Box 1 Coeur D'Alene, ID 83816-0316 Phone: (208) 667-3511 Fax: (208) 667-2213	Members: 300 Staff: Budget: Contact: Justin Rice

The Coalition for Responsible Mining Law (CRML) comprises mining company executives, exploration geologists, small miners, and others interested in mining laws, organized as a means of coalescing Western mining interests behind a proposal to preserve the basic provisions of the National Mining Law (Mining Law of 1872). The coalition seeks to raise awareness about the law within the mineral industry, Congress, and the general public through specialized education. Publications include a periodic newsletter.

Interstate Mining Compact Commission 459B Carlisle Dr. Herndon, VA 22070 Phone: (703) 709-8654 Fax: (703) 709-8655	Members: 17 Staff: 2 Budget: $150,000 Contact: Gregory E. Conrad

The Interstate Mining Compact Commission (IMCC) is comprised of States engaged in surface mining operations. The commission's purpose is to bring together State officials to discuss mining problems of national scope and significance. An effort is made to promote cooperation between States, private mining groups, and the Federal government, and to discuss, encourage, endorse, or sponsor activities, programs, and legislation to advance mined land reclamation. The IMCC publishes the *NASL Newsletter* quarterly.

Gold

Gold Institute 1112 16th St. NW, Ste. 240 Washington, DC 20036 Phone: (202) 835-0185 Fax: (202) 835-0155	Members: 66 Staff: 10 Budget: Contact: John Lutley

The institute represents gold mining and refining companies, manufacturers of products containing gold, and others who hold and supply gold. The institute advances the gold industry's interests by "developing information from worldwide sources on gold uses, research, technology, markets, and reference data," and encourages the development and use of gold and gold products. Publications include the bi-monthly *Gold News*.

R0076211

Lead

Lead Industries Association 295 Madison Ave. New York, NY 10017 Phone: (212) 578-4750 Fax: (212) 684-7714	Members: 70 Staff: 4 Budget: Contact: Jerome Smith

The Lead Industries Association consists of mining companies, smelters, refiners, and manufacturers of lead products. The association provides technical information to consumers, maintains a library, and gathers statistics. Its primary semi-annual publication is LEAD.

Iron and Steel

American Iron and Steel Institute 1101 17th St. NW, Suite 1300 Washington, DC 20036-4700 Phone: (202) 452-7100 Fax: (202) 463-6573	Members: 1200 Staff: 44 Budget: Contact: Andrew G. Sharkey III

Members of the American Iron and Steel Institute operate steel mills, blast furnaces, finishing mills, and iron ore mines. The Institute conducts extensive research programs on manufacturing technology, basic materials, environmental quality control, energy, and fuels consumption. In addition to technical manuals and pamphlets, the Institute also publishes the *American Iron and Steel Institute-Annual Statistical Report.*

American Iron Ore Association 614 Superior Ave, W Cleveland, OH 44113-1383 Phone: (216) 241-8261 Fax: (216) 241-8262	Members: 12 Staff: Budget: $260,000 Contact: George Ryan

The American Iron Ore Association represents iron ore producing companies in the U.S. and Canada. The organization's goals are to compile and disseminate statistics concerning the iron ore industry, and to provide a forum for discussing industry problems. The Association publishes a variety of documents, among them annual and monthly reports that detail significant occurrences in the industry.

Aluminum

Aluminum Association 900 19th St. NW, Ste. 300 Washington, DC 20006 Phone: (202) 862-5100 Fax: (202) 862-5164	Members: 86 Staff: 27 Budget: $4,300,000 Contact: David Parker

The Aluminum Association consists of producers of aluminum and manufactures of semi-fabricated aluminum products. The association represents members' interests in legislative activity and conducts seminars and workshops. In addition, the Association maintains a library and publishes various documents, including a monthly *Aluminum Situation*.

Copper

American Copper Council 2 South End Ave., No. 4C New York, NY 10280 Phone: (212) 945-4990	Members: 175 Staff: 2 Budget: $300,000 Contact: Mary Boland

The American Copper Council consists of producers, fabricators, merchants, consumers, and traders of copper. The council provides a forum for exchanging news and opinions between copper industry executives and government officials. In addition, the council maintains a relationship with the metal trade press and contributes data and background information related to copper industry events. A newsletter is published quarterly.

Zinc

American Zinc Association 1112 16th St., NW, Suite 240 Washington, DC 20036 Phone: (202) 835-0164 Fax: (202) 835-0155	Contact: George Vary

The AZA is an international association that represents primary and secondary producers of zinc metal, oxide, and dust from the U.S., Canada, Mexico, Australia, Finland, Norway, and Spain, who sell in the U.S. market -- the largest single-country zinc market in the world. The association's primary goal is to promote awareness of and to educate the public about zinc and its many uses; *Zinc Essentials* is the association's newsletter.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

General Profile

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc., Detroit, Michigan, 1992.

Mineral Commodity Summaries 1994, Bureau of Mines.

Minerals Yearbook, Metals and Minerals, vol. I, Bureau of Mines, 1992.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

Sustainable Environmental Law, Ch. 16, Campbell-Mohn, Environmental Law Institute, 1993.

U.S. Industrial Outlook 1994, Department of Commerce.

1987 Census of Manufacturers Industry Series 10A: Iron Ores, Bureau of the Census, April 1990 (MC87-I-10A).

1987 Census of Manufacturers Industry Series 10B: Copper, Lead and Zinc, Gold, and Silver Ores, Bureau of the Census, April 1990 (MC87-I-10B).

1987 Census of Manufacturers Industry Series 10C: Ferroalloy, Misc. Metal Ores and Services, Bureau of the Census, April 1990 (MC87-I-10C).

SIC Code Profile 10, Metal Mining, September 1994 U.S. EPA, Office of Pollution Prevention and Toxics.

Technical Document: Background for NEPA Reviewers, Non-Coal Mining Operations, December 1994, U.S. EPA.

Mining Waste Releases and Environmental Effects Summaries, Draft, March 1994, U.S. EPA.

Hardrock Mining Framework, Draft, March 1995, U.S. EPA.

Acid Mine Drainage from Mines in National Forests, a Management Challenge, Program Aid 1505, 1993, USDA Forest Service.

Regulatory Profile

CRS Issue Brief, The 1872 Mining Law: Time to Reform?, Marc Humphries, Environment and Natural Resources Policy Division, Congressional Research Service, Library of Congress, July 7, 1994. (Order Code IB89130).

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Technical Resource Document: Extraction and Beneficiation of Ores and Minerals, Volume 4, Copper, August 1994 U.S. EPA.

Technical Document: Background for NEPA Reviewers, Non-Coal Mining Operations, December 1994, U.S. EPA.

The Scope of the Bevill Exclusion for Mining Wastes, Van Housman, Environmental Law Reporter, November 1994.

Mission Support Review of the Aerometric Information Retrieval System (AIRS), July 1992, U.S. EPA, Office of Information Resources Management.

Hardrock Mining Framework, Draft, March 1995, U.S. EPA.

Unified Agenda, 59 Federal Register, April 1994.

Process Descriptions

Annual Report: Copper, 1992, U.S. Bureau of Mines.

Annual Report: Gold, 1992, U.S. Bureau of Mines.

Annual Report: Iron Ore, 1992, U.S. Bureau of Mines.

Annual Report: Lead, 1992, U.S. Bureau of Mines.

Annual Report: Zinc, 1992, U.S. Bureau of Mines.

Technical Resource Document: Extraction and Beneficiation of Ores and Minerals, Volume 4, Copper, August 1994 U.S. EPA.

McGraw-Hill Encyclopedia of Science & Technology, 6th Edition, McGraw-Hill Book Company, New York, NY, 1992.

Pollution Prevention

Control of Water Pollution from Surface Mining Operations, U.S. Bureau of Mines, 1981.

Innovative Methods of Managing Environmental Releases at Mine Sites, April 1994 U.S. EPA.

Technical Resource Document: Extraction and Beneficiation of Ores and Minerals, Volume 4, Copper, August 1994 U.S. EPA.

Technical Document: Background for NEPA Reviewers, Non-Coal Mining Operations, December 1994, U.S. EPA.

Mining Waste Research in the U.S. Bureau of Mines, Valois Shea-Albin, 1992.

Mining's Future: Meeting the Environmental Challenge, Connolly, R.E., Battelle Press, 1990.

Mining: Technical Support Document, Internal Training Workshop Principles of Environmental Enforcement, Draft April 1994 U.S. EPA.

The Use of Constructed Wetlands in the Treatment of Acid Mine Drainage, Perry, Allen, Cambridge University Press, 1991.

Contacts*

Name	Organization	Telephone
John Roach	U.S. Bureau of the Census	301-703-7066
Roger Wilmoth	U.S. EPA Office of Research and Development	513-569-7509
Mel Shupe	U.S. DOE, Western Environmental Technology Office	406-494-7205

* Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Name	Organization	Telephone
Melanie Pallman	U.S. EPA Region VIII (inspector)	303-293-1626
Dan Tangerone	U.S. EPA Region X (inspector)	206-553-1630
Ron Clawson	U.S. EPA Region IX (inspector)	415-744-1888
General Information	U.S. Bureau of Mines	202-501-9650
Division of Mineral Commodities	U.S. Bureau of Mines	202-501-9448
Division of Regulatory and Policy Analysis	U.S. Bureau of Mines	202-501-9732
Division of Environmental Technology	U.S. Bureau of Mines	202-501-9271

EPA Document Availability

Per the March 1, 1995 Federal Register, the following technical documents concerning wastes from non-coal extraction and beneficiation, were issued by the U.S. EPA, and are available at the RCRA docket, EPA Headquarters, Washington, D.C., and all EPA Regional Libraries. Copies of most documents may be purchased from the National Technical Information Service at (800) 553-NTIS. Most documents are also available electronically on the Internet System, through the EPA Public Access Gopher Server.

The following technical resource documents (TRDs) have been peer reviewed by State representatives, Federal land management agencies, mining companies, and public interest groups:

TRD Vol.1: Lead-Zinc (NTIS PB94-170248)
TRD Vol.2: Gold (NTIS PB94-170305)
TRD Vol.3: Iron (NTIS PB94-195203)
TRD Vol.4: Copper (NTIS PB94-200979)
TRD Vol.5: Uranium (NTIS PB94-200987)
TRD Vol.6: Gold Placer (NTIS PB94-201811)
TRD Vol.7: Phosphate & Molybdenum (NTIS PB94-201001)

The documents listed below discuss current mining waste management and engineering practices, and have been peer reviewed by State representatives, Federal land management agencies, mining companies, and public interest groups:

Innovative Methods of Managing Environmental Releases at Mine Sites (NTIS PB94-170255)
Design and Evaluation of Tailings Dams (NTIS PB94-201845)
Treatment of Cyanide Heap Leaches & Tailings (NTIS PB94-201837)
Acid Mine Drainage Prediction (NTIS PB94-201829)

WASTE: An Information Retrieval System for Mill Tailings References (not at NTIS; available electronically or at RCRA docket)

The following documents provide historical context for EPA's mine waste activities:

- Report to Congress on Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale (NTIS PB88-162631)
- Strawman II (NTIS PB91-178418)
- U.S. EPA Mine Waste Policy Dialogue Committee Meeting Summaries and Supporting Material (NTIS PB95-122529).

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies: environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

R0076219

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Order Processing Code:
* 3212

Qty.	Stock Number	Published in 1995 — Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	Published in 1997 — Title	Price Each	Total Price
	055-000-00570-2	Air Transportation Industry, 90 pages	$ 7.50	
	055-000-00571-1	Ground Transportation Industry, 130 pages	10.00	
	055-000-00572-9	Water Transportation Industry, 90 pages	7.50	
	055-000-00573-7	Metal Casting Industry, 150 pages	13.00	
	055-000-00574-5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055-000-00575-3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055-000-00576-1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055-000-00577-0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055-000-00578-8	Textile Industry, 130 pages	10.00	
	055-000-00579-6	Sector Notebook Data Refresh -1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account [ ] – [ ]

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250-7954

Important: Please include this completed order form with your remittance.

R0076220

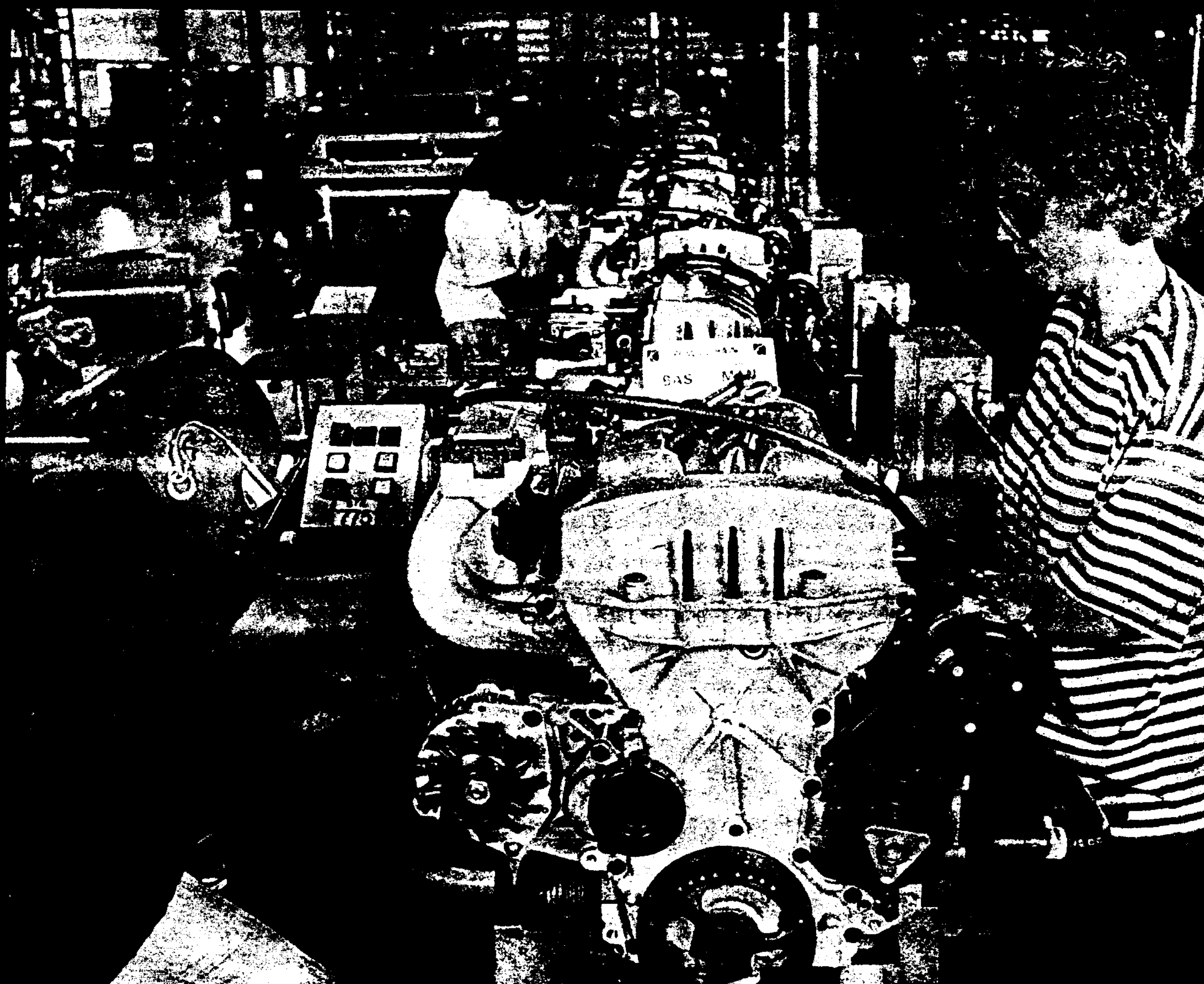
United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

Official Business
Penalty for Private Use
$300

United States Environmental Protection Agency
Enforcement And Compliance Assurance (2221A)
EPA 310-R-95-009
September 1995

EPA

Profile Of The Motor Vehicle Assembly Industry



SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

Recycled/Recyclable • Printed with Vegetable Based Inks on Recycled Paper (20% Postconsumer)

EPA/310-R-95-009

EPA Office of Compliance Sector Notebook Project

Profile of the: Motor Vehicle Assembly Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048276-3

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph courtesy of Saturn Motors, Spring Hill, Tennessee. Special thanks to Jennifer Graham for providing photographs.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
TABLE OF CONTENTS

Page

R0076227

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
TABLE OF CONTENTS (CONT'D)

Page

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
TABLE OF CONTENTS (CONT'D)

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
TABLE OF CONTENTS (CONT'D)

Page

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
EXHIBITS INDEX

MOTOR VEHICLE ASSEMBLY INDUSTRY (SIC 37) EXHIBITS INDEX (CONT'D)

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
LIST OF ACRONYMS

AFS - AIRS Facility Subsystem (CAA database)
AIRS - Aerometric Information Retrieval System (CAA database)
BIFs - Boilers and Industrial Furnaces (RCRA)
BOD - Biochemical Oxygen Demand
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CO - Carbon Monoxide
COD - Chemical Oxygen Demand
CSI - Common Sense Initiative
CWA - Clean Water Act
D&B - Dun and Bradstreet Marketing Index
ELP - Environmental Leadership Program
EPA - United States Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
HAPs - Hazardous Air Pollutants (CAA)
HSDB - Hazardous Substances Data Bank
IDEA - Integrated Data for Enforcement Analysis
LDR - Land Disposal Restrictions (RCRA)
LEPCs - Local Emergency Planning Committees
MACT - Maximum Achievable Control Technology (CAA)
MCLGs - Maximum Contaminant Level Goals
MCLs - Maximum Contaminant Levels
MEK - Methyl Ethyl Ketone
MSDSs - Material Safety Data Sheets
NAAQS - National Ambient Air Quality Standards (CAA)
NAFTA - North American Free Trade Agreement
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NEIC - National Enforcement Investigation Center
NESHAP - National Emission Standards for Hazardous Air Pollutants
NO_2 - Nitrogen Dioxide
NOV - Notice of Violation
NO_X - Nitrogen Oxide
NPDES - National Pollution Discharge Elimination System (CWA)

MOTOR VEHICLE ASSEMBLY INDUSTRY
(SIC 37)
LIST OF ACRONYMS (CONT'D)

NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement of Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

MOTOR VEHICLE ASSEMBLY INDUSTRY (SIC 37)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Motor Vehicle Equipment industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

This industry notebook is designed to provide an overview of the motor vehicles and motor vehicle equipment industry as listed under the Standard Industrial Classification (SIC) code 37. Establishments listed under this code are engaged primarily in the manufacture and assembly of equipment for the transportation of passengers and cargo by land, air, and water.

Due to the broad scope of the industries listed under SIC 37, this notebook will focus on the three-digit SIC 371 which is limited to motor vehicles and motor vehicle equipment (also known as the automotive industry). The primary focus within SIC 371 are numbers 3711 - motor vehicles and passenger car bodies, 3713 - truck and bus bodies, and 3714 - motor vehicle parts and accessories.

Industry groups not covered by this profile include: SIC 372 - Aircraft and Parts; 373 - Ship and Boat Building and Repairing; 374 - Railroad Equipment; 375 - Motorcycles, Bicycles, and Parts; 376 - Guided Missiles and Space Vehicles and Parts; and 379 - Miscellaneous Transportation Equipment. The following automotive products are also not covered in this profile: diesel engines, tires, automobile stampings, vehicular lighting equipment, carburetors, pistons, ignition systems, and cabs for off-highway construction trucks.

II.B. Characterization of Motor Vehicle and Motor Vehicle Equipment Industry

The U.S. motor vehicle and motor vehicle equipment industry is a diverse and technically dynamic industry which plays a vital role in the U.S. economy. The massive size of the automotive industry and the diverse nature of parts required to produce a car requires the support of many other major U.S. industries such as the plastics and rubber industry and the electronic components industry.

R0076238

Facilities involved with the manufacturing of automobiles are located across the U.S. and are organized based on the types of products produced. Businesses involved in the manufacturing of these products range from the large "Big Three" automakers, General Motors Corporation (GM), Ford Motor Company., and Chrysler Corporation, to smaller, independent automotive parts suppliers such as Dana Corporation, Allied Signal, and Borg Warner. Other facilities involved in the manufacture of automobiles include Toyota, Honda, Nissan, Subaru, Isuzu, Auto Alliance, BMW, and Mitsubishi.

II.B.1. Industry Size and Geographic Distribution

The motor vehicle and motor vehicle equipment industry is a key component in the U.S. economy, accounting for a substantial percentage of direct and indirect employment as well as overall industrial output. The vast size and scope of the industry is best understood by examining the quantity and distribution of automotive facilities located around the U.S and the number of individuals employed by these facilities.

The U.S. Industrial Outlook 1994 states that an estimated 6.7 million persons were employed directly and in allied automotive industries in 1991. According to the Department of Commerce's *U.S. Global Trade Outlook, 1995-2000,* in 1992 the total direct employment for SIC 3711, industries manufacturing just motor vehicles and passenger car bodies alone, was 314,000. This figure is down from a peak high in 1985 of 408,000. The U.S. Bureau of Labor Statistics estimates that an additional six percent employment loss will occur by 2005 in the motor vehicles manufacturing industry. This loss in jobs will most likely result from a decrease in the number of individuals needed to manufacture a car.

Most individuals employed by the motor vehicle and motor vehicle equipment industry work at facilities employing between 20 and 49 individuals (See Exhibit 1). These facilities, as well as the larger and smaller operations, are located throughout the United States. The vast majority of production is concentrated in the Great Lakes Region. According to 1991 data in the *AAMA Motor Vehicle Facts and Figures '94,* the Great Lakes Region contains over 1,700 motor vehicle and equipment manufacturers. This figure represents 39 percent of the 4,467 facilities in the United States. California, Missouri, and Texas also post a large number of automotive industries. The number of establishments manufacturing motor vehicles and motor vehicle equipment increased for all size facilities from 1982 to 1987. The value of shipments also increased during the same five year period.

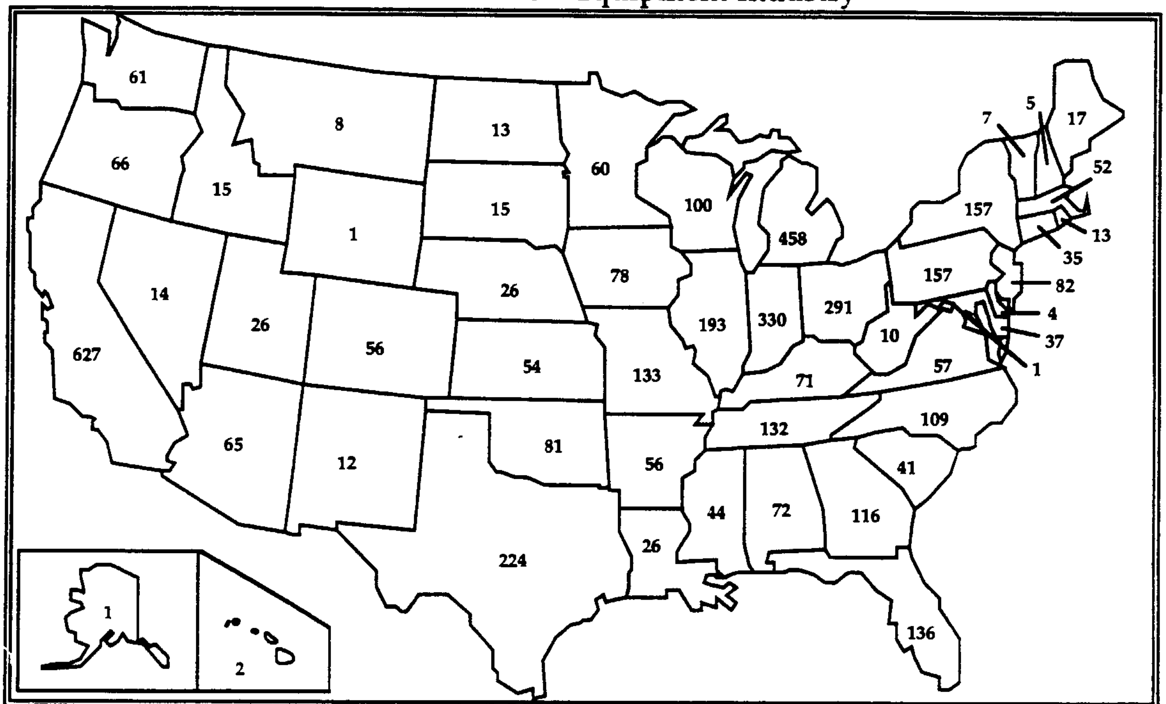
Exhibit 1
Size Distribution of Motor Vehicle and Motor Vehicle Equipment Manufacturing Establishments

	1982		1987	
Number of Employees	**Number of Establishments**	**Value of Shipments (millions of dollars)**	**Number of Establishments**	**Value of Shipments (millions of dollars)**
1-4	851	127.5	918	197.7
5-9	502	246.5	549	407.3
10-19	562	567.5	647	895.9
20-49	579	1,306.9	650	2,132.4
50-99	320	1,897.5	382	2,919.8
100-249	295	4,062.0	362	6,761.1
250-499	148	4,739.9	202	9,475.3
≥500	218	96,580.0	226	177,151.5
Totals	**3,475**	**128,057.4**	**3,936**	**199,941.0**

Source: Census of Manufacturers: 1982, 1987, Bureau of the Census, U.S. Department of Commerce.

States in the Great Lakes Region are home to the majority of automotive assembly plants. As International companies have moved facilities to the U.S., additional States, including Tennessee, California, and Kentucky have become the site of automotive plants. The geographic distribution of manufacturing plants will further increase with the completion of a BMW plant in Spartansburg, SC in 1995 and start of production at the Mercedes Benz plant in January 1997 in Tuscaloosa, AL. Exhibit 2 shows the geographic distribution of industries listed under SIC 37 producing motor vehicles and motor vehicle equipment.

Exhibit 2
Geographic Distribution of the Motor Vehicles and Motor Vehicle Equipment Industry



Source: AAMA Motor Vehicle Facts & Figures '94, compiled from 1991 U.S. Department of Commerce, Bureau of the Census data.

Motor Vehicle Equipment

In 1992, the largest number of automotive parts producers, including approximately 450 relatively small aftermarket part manufacturers, were located in California, while approximately 315 original equipment parts manufacturers were located in Michigan. Indiana and Ohio were the sites of 228 and 205 equipment parts manufacturers respectively. In order to minimize transportation costs and maximize responsiveness to automakers, producers of original equipment parts are located in close proximity to auto assembly facilities; most are located in Michigan, Indiana, Illinois, and Ohio. Conversely, aftermarket suppliers have little incentive to locate near automotive plants and are thus located across the country. A concentration of aftermarket suppliers are located in California, Texas, and Florida.

The U.S. automotive industry is the largest manufacturing industry in North America, accounting for approximately four percent of the gross national product (GNP). The U.S. automotive industry contains the number one and two manufacturers of automobiles in the world, GM and Ford (see Exhibit 3). According to 1993 data from the American Automobile Manufacturers Association (AAMA), the U.S. was the third largest producer of cars in the world, behind Europe and Asia respectively, dominating 30.3 percent of the market.

Exhibit 3
Top 10 Motor Vehicle Manufacturers Ranked by World Production-1994

Manufacturer	Country	Passenger Cars	Commercial Vehicles	Total
General Motors	United States	4,989,938	875,890	6,865,828
Ford	United States	3,685,415	2,058,877	5,744,294
Toyota	Japan	3,649,640	838,251	4,487,891
Volkswagen	Germany	3,119,997	165,699	3,285,696
Nissan	Japan	2,222,985	675,200	2,898,185
PSA	France	2,252,121	185,605	2,437,726
Renault	France	1,929,858	334,473	2,264,331
Chrysler	United States	727,928	1,254,748	1,982,676
Fiat	Italy	1,557,556	242,844	1,800,400
Honda	Japan	1,629,666	132.531	1,762,19

Source: *AAMA Motor Vehicle Facts & Figures '94.*

II.B.2. Product Characterization

The motor vehicles and motor vehicle equipment industry produces a wide range of diverse products from ambulances and automobiles to the cylinder heads, ball joints, and horns that go in these vehicles. The Bureau of the Census' SIC code categorizes the automotive industry based on the type of products manufactured. The following is a list of the four-digit SIC codes found under Industry Group Number 371:

SIC 3711 - Motor Vehicle and Passenger Car Bodies
SIC 3713 - Truck and Bus Bodies
SIC 3714 - Motor Vehicle Parts and Accessories
SIC 3715 - Truck Trailers - (not covered in this profile)
SIC 3716 - Motor Homes - (not covered in this profile)

The motor vehicle and motor vehicle equipment industry is organized into four primary areas based on the types of product produced. These areas are: (1) passenger cars and light trucks; (2) medium and heavy duty trucks; (3) truck trailers; (4) and automotive parts and accessories. The automotive parts industry is further broken down into two sectors, original equipment suppliers and aftermarket suppliers. Original equipment suppliers provide parts directly to automakers while aftermarket suppliers provide parts exclusively to the replacement parts market. The original equipment market accounts for approximately 80 percent of all motor vehicle parts and accessories consumed in the U.S., with the remaining 20 percent accounted for by the aftermarket.

II.B.3. Economic Trends

Economic Health

Motor Vehicles

According to the Department of Commerce's *U.S. Global Trade Outlook, 1995-2000,* worldwide sales volume of cars, trucks, and buses have grown 1.2 percent annually during the past ten years. Slow growth in the industry can be attributed to the saturation of the market in developed nations. In order to adjust to the long-term changes in demand, the motor vehicle industry is currently undergoing a global reorganization. Within the next ten years, as companies consolidate and restructure, perhaps as few as ten mega-manufacturing alliances will dominate developed markets.

The Big Three suffered global net losses in 1992 of $30 billion, due in large part to competition from foreign manufacturers. These competitive pressures have stimulated the development of a number of cooperative manufacturing and marketing ventures. Examples of such ventures include GM's "Geo," a compact sedan manufactured in a 50-50 joint venture between GM and Toyota, and a sport-utility vehicle produced in a 50-50 joint venture between GM and Suzuki. Another example is the Ford and Auto Alliance Michigan plant, which manufactures the Ford Probe and the Mazda MX-6 in a 50-50 venture between Ford and Mazda.

Production of passenger cars and light trucks increased 13 percent in 1993. Total sales also increased nine percent from 1992. These increases are likely the result of improvements in vehicle design and added features, product quality, and manufacturing technology. One factor dampening sales in the U.S. market is the fact that the general population is keeping their cars longer. Data collected by the AAMA shows that the mean average age of the passenger cars in the U.S. automobile fleet in 1993 was 8.3 years - the highest since 1948. Another factor expected to effect sales is that fewer individuals will be reaching driving age in the next several years. This negative impact could potentially be offset by the baby boom's entry into their peak earning years, a time when they can afford more expensive cars.

Future growth in the passenger car and light truck sector of the automotive industry is expected to be no more than one to two percent in the coming years. In response to an essentially saturated U.S.

market for new passenger cars and light trucks, competition among foreign and U.S. manufacturers is growing. As a result of this competition, many companies have gone out of business, while others have become more competitive and increased their market share, often by investing in new or renovated facilities. In 1993, motor vehicle and equipment manufacturers spent approximately $12 billion on new plant facilities and equipment (AAMA, 1995), and AAMA estimates that motor vehicle and equipment manufactures spent an additional estimated $15.7 billion in 1994. Another benefit of the increased competition has been a reduction of operating expenses as manufacturers have made strides in improving technology and increasing productivity while reducing overhead.

In 1992, 28 percent of all vehicle miles traveled in the U.S. can be attributed to commercial truck use (AAMA Facts and Figures, 1994). In fact, the U.S. truck market tends to be a magnification of the U.S. economy's business cycle (outside of normal replacement cycles). U.S. sales of medium-and heavy-duty trucks (14,050 gross vehicle weight rating (GVWR) and greater), grew 16 percent between 1993 and 1994, an increase of approximately 50,000 units. Sales for the industry through the first five months of 1995 were 167,000 units, a 22 percent increase over the same period in 1994. New safety regulations outlined by the National Highway Traffic Safety Administration (NHTSA) will impact the truck and trailer industry. Safety performance standards for new anti-lock brake systems are expected to be complete by October 1995. Regulations for automatically adjustable brakes went into effect in October 1993 for hydraulic brakes and for air brakes in October 1994. Regulations proposed by NHTSA for under-ride guards are in the early stages of the regulatory development process. Once in place, these new regulations should reduce the number of fatalities that are attributed to rear-end collisions involving straight body trucks and truck trailers.

Motor Vehicle Equipment

According to the Department of Commerce's *U.S. Global Trade Outlook, 1995-2000,* the U.S. automotive parts industry is emerging from a massive restructuring that has enabled it to greatly strengthen its competitive position in relation to Japan, its major rival. Since 1987, productivity has increased about three percent annually and quality has improved greatly. The global automotive parts market will total about $460 billion in 1995 and an estimated $519 billion in 2000.

In 1992, the U.S. International Trade Commission estimated that there were approximately 5,000 U.S. parts and accessories manufacturers. These manufacturers are estimated to produce 22 percent, or $65 billion, of world production of certain motor vehicle parts. The U.S. is the third largest producer of automotive parts, behind Japan at 35 percent and the European Union at 23 percent of worldwide production. A reduction in passenger car production and an increase in the use of foreign-produced parts has resulted in a decline in shipments of U.S. parts, from $68 billion in 1988 to $65 billion in 1992. The drop in production has resulted in a decline of sales and employment. In 1988, 453,000 were employed in the motor vehicle equipment industry. Employment dropped to a low of 407,000 in 1991 before increasing to 437,000 in 1992.

The industry is currently undergoing a significant restructuring. Factors influencing this restructuring include: increased competition from Japan, new and innovative organizational systems, and the passage of the North American Free Trade Agreement (NAFTA). U.S. automakers and parts producers are trying to produce higher-quality motor vehicles and parts in a more cost effective manner. To accomplish this goal, lean and/or agile production techniques are being implemented. These techniques, which ultimately use less of everything in the production process, also limit the number of direct suppliers of components.

Original equipment suppliers have been subject to changes in supplier relations with the Big Three automakers over the past few years. Between 1988 and 1991, taking advantage of new manufacturing technologies, the Big Three gradually reduced the number of suppliers needed. Chrysler, for example, ordered parts from more than 3,000 suppliers in the 1970s, but by 1993 reduced the number of suppliers to between 600 and 800 per model line. As a result of this change in supplier relationships, original equipment manufacturers have altered their role in the industry by providing automakers with services such as financing for research and development, inventory, logistics, and tooling.

Economic uncertainties caused consumers to defer scheduled maintenance and servicing of their cars between 1988 and 1992. This resulted in a leveling off of aftermarket parts sales during the same years. Industry sources claim that better designed and engineered original equipment parts, such as longer lasting shock absorbers, also contributed to the flat market. New diagnostic technologies which identify possible faulty parts and reduce the need for preventative maintenance also played a role. The market is predicted to see a turn-around based on the Clean Air Act Amendments of 1990 and stricter emissions standards, which is anticipated to result in more used car repairs and an increase in replacement parts.

Future Economic Outlook

Estimates of third-quarter earnings for 1994 show that earnings of U.S. automakers will likely triple from the previous year. This boom in business comes despite plant closures that are traditional during the third quarter due to employee vacations and production changeovers for new fall models. AAMA estimates that the Big Three earned $2.3 billion during the period, compared to $773 million during third-quarter 1993. AAMA indicates that sales and earnings may be dropping in 1995.

According to AAMA, growth has continued through the first quarter of 1995, compared to the same period in 1994, with a combined earnings for the Big Three of about $4.3 billion. Financial strength over the last few quarters has been due, in part, to plants operating at high capacity, and to new models being sold without discounts. The weak dollar and strong Japanese yen also have played a role. Predictions for continued growth of that magnitude through the remainder of 1995, however, are less certain.

In the past 25 years, a growing number of foreign automobile manufacturers have started doing business in the U.S., and they now play an important role in the U.S. economy. Since the mid-1980s, seven large foreign automobile manufacturing plants have been constructed, representing an investment of over $11 billion (See Exhibit 4). According to AIAM, factories which produce automobile brands such as Honda, Isuzu, Mazda, Mitsubishi, Nissan, Subaru, and Toyota, provide approximately 36,000 manufacturing jobs in the U.S.; with over 216,000 jobs in the automotive supply industries. These plants have proven to be extremely efficient, with output increasing 90 percent since 1988. In 1992 alone, 1,787,500 passenger cars were produced in new U.S. factories by international companies, a figure second only to GM's output. One out of every four passenger cars produced in the U.S. today is the product of a foreign manufacturer.

Exhibit 4
Distribution of Automotive Assembly Plants - 1992

State	Number of Big Three Plants	Number of Foreign-Owned Plants
Michigan	16	1
Ohio	2	2
Kentucky	2	1
Illinois	2	1
Tennessee	1	1
Indiana	1	1
California	U.S. Foreign Joint Ventures 1	

Source: Ward's Automotive Reports, Automotive News Market Data Book.

The recent passage of the NAFTA should prove beneficial to the auto industry as goods and services will be able to flow more freely between the U.S. and Mexico and Canada. Although Mexico has been a strong market for U.S. automotive and heavy-duty aftermarket components in the past, exports to Mexico have been limited by quotas and other trade restrictions. The passage of NAFTA and the elimination of past barriers to truck imports should also prove beneficial to medium- and heavy-duty trucks manufacturers, and Mexico could prove to be one of the fastest growing truck markets of this decade.

Another recent development that should facilitate further trade between the U.S. and Mexico was the creation of the Pan American Automotive Components Exposition (PAACE). PAACE, which had its first meeting in July 1994, is sponsored by 12 North American associations. The purpose of the exposition is to bring an international show to the Mexican marketplace as well as establish PAACE as the dominant show for automotive and heavy duty equipment in the future. Plans are currently underway for PAACE 1995.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the Motor Vehicles and Motor Vehicle Equipment industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Motor Vehicle and Motor Vehicle Equipment Industry

There is no single production process for Industry Group Number 371. Instead, numerous processes are employed to manufacture motor vehicles and motor vehicle equipment. This section will focus on the significant production processes including those used in the foundry, metal shop, assembly line, and paint shop.

III.A.1. Motor Vehicle Equipment Manufacturing

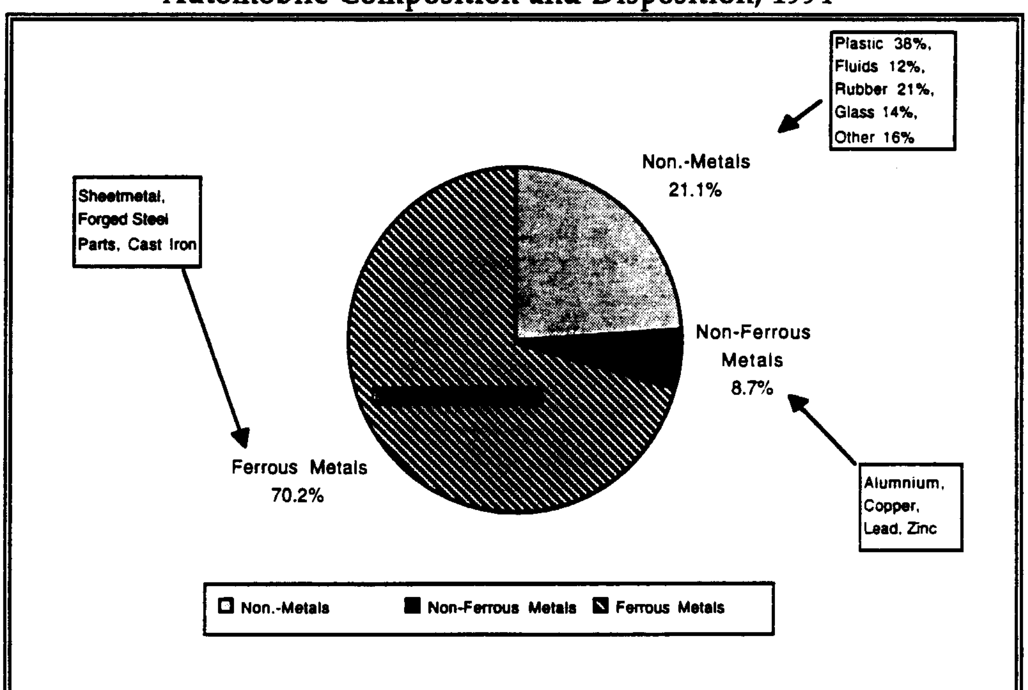
Motor vehicle parts and accessories include both finished and semi-finished components. Approximately 8,000 to 10,000 different parts are ultimately assembled into approximately 100 major motor vehicle components, including suspension systems, transmissions, and radiators. These parts are eventually transported to an automotive manufacturing plant for assembly.

According to a 1993 publication by the University of Michigan Transportation Research Institute entitled "Material Selection Process in the Automotive Industry," material selection plays a vital role in the production process. Materials are ultimately selected based on factors such as performance (strength vs. durability, surface finish, corrosion resistance), cost, component manufacturing, consumer preference, and competitive responses.

In the past, automobiles have been composed primarily of iron and steel. Steel has remained a major automotive component because of its structural integrity and ability to maintain dimensional geometry throughout the manufacturing process (See Exhibit 5).

In response to increasing demands for more fuel efficient cars, the past ten years have seen changes in the composition of materials used in automobiles (See Exhibit 6). Iron and steel use has steadily decreased, while plastics and aluminum has steadily increased. Aluminum and plastics are valuable car components not only for their lighter weight, but also because of their inherent corrosion resistance. Although the use of plastics in the automotive industry is increasing, expansion in this area is finite because of limitations in current plastics materials.

Exhibit 5
Automobile Composition and Disposition, 1994



Source: Automotive Industries, 1992 - from AAMA Motor Vehicle Facts and Figures '94.

R0076249

Exhibit 6
Automotive Material Usage 1984 to 1994 Model Year
(in pounds)*

Material	1994	1992	1990	1988	1986	1984
Conventional Steel	1,388.5	1,379.0	1,246.5	1,337.0	1,446.0	1,487.5
High Strength Steel	263.0	247.0	233.0	227.5	221.0	214.0
Stainless Steel	45.0	41.5	31.5	31.0	30.0	29.0
Other Steels	42.5	42.0	53.0	46.5	47.0	45.0
Iron	408.0	429.5	398.0	426.5	446.5	454.5
Aluminum	182.0	173.5	158.5	150.0	141.5	137.0
Rubber	134.0	133.0	128.0	130.0	131.5	133.5
Plastics/Composites	245.5	243.0	222.0	219.5	216.0	206.5
Glass	89.0	88.0	82.5	86.0	86.5	87.0
Copper and Brass	42.0	45.0	46.0	49.5	43.0	44.0
Zinc Die Castings	16.0	16.0	19.0	19.5	17.0	17.0
Powder Metal Parts	27.0	25.0	23.0	21.5	20.0	18.5
Fluids and Lubricants	189.5	177.0	167.0	176.5	182.5	180.0
Other Materials	99.0	96.0	88.0	89.0	89.5	88.0
TOTAL	**3,171.0**	**3,135.5**	**2,896.0**	**3,010.0**	**3,118.0**	**3,141.5**

Source: "Material Usage, Vehicles Retired From Use and Vehicle Recycling" - from AAMA Motor Vehicle Facts & Figures '94.

* Represents consumption per passenger car unit built in the U.S., rounded to the nearest tenth of a pound.

The manufacturing processes used to produce the thousands of discrete parts and accessories vary depending on the end product and materials used. Different process are employed for the production of metal components versus the production of plastic components. Most processes, however, typically include casting, forging, molding, extrusion, stamping, and welding. Exhibit 7 lists major automotive parts and the primary materials and production processes used to manufacture them.

III.A.1.a. *Foundry Operations*

Foundries, whether they are integrated with automotive assembly facilities or independent shops, cast metal products which play a key role in the production of motor vehicles and motor vehicle equipment. As discussed previously, even though aluminum and other metals are used increasingly in the production of automobiles and their parts, iron and steel are still the major metal components of an automobile. Because of this, the following discussion will focus on iron foundries and the typical production processes.

The main steps in producing cast iron motor vehicle products are as follows (see Exhibit 8):

- Pattern design and production
- Sand formulation
- Mold and core production
- Metal heating and alloying
- Metal molding
- Mold shakeout
- Product finishing and heat treating
- Inspection.

The process begins with the mixing of moist silica sand with clay (3 to 20 percent) and water (two to five percent) to produce the "green sand," which forms the basis of the mold. Other additives, including organics such as seacoal or oat hulls, may be added to the green sand to help prevent casting defects. The core is then created using molded sand and often includes binders, such as resins, phenol, and/or formaldehyde. The core is the internal section of a casting used to produce the open areas needed inside such items as an engine or a drive train. After the core has been molded, it is baked to ensure its shape, and then combined with the rest of the casting mold in preparation for casting. At the same time the core is being created, iron is being melted. The iron charge, whether it be scrap or new iron, is combined with coal (as a fuel) and other additives such a calcium carbide and magnesium, and fed into a furnace, which removes sulfur, (usually an electric arc, an electric induction, or a cupola furnace).

Calcium carbide may be added for certain kinds of iron casting, and magnesium is added to produce a more ductile iron. Once the iron reaches the appropriate temperature, it is poured into the prepared mold. The mold then proceeds through the cooling tunnel and is placed on a grid to undergo a process called "shakeout. " During shakeout the grid vibrates, shaking loose the mold and core sand from the casting. The mold and core are then separated from the product which is ready for finishing.

The finishing process is made up of many different steps depending upon the final product. The surface may be smoothed using an oxygen torch to remove any metal snags or chips, it may be blast-cleaned to remove any remaining sand, or it may be pickled using acids to achieve the correct surface. If necessary, the item may be welded to ensure the tightness of any seams or seals. After finishing, the item undergoes a final heat treatment to ensure it has the proper metallurgical properties. The item is then ready for inspection. Inspection may take place in any number of ways be it visually, by x- or gamma ray, ultrasonic, or magnetic particle. Once an item passes inspection, it is ready to be shipped to the assembly area.

Exhibit 7
Identification of Major Automobile Parts by Material and Process

Automotive Part	Primary Materials	Primary Process
ENGINE		
Block	Iron Aluminum	Casting
Cylinder Head	Iron Aluminum	Casting Machining
Intake Manifold	Plastic Aluminum	Casting Molding Machining
Connecting Rods	Powder Metal Steel	Molding Forging Machining
Pistons	Aluminum	Forging Machining
Camshaft	Iron Steel Powder Metal	Molding Forging Machining
Valves	Steel Magnesium	Stamping Machining
Exhaust Systems	Stainless Steel Aluminum Iron	Extruding Stamping
TRANSAXLE		
Transmission Case	Aluminum Magnesium	Casting Machining
Gear Sets	Steel	Blanking Machining
Torque Converter	Magnesium Steel	Stamping Casting
CV Joint Assemblies	Steel Rubber	Casting Forging Extruding Stamping
BODY STRUCTURE		
Body Panels	Steel Plastic Aluminum	Stamping Molding
Bumper Assemblies	Steel Plastic Aluminum	Stamping Molding

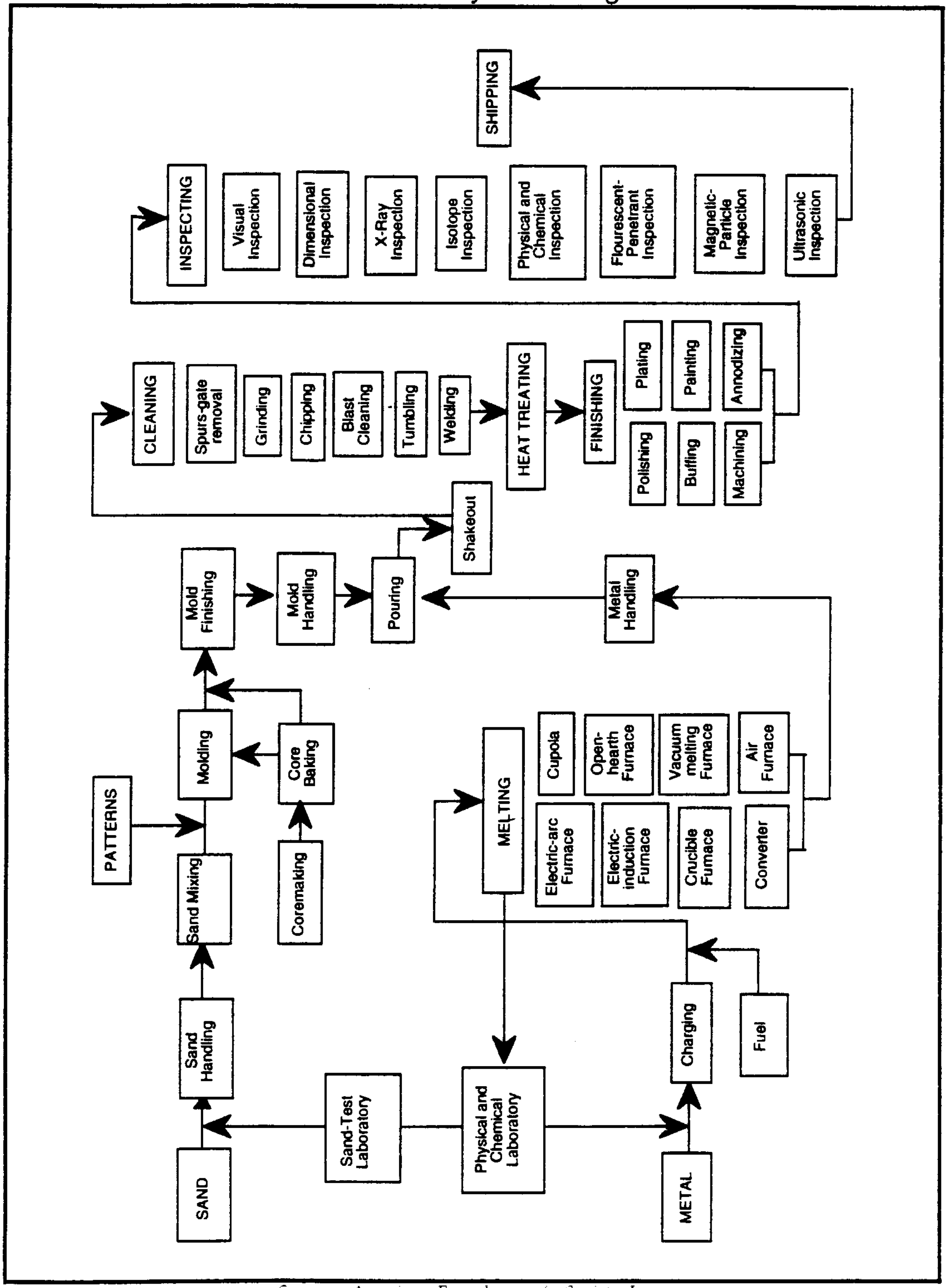
Exhibit 7 (cont'd)
Identification of Major Automobile Parts by Material and Process

Automotive Part	Primary Materials	Primary Process
CHASSIS/SUSPENSION		
Steering Gear/Column	Steel Magnesium Aluminum	Casting Stamping Forging Machining
Rear Axle Assembly	Steel Plastic	Stamping Molding
Front Suspension	Steel Aluminum	Stamping Forging
Wheels	Steel Aluminum	Stamping Forging
Brakes	Steel Friction Materials	Stamping Forging
SEATS/TRIM		
Seats	Steel Fabric Foam	Molding Stamping
Instrument Panel	Steel Fabric Foam	Molding Stamping
Headliner/Carpeting	Synthetic Fiber	Molding
Exterior Trim	Plastic Aluminum Zinc Die Casting	Molding Casting Stamping
HVAC SYSTEM		
A/C Compressor	Aluminum Steel Plastic	Casting Molding Stamping
Radiator/Heater Core	Copper Aluminum Plastic	Extruding Molding
Engine Fan	Plastic Steel	Stamping Molding

Source: University of Michigan Transportation Research Institute, "Material Selection in the Automotive Industry," 1993.

R0076253

Exhibit 8
General Foundry Flow Diagram



Source: American Foundrymen's Society Inc.

III.A.1.b. *Metal Fabricating*

Another major process in the manufacturing of automotive parts is metal fabrication. Metal fabrication involves the shaping of metal components. Many automotive parts, including fenders, hubcaps, and body parts are manufactured in metal fabricating shops. A typical large-scale production of these items starts with molten metal (ferrous or nonferrous) containing the correct metallurgical properties. Once the metal has been produced, it is cast into a shape that can enter the rolling process. Shearing and forming operations are then performed to cut materials into a desired shape and size and bend or form materials into specified shapes.

Shearing (or cutting) operations include punching, piercing, blanking, cutoff, parting, shearing, and trimming. Basically, these are operations that produce holes or openings, or that produce blanks or parts. The most common hole-making operation is punching. Piercing is similar to punching, but produces a raised-edge hole rather than a cut hole. Cutoff, parting, and shearing are similar operations with different applications: parting produces both a part and scrap pieces; cutoff and shearing produce parts with no scrap; shearing is used where the cut edge is straight; and cutoff produces an edge shape other than straight. Trimming is performed to shape or remove excess material from the edges of parts.
Forming operations shape parts by forcing them into a specified configuration, and include bending, forming, extruding, drawing, rolling, spinning, coining, and forging. Bending is the simplest forming operation; the part is simply bent to a specific angle or shape. Bending operations normally produce flat-shapes, while forming produces both two- and three-dimensional shapes.

Extruding is the process of forming a specific shape from a solid blank by forcing the blank through a die of the desired shape. Complicated and intricate cross-sectional shapes can be produced by extruding. Rolling is a process that passes the material through a set or series of rollers that bend and form the part into the desired shape. Coining is a process that alters the form of the part by changing its thickness; it produces a three-dimensional relief on one or both sides of the part, as found on coins.

Drawing and spinning form sheet stock into three-dimensional shapes. Drawing uses a punch to force the sheet stock into a die, where the desired part shape is formed in the space between the punch and die. In spinning, pressure is applied to the sheet while it spins on a rotating form so that the sheet acquires the shape of the form.

Forging operations produce a specific part shape, much like casting. The forging process is used in the automotive industry when manufacturing parts such as pistons, connecting rods, and the aluminum and steel portion of the wheels. However, rather than using molten materials, forging uses externally applied pressure that either strikes or squeezes a heated blank into a die of the required shape. Forging operations use machines that apply repeated hammer blows to a red-hot blank to force the material to conform to the shape of the die opening. Squeezing acts in much the same way, except it uses pressure to squeeze rather than strike the blank. Forging uses a series of die cavities to change the shape of the blank in increments. The blank is moved from station to station in the die to form the part. Depending on the shape, a forging die can have from one to over a dozen individual cavities.

Once shearing and forming activities are complete, the material is machined. This entails shaping or forming a workpiece by removing material from pieces of raw stock with machine tools. The principal processes involved in machining are hole-making, milling, turning, shaping/planing, broaching, sawing, and grinding.

III.A.1.c. *Metal Finishing/Electroplating*

Numerous methods are used to finish metal products. However, prior to applying the finishing application, the surface must be prepared. One of the most important aspects of a finished product is the surface cleanliness and quality. Without a properly cleaned surface, even the most expensive coatings will fail to adhere or prevent corrosion.

Pickling and salt bath processes are used to finish steel products by chemically removing oxides and scale from the surface of the steel. Most carbon steel is pickled with sulfuric or hydrochloric acid, while stainless steel is pickled with hydrochloric, nitric, and hydrofluoric acids. Steel generally passes from the pickling bath through a series of rinses. Alkaline cleansers are used to remove mineral oils and animal fats and oils from the steel surface. Common alkaline cleaning agents include: caustic soda, soda ash, alkaline silicates, and phosphates. Electrolytic cleaning as well as various abrasive methods, such as sand blasting, are also commonly used to remove surface oxides.

Steel products are often coated to inhibit oxidation and extend the life of the product. Coated products can also be painted to further inhibit corrosion. Common coating processes include galvanizing, tin coating, chromium coating, and terne coating (lead and tin). An example of a coated automotive part is the radiator, which is usually spray painted with a chromium coat to prevent corrosion; some water based coats are now being utilized. Rinse water from the coating process may contain zinc, lead, cadmium, or chromium.

Metal finishing and electroplating activities are performed on a number of metals and serve a variety of purposes; the primary purpose being protection against corrosion. This is particularly important to the automotive industry because of the harsh weather and road conditions to which automobiles may be subject. Metal finishing and electroplating can also be performed for decorative purposes. These plating processes involve immersing the article to be coated/plated into a bath consisting of acids, bases, salts, etc.

The metals used in electroplating operations (both common and precious metal plating) include cadmium, lead, chromium, copper, nickel, zinc, gold, and silver. Cyanides are also used extensively in electroplating solutions and in some stripping and cleaning solutions.

Electroless plating is the chemical deposition of a metal coating onto a metal object, by immersion of the object in an appropriate plating solution. In electroless nickel plating, the source of nickel is a salt, and a reducer is used to reduce the nickel to its base state. A complexing agent is used to hold the metal ion in the solution. Immersion plating produces a metal deposit by chemical displacement. Immersion plating baths are usually formulations of metal salts, alkalies, and complexing agents (typically cyanide or ammonia).

Etching is the process used to produce specific design configurations or surface appearances on parts by controlled dissolution with chemical reagents or etchants. Etching solutions are commonly made up of strong acids or bases with spent etchants containing high concentrations of spent metal. The solutions include ferric chloride, nitric acid, ammonium persulfate, chromic acid, cupric chloride, and hydrochloric acid.

Anodizing uses the piece to be coated, generally with an aluminum surface, as an anode in an electrolytic cell. Anodizing provides aluminum parts with a hard abrasion- and corrosion-resistant film. This coating is porous, allowing it to be dyed or to absorb lubricants. This method is used both in decorative applications, including automotive trim and bumper systems, and in engineering applications such as aircraft landing gear struts. Anodizing is usually performed using either sulfuric or chromic acid often followed by a hot water bath, though nickel acetate or sodium potassium dichromate seal may also be used.

III.A.2. Motor Vehicle Assembly

Once the various automotive parts are produced, they are ready to be brought together for assembly. Automotive assembly is a complex process that involves many different steps. Assembly begins with parts which arrive in the assembly plant "just-in-time." "Just-in-time" is a concept that means parts arrive only when they are needed for assembly; only enough product is sent for a given day's work. This concept, which revolutionized the automotive industry, has improved productivity, lowered costs, and provided for better quality management.

Although techniques used to assemble an automobile vary from manufacturer to manufacturer, the first major step in assembly is the body shop. At this stage the car begins to take shape as sides are welded together and then attached to the underbody of the car. The underbody is composed of three primary pieces of galvanized steel which include the floor pan and components for the engine and trunk. After the underbody has been welded together by robotics, it is tested for dimensional and structural accuracy. It is then joined together in a tab-slot fashion with the side frame and various other side-assemblies. A worker then taps tabs into slots, and a robot clamps the tabs. Roof supports and the roof are now ready for installation. The car is now ready for final welding. Approximately 3,500-4,000 spots require welding. Most welding is done by robots, with workers doing only spot jobs. Trunk lids and hoods will then be installed.

III.A.3. Motor Vehicle Painting/Finishing

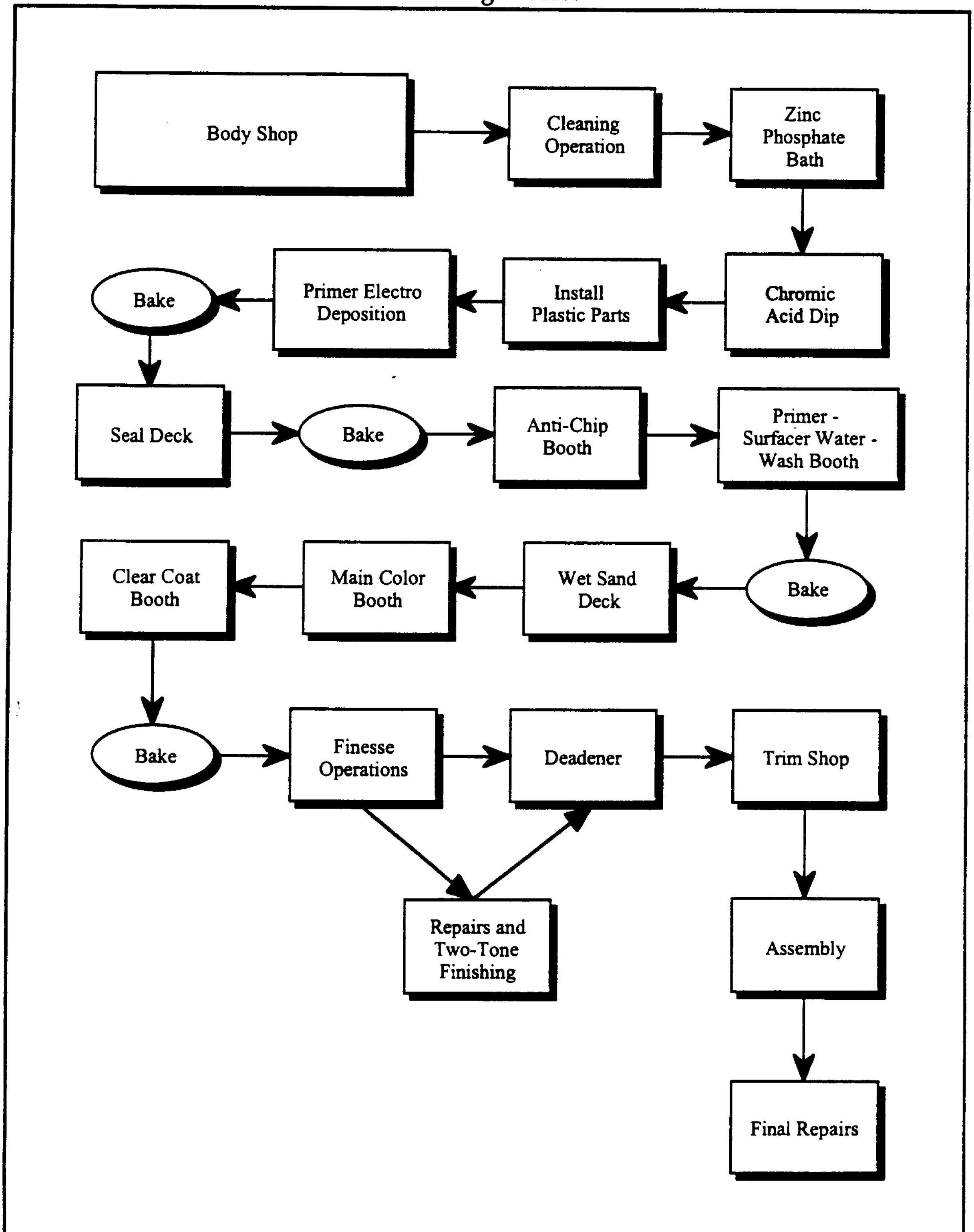
Automotive finishing is a multi-step process subdivided into four categories: 1) anti-corrosion operations, consisting of cleaning applications, a phosphate bath, and a chromic acid bath; 2) priming operations, consisting of a electrodeposition primer bath, an anti-chip application, and a primer-surfacer application; 3) joint sealant application; and 4) finishing operations, consisting of a color coat application, a clear coat application, and any painting necessary for two-tone color or touch-up applications. The stages of the automotive finishing process are illustrated in Exhibit 9.

After the automobile body has been assembled, anti-corrosion operations prepare the body for the painting/finishing process. Initially, the body is sprayed with and immersed in a cleaning agent, typically consisting of detergents, to remove residual oils and dirt. The body is then dipped into a phosphate bath, typically zinc phosphate, to prevent corrosion. The phosphate process also improves the adhesion of the primer to the metal. The body is then rinsed with chromic acid, further enhancing the anti-corrosion properties of the zinc phosphate coating. The anti-corrosion operations conclude with another series of rinsing steps.

Priming operations further prepare the body for finishing by applying various layers of coatings designed to protect the metal surface from corrosion and assure good adhesion of subsequent coatings. Prior to the application of these primer coats, however, plastic parts to be painted and finished with the body are installed.

As illustrated in Exhibit 10, a primer coating is applied to the body using an electrodeposition method, creating a strong bond between the coating and the body to provide a more durable coating. In electrodeposition, a negatively-charged auto body is immersed in a positively-charged 60,000 to 80,000 gallon bath of primer for approximately three minutes. The coating particles, insoluble in the liquid and positively-charged, migrate toward the body and are, in effect, "plated" onto the body surface.

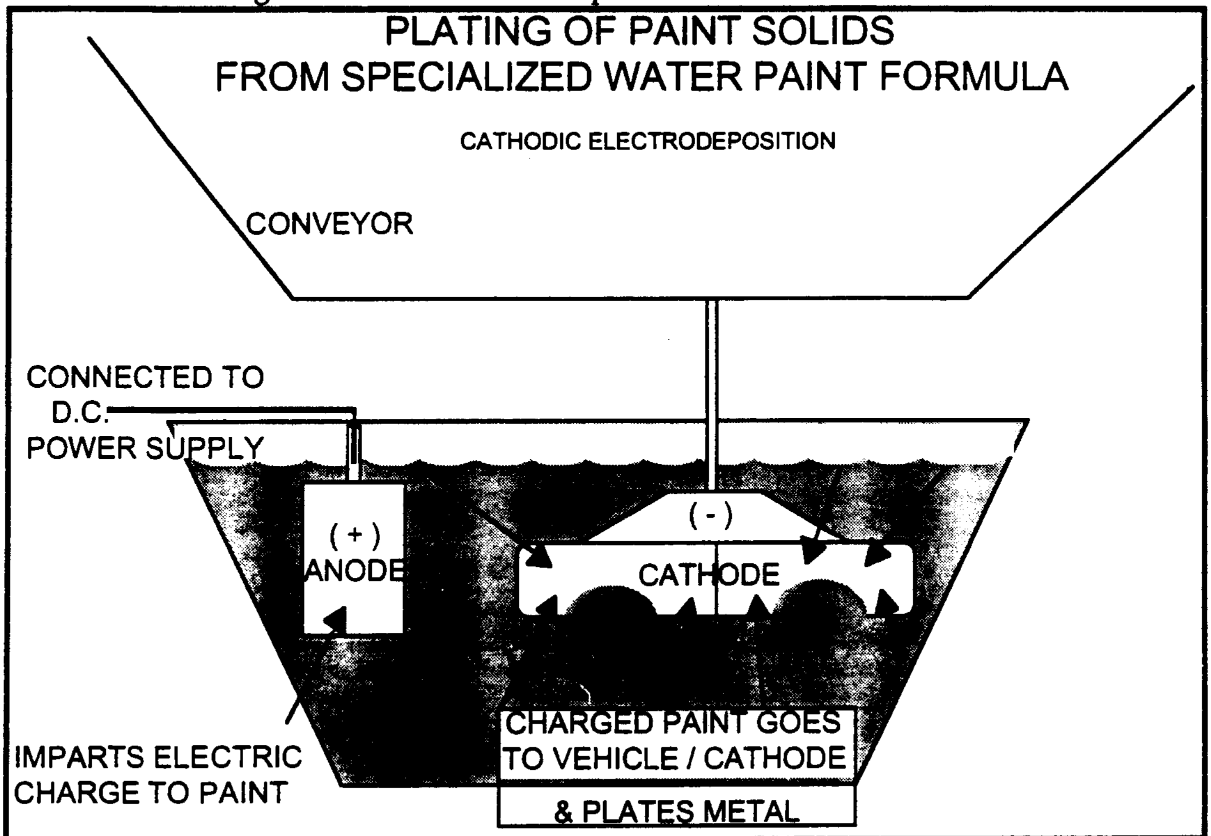
Exhibit 9
Car Painting Process



Source: American Automobile Manufacturers Association.

R0076260

Exhibit 10
Plating of Paint Solids from Specialized Water Paint Formula



Source: American Automobile Manufacturers Association.

Although the primer bath is mostly water-based with only small amounts of organic solvent (less than five to ten percent), fugitive emissions consisting of volatile organic compounds (VOCs) can occur. However, the amount of these emissions is quite small. In addition to solvents and pigments, the electrodeposition bath contains lead, although the amount of lead used has been decreasing over the years.

Prior to baking, excess primer is removed through several rinsing stages. The rinsing operations use various systems to recover excess electrodeposited primer. Once the body is thoroughly rinsed, it is baked for approximately 20 minutes at 350 to 380 degrees Fahrenheit. VOC emissions resulting from the baking stage are incinerated at approximately 90 percent of automotive and automotive parts facilities.

Next, the body is further water-proofed by sealing spot-welded joints of the body. Water-proofing is accomplished through the application of a paste or putty-like substance. This sealant usually consists of polyvinyl chloride and small amounts of solvents. The body is again baked to ensure that the sealant adheres thoroughly to the spot-welded areas.

After water-proofing, the automobile body proceeds to the anti-chip booth. Here, a substance usually consisting of a urethane or an epoxy ester resin, in conjunction with solvents, is applied locally to certain areas along the base of the body, such as the rocker panel or the front of the car. This anti-chip substance protects the lower portions of the automobile body from small objects, such as rocks, which can fly up and damage automotive finishes.

The primer-surfacer coating, unlike the initial electrodeposition primer coating, is applied by spray application in a water-wash spray booth. The primer-surfacer consists primarily of pigments, polyester or epoxy ester resins, and solvents. Due to the composition of this coating, the primer-surfacer creates a durable finish which can be sanded. The pigments used in this finish provide additional color layers in case the primary color coating is damaged. The water-wash spray booth is generally 100 to 150 feet long and applies the primer-surfacer in a constant air stream through which the automobile body moves. A continuous stream of air, usually from ceiling to floor, is used to transport airborne particulates and solvents from primer-surfacer overspray. The air passes through a water curtain which captures a portion of the airborne solvents for reuse or treatment at a waste water facility. Efforts have been made at certain facilities to recycle this air to reduce VOC emissions.

After the primer-surfacer coating is baked, the body is then sanded, if necessary, to remove any dirt or coating flaws. This is accomplished using a dry sanding technique. The primary environmental concern at this stage of the finishing process is the generation of particulate matter.

The next step of the finishing process is the application of the primary color coating. This is accomplished in a manner similar to the application of primer-surfacer. One difference between these two steps is the amount of pigments and solvents used in the application process. VOC emissions from primary color coating operations can be double that released from primer-surfacer operations. In addition to the pigments and solvents, aluminum or mica flakes can be added to the primary color coating to create a finish with unique reflective qualities. Instead of baking, the primary color coat is allowed to "flash off," in other words, the solvent evaporates without the application of heat.

Pigments, used to formulate both primers and paints, are an integral part of the paint formulation, which also contains other substances. The pigmented resin forms a coating on the body surface as the solvent dries. The chemical composition of a pigment varies according to its color, as illustrated in Exhibit 11.

Exhibit 11
Chemical Components of Pigments Found in Paint

Pigment Color	Chemical Components
White	Titanium dioxide, white lead, zinc oxide
Red	Iron oxides, calcium sulfate, cadmium selenide
Orange	Lead chromate-molybdate
Brown	Iron oxides
Yellow	Iron oxides, lead chromate, calcium sulfide
Green	Chromium oxide, copper, phosphotungstic acid, phosphomolybdic acid
Blue	Ferric ferrocyanide, copper
Purple	Manganese phosphate
Black	Black iron oxide
Metallic	Aluminum, bronze, copper, lead, nickel, stainless steel, silver, powdered zinc

Source: McGraw Hill Encyclopedia of Science and Technology, 1987.

After the primary color coating is allowed to air-dry briefly, the final coating, a clear coat, is applied. The clear coat adds luster and durability to the automotive finish. This coating generally consists of a modified acrylic or a urethane and is baked for approximately 30 minutes.

Following the baking of the clear coat, the body is inspected for imperfections in the finish. Operators finesse minor flaws through light sanding and polishing and without any repainting.

Once the clear coat is baked, a coating known as deadener is applied to certain areas of the automobile underbody. Deadener, generally a solvent-based resin of tar-like consistency, is applied to areas such as the inside of wheel wells to reduce noise. In addition, anti-corrosion wax is applied to other areas, such as the inside of doors, to further seal the automobile body and prevent moisture damage. This wax contains aluminum flake pigment and is applied using a spray wand.

After painting and finishing, two types of trim are installed - hard and soft. Hard trim, such as instrument panels, steering columns, weather stripping, and body glass, is installed first. The car body is then passed through a water test where, by using phosphorous and a black light, leaks are identified. Soft trim, including seats, door pads, roof panel insulation, carpeting, and upholstery, is then installed. The only VOC emissions resulting from this stage of the process originate from the use of adhesives to attach items, such as seat covers and carpeting.

Next, the automobile body is fitted with the following: gas tank, catalytic converter, muffler, tail pipe, and bumpers. Concurrently, the engine goes through a process known as "dressing," which consists of installing the transmission, coolant hoses, the alternator, and other components. The engine and tires are then attached to the body, completing the assembly process.

The finished vehicle is then rigorously inspected to ensure that no damage has occurred as a result of the final assembly stages. If there is major damage, the entire body part is replaced. However, if the damage is minor, such as a scratch, paint is taken to the end of the line and applied using a hand-operated spray gun. Because the automobile cannot be baked at temperatures as high as in earlier stages of the finishing process, the paint is catalyzed prior to application to allow for faster drying at lower temperatures. Approximately two percent of all automobiles manufactured require this touch-up work. Because the paint used in this step is applied using a hand-operated spray gun, fugitive air emissions are likely to be generated (depending on system design).

R0076264

Generally, spray and immersion finishing methods are to a certain extent interchangeable, and the application method for various coatings varies from facility to facility. The same variance applies to the number and order of rinsing steps for cleaning, phosphating, and electrodeposition primer operations. Spray rinsing the body prior to immersion rinsing decreases the amount of residues deposited in the bath and allows for greater solvent recovery.

In addition to the above-mentioned uses of solvents as ingredients of coatings, solvents are often used in facility and equipment cleanup operations. Efforts have been made at several facilities to reduce the amount of solvent used for this purpose, thereby reducing fugitive VOC emissions, and to reuse these solvents when preparing batches of coatings used in certain stages of the finishing process.

The expanded use of alternative coating methods, such as electrostatic powder spray, is being researched. Powder coatings are being used instead of solvent-based coatings for some initial coating steps, such as the anti-chip and the primer-surfacer process.

III.A.4. Emerging Industry Trends

Motor vehicles manufactured today are produced more efficiently, brought to market more quickly, and designed to be more environmentally sensitive than the models of the 1980s. As a result, these vehicles are proving to have less of a negative impact on the environment. Automobile manufacturers are striving to meet new air emission standards, and are developing motor vehicles and motor vehicle equipment that meet the demands of the growing market niche for "green" automobiles. Much of the information for this section was adapted from the 1994 publication entitled "Automotive Demand, Markets, and Material Selection Processes" by David J. Andrea and Brett C. Smith of the University of Michigan.

In order for motor vehicle and motor vehicle equipment manufacturers to remain competitive, it is becoming more important to strike a balance between environmental issues and industrial demands. Approaches such as life cycle assessment (LCA), design for recycling (DFR™), and design for disassembly (DFD) encourage the development of products that are more environmentally acceptable. These approaches are in various stages of implementation in the automotive industry. Evidence of their influence can be seen in some of the initiatives currently underway in the automotive industry, some of which are addressed later in this profile.

III.A.4.a. *Life Cycle Assessment*

LCA is an environmental approach that focuses on the environmental costs associated with each stage of the product life cycle (See Exhibit 12). LCA requires the evaluation of environmental effect at every stage of the cycle. The evaluation focuses on such factors the waste streams generated during material acquisition and manufacturing, as well as energy consumption during processing and distribution. Attempts to implement this structured approach have begun, although full LCAs for automobiles have not yet been achieved due to product complexity.

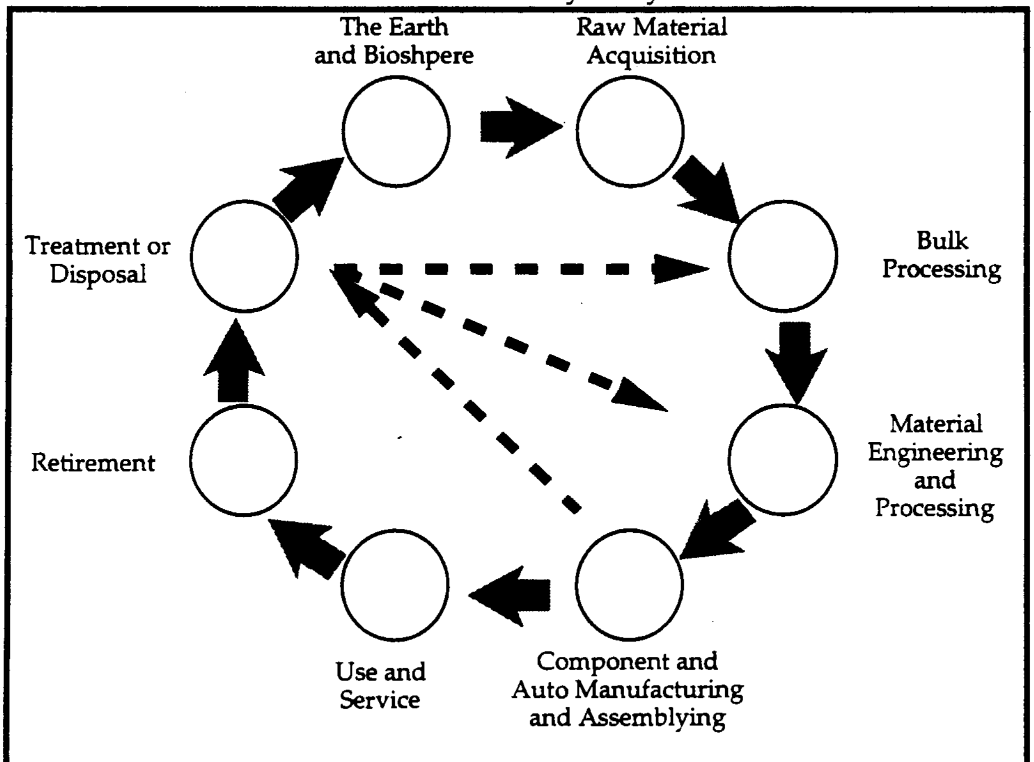
According to General Motors' 1994 Environmental Report, LCA is an important part of the company's commitment to product stewardship. To implement this commitment, GM environmental personnel work closely with vehicle design teams to integrate environmental principles into the earliest possible stages of the product program management process. As part of this process, various statements of work, which specify the health, safety, and facility environmental criteria that must be met before a product can be released to the next development phase, are used to provide a framework for an environmental and health evaluation of GM products. Ford and other automakers are also working to develop LCA technology. LCA promises to be a useful tool and its future applications in the automotive industry should improve overall industry environmental performance.

III.A.4.b. *Recycling*

An important part of LCA is the "retirement" of a given product. Once a product reaches the retirement stage, it becomes eligible for recycling, another environmental trend.

Autos have been recycled for many years in the U.S., and today approximately 94 percent (or approximately 9 million) of all automobiles scrapped in the U.S. are collected and recycled. This effort results in approximately 11 million tons of recycled steel and 800,000 tons of recycled nonferrous metals, and saves an estimated 85 million barrels of oil that would be used to manufacture new parts. The U.S. boasts one of the most effective and prosperous vehicle recycling industries in the world. At least 75 percent of the material collected from scrap vehicles (steel, aluminum, copper) is recycled for raw material use. According to the Automotive Recyclers Association (ARA), the automotive remanufacturing and recycling industry is responsible for approximately five billion dollars in annual sales.

Exhibit 12
The Product Life Cycle System



Source: Automotive Demand, Markets, and Material Selection Process, Society of Automotive Engineers - Technical Paper Series, International Congress & Exposition, Detroit, Michigan, 1994.

Three operations are primarily responsible for vehicle recycling - automobile scrappage/disassembly, automobile shredders, and materials recycling. There are an estimated 12,000 automobile scrappage/disassembly operations in the United States. Vehicles taken to these businesses are subject to two major dismantling steps: (1) drainage and removal of hazardous and recyclable fluids (oil, auto coolants, CFCs), and (2) removal of parts from the vehicle, which, if undamaged, are then cleaned, tested, inventoried, and sold, and if damaged, are recycled with similar materials. The remaining hulk is then flattened and taken to a shredder.

There are an estimated 200 shredding operations in North America. These operations use large machines to shred the hulk into fist-sized pieces which are then separated by material types: ferrous, nonferrous, and automotive shredder residue (ASR) or "shredder fluff."

Shredder output is first sorted by magnetic separation to "capture" the ferrous materials, which are then transported to a mill. Nonferrous metals are then hand-sorted from a conveyor belt and sold for use in new products. The remaining material (approximately 25 percent) is sent to landfills. This material is composed primarily of plastics, rubber, glass, dirt, fibers from carpet, seat foam, and undrained fluids. This waste currently constitutes about 1.5 percent of total municipal landfill waste. The amount of waste generated by shredding will be greatly reduced when vehicles are designed using concepts such as DFR and DFD.

III.A.4.c. *Other Initiatives*

Three important trends impacting vehicle development are: the increased use of lighter weight materials such as aluminum, plastic, and the various composites; the use of alternative fuels; and increased use of electric components.

The Federal Corporate Average Fuel Economy (CAFE) Requirements, which mandate average motor-vehicle fuel economy standards for passenger automobiles and light trucks, will push the increased usage of lighter-weight materials by encouraging lower vehicle weight and increased fuel efficiency. Industry experts predict that the use of lighter weight materials will increase 38 percent between 1992 and 2000. A study conducted by the University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation (OSAT), entitled Delphi VII, states that industry experts expect to see a three percent drop in average weight of a North American produced automobile by 1998 and an eight percent drop by 2003. Light-truck weight is expected to see similar reductions with a five percent decrease by 1998 and a seven percent decrease by 2003.

In order to produce lighter-weight vehicles, new lightweight materials are needed. The use of materials such as aluminum, magnesium, and plastic could potentially increase 15 to 20 percent by 2003. The use of heavier material such as steel and cast iron, which account for the majority of car weight, is expected to fall 9 to 15 percent within the same time frame (See Exhibit 13). Currently, Ford is the largest user of aluminum per vehicle in North America. In 1991, the use of aluminum in Ford vehicles was 15 percent above the industry average. Likewise, Ford researchers and engineers embarked on the "Synthesis 1020" program, which is part of a $25 million effort to determine the feasibility of a high-volume aluminum intensive vehicle (AIV). Under that initiative, Ford built 40 AIV's which now are being fleet-tested. Chrysler is also exploring the use of aluminum in cars and may begin building an aluminum intensive car in 1996, employing 600 to 700 pounds of aluminum per car. The reduction in weight for a midsize vehicle would cut gasoline consumption by one gallon for each 100 miles driven.

Exhibit 13
Material Content Forecast for Passenger Cars

Material Content	Estimated Current Weight 27.5 mpg*	Median Responses**		
		1988	1998	2003
Steel	1709	-1%	-5%	-9%
Cast Iron	430	-5%	-10%	-15%
Aluminum	174	+10%	+15%	+ 20%
Plastics	243	5%	10%	15%
Copper (including electrical)	45	0	0	0
Zinc	37	0	-4%	-4%
Magnesium	7	5%	8%	15%
Glass	88	0	0	0
Ceramics	2	2%	3%	5%
Powdered Metals	25	4%	4%	10%
Rubber				
-Tires (inc. spare)	94	0	0	0
-All other rubber	39	0	0	0

Source: Ward's Automotive Yearbook, 1992 and various OSAT estimates.

* Miles Per Gallon
** Percent change in material content

In order to satisfy the requirements of the CAA by lowering the emission of hydrocarbons, carbon monoxide, and oxides of nitrogen, the use of alternative fuel sources is being explored. Various alternatives are being explored with different levels of success (See Exhibit 14). Oxygenated fuels, fuels that are blended with either alcohol or ethers, are slowly becoming more common in the United States. Oxygenated fuels are beneficial because they reduce emissions of carbon monoxide without requiring vehicle adjustments. This is particularly true in older cars (pre-1981) which do not have systems which maintain a constant air-fuel mixture. At least two States with severe carbon monoxide problems, Colorado and Arizona, have implemented mandatory oxygenated fuel programs in order to meet ambient air quality standards. Currently, the State of California plans to mandate the sale of electric cars beginning in 1998. Research and development on electric car technology by the U.S. car companies predates the California mandate by several years. The main problem with manufacturing as well as driving electric cars is the battery; a long-lasting battery has not yet been developed.

Exhibit 14
Use of Alternative Fuels Forecast

Alternative Fuels	Estimate 1992	Passenger Cars Median Response	
		1998	2003
Alcohol or Alcohol/gasoline (>10% alcohol; includes flex fuel or variable fuel)	0.5%	1.0%	5.0%
Diesel	1.2%	1.0%	2.0%
Electric	0.0%	0.2%	2.0%
Electric/gasoline hybrid	0.0%	0.0%	1.0%
Natural gas	0.0%	0.5%	2.0%
Propane	0.0%	0.1%	0.5%

Source: UMTRI Research Review, *Delphi VII - Forecast and Analysis of the North American Automotive Industry, Information taken from various OSAT estimates.*

Electronic components such as anti-lock brakes, electric windows, sun- and moon-roofs have become more prominent in vehicles. This being so, producers of specific motor-vehicle parts and accessories will be replaced or transformed from manufacturers of mechanically engineered products to producers of electronic goods. By the year 2000, the proportionate value of electronic components used in the automotive industry is expected to increase by more than 200 percent from 1987 levels. A study by Volkswagen estimates that by the year 2000, approximately 25 percent of a vehicle's manufacturing cost will be attributed to electronics.

III.A.4.d. *Manufacturer Initiatives*

In response to new standards and other environmental concerns, the Big Three have committed substantial resources to researching and developing new technology. One Big Three joint research initiative, under the umbrella of the U.S. Council for Automotive Research (USCAR), is Low Emission Paint Consortium (LEPC), which aims to develop new technologies for low emitting paint processes. In July 1995, the LEPC dedicated a new facility at Wixom, Michigan, to test powder paint and other technologies. In addition to other research initiatives relating to production, USCAR sponsors several that relate to releases from the car. One example is the Low Emissions Technologies Research and Development Partnership. This partnership was formed to explore ways to reduce automotive emissions by improving the performance of catalytic converters and other exhaust related components, and by refining the internal combustion process. The partnership is also researching the feasibility of alternative fuel sources such as ethanol/methanol gasoline mixtures, liquid natural gas (LNG), and liquid petroleum gas.

To respond to perceived future demands for electric cars, The Big Three, together with the U.S. Department of Energy (DOE), formed the U.S. Advanced Battery Consortium. The goal of this consortium is to develop new battery storage technology.

Another Big Three initiative is aimed at developing new materials for vehicles. The U.S. Automotive Materials Partnership will explore the use of materials such as polymer composites, aluminum, plastics, iron, steel, ceramics, and advanced metals. The use of these products in automotive manufacturing is expected to lead to lighter, cleaner, and safer vehicles. Automakers are also exploring the feasibility of developing aluminum vehicles. The Aluminum Association reports that a mid-size sedan using 1,000 pounds of aluminum would be 25 percent lighter and 20 percent more fuel efficient than a car composed entirely of steel. The aluminum content of cars has increased over the years from an average of 78 pounds in 1970 to 191 pounds today.

An additional Big Three initiative - the Vehicle Recycling Partnership (VRP) - is exploring techniques to increase automotive recycling. Although 94 percent of all vehicles are taken to recycling facilities, only 75 percent of a vehicle's actual weight is claimed for recycling purposes. One area of particular interest in automotive recycling is plastics. A recent industry study claims that as much as one billion pounds of automotive plastics end up in landfills. New technologies such as "polymer renewal" recycling are being developed to recycle thermoplastic polyester, nylon, and acetal into first-quality polymers. Ford was the first North American automaker to recycle plastic parts from previously built vehicles. Ford and GM also are making new parts from recycled plastic bumpers. According to AAMA, the automakers are helping to stimulate the market for used materials by incorporating recycled materials into the car. For example, Ford is making: protective seat covers from recycled plastic; splash shields from battery casings; grille opening reinforcements and luggage racks from recycled soda pop bottles; grilles from computer housings and telephones, head lamp housings from plastic water cooler bottles, and on a test basis, brake pedal pads from tires.

Heightened competition has led the Big Three to initiate several jointly funded research products, including the Partnership for a New Generation of Vehicles (PNGV). PNGV is designed to generate technologies that will lead to more environmentally friendly cars. PNGV is joining Federal agencies, under the leadership of the Commerce Department's Technology Administration, to initiate the New Technology Initiative. The goal of this initiative, introduced by

President Clinton in 1993, is to develop a new generation of vehicles with three times greater fuel efficiency.

III.B. Raw Material Inputs and Pollution Outputs

The many different production processes employed to manufacture a motor vehicle require a vast amount of material input and generate large amounts of waste. The outputs resulting from the various stages of production range from air emissions from foundry operations to spent solvents from surface painting and finishing.

Exhibit 15 highlights the production processes, the material inputs, and the various wastes resulting from these operations. Process waste pollutants are treated or neutralized before discharge.

Exhibit 15
Material Inputs/Pollution Outputs

Process	Material Input	Air Emissions	Process Wastes (Waste Water & Liquids	Other Wastes
Metal Shaping				
Metal Cutting and/or Forming	Cutting oils, degreasing and cleaning solvents, acids, and metals	Solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)	Acid/alkaline wastes (e.g., hydrochloric, sulfuric and nitric acids) and waste oils	Metal wastes (e.g., copper, chromium and nickel) and solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)
Heat Treating	Acid/alkaline solutions (e.g., hydrochloric and sulfuric acid), cyanide salts, and oils		Acid/alkaline wastes, cyanide wastes, and waste oils	Metal wastes (e.g., copper, chromium, and nickel)
Surface Preparation				
Solvent Cleaning	Acid/alkaline cleaners and solvents	Solvent wastes (e.g., acetone, xylene, toluene, etc.)	Acid/alkaline wastes	Ignitable wastes, solvent wastes, (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.) and still bottoms
Pickling	Acid/alkaline solutions		Acid/alkaline wastes	Metal wastes
Surface Finishing				
Electroplating	Acid/alkaline solutions, metal bearing and cyanide bearing solutions		Acid/alkaline wastes, cyanide wastes, plating wastes, and wastewaters	Metal wastes, reactive wastes, and solvent wastes

R0076273

Exhibit 15
Material Inputs/Pollution Outputs (cont'd)

Process	Material Input	Air Emissions	Process Wastes (Waste Water & Liquids	Other Wastes
Surface Finishing (contd)				
Surface Finishing	Solvents	Solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)		Metal paint wastes, solvent wastes, ignitable paint wastes, and still bottoms
Facility Cleanup	Solvents	Solvent wastes (e.g., 1,1,1-trichloroethane, acetone, xylene, toluene, etc.)		Solvent wastes and still bottoms

The discussion of pollution outputs from automotive manufacturing follows the same format as the discussion of the manufacturing process: foundry operations; metal fabricating; metal finishing; assembly; painting/coating; and dismantling/shredding.

III.B.1. Foundry Operations

Iron foundries create a number of wastes which may pose environmental concerns. Gas and particulate emissions are a concern throughout the casting process. Dust created during sand preparation, molding, and shakeout is of concern due to the carcinogenic potential of the crystalline silica in the sand. Gases containing lead and cadmium and other particulate matter and sulfur dioxide are also created during foundry operation, especially during the melting of the iron.

The wastewaters generated during foundry operations may also be of an environmental concern. Wastewaters are generated primarily during slag quenching operations (water is sprayed on the slag to both cool it as well as pelletize it) and by the wet scrubbers employed as air pollution control devices connected to furnaces and sand and shakeout operations. Due to the presence of cadmium and lead in iron, these metals may both be present in wastewaters.

Foundry operations also create many waste materials that meet the definition of a RCRA hazardous waste. Of primary concern is the calcium carbide desulfurization slag created during the melting of the iron. This slag readily reacts with water to create acetylene gas, a trait which causes it to be classified as a D003 reactive hazardous waste. Other materials such as wastewater sludges and baghouse dust may also fail the toxicity characteristic for lead and cadmium and would then be classified as D008 and D006 respectively. Foundries may also use solvents for cleaning, which when spent, may be characterized as characteristic (ignitable or toxic) or listed hazardous waste depending upon the formulations used.

III.B.2. Metal Fabricating

Each of the metal shaping processes can result in wastes containing constituents of concern (depending on the metal being used). In general, there are two categories of waste generated in metal shaping operations: scrap metal and metalworking fluids/oils.

Scrap metal may consist of metal removed from the original piece (e.g., steel or aluminum). Quite often, scrap is reintroduced into the process as a feedstock.

In general, metalworking fluids can be petroleum-based, oil-water emulsions, or synthetic emulsions that are applied to either the tool or the metal being tooled to facilitate the shaping operation. Metalworking fluid is used to:

- Keep tool and workpiece temperature down and aid lubrication,
- Provide a good finish
- Wash away chips and metal debris
- Inhibit corrosion or surface oxidation.

Metalworking fluids typically become contaminated and spent with extended use and reuse. When disposed, these oils may contain constituents of concern, including metals (cadmium, chromium, and lead), and therefore must be tested to see if they are considered a RCRA hazardous waste. Many fluids may contain chemical additives such as chlorine, sulfur and phosphorus compounds, phenols, cresols, and alkalines. In the past, such oils have commonly been mixed with used cleaning fluids and solvents (including chlorinated solvents). Air emissions may result through volatilization during storage, fugitive losses during use, and direct ventilation of fumes.

Surface preparation operations generate wastes contaminated with solvents and/or metals depending on the type of cleaning operation. Concentrated solvent-bearing wastes and releases may arise from degreasing operations. Degreasing operations may result in solvent-bearing wastewaters, air emissions, and materials in solid form.

R0076275

Solvents may be rinsed into wash waters and/or spilled into floor drains. Although contamination of the wastewater is possible, procedures are in place to prevent such pollution in the first place. Air emissions may result through volatilization during storage, fugitive losses during use, and direct ventilation of fumes. Any solid wastes (e.g., wastewater treatment sludges, still bottoms, cleaning tank residues, machining fluid residues, etc.) generated by the operation may be contaminated with solvents, some of which may meet RCRA hazardous waste listings F001 and F005.

Chemical treatment operations can result in wastes that contain metals of concern. Alkaline, acid, mechanical, and abrasive cleaning methods can generate waste streams such as spent cleaning media, wastewaters, and rinse waters. Such wastes consist primarily of the metal complexes or particles, the cleaning compound, contaminants from the metal surface, and water. In many cases, chemical treatment operations are used in conjunction with organic solvent cleaning systems. As such, many of these wastes may be cross-contaminated with solvents.

The nature of the waste will depend upon the specific cleaning application and manufacturing operation. Wastes from surface preparation operations may contribute to commingled waste streams such as wastewaters discharged to centralized treatment. Further, such operations can result in direct releases such as fugitive emissions and easily segregated wastes such as cleaning tank residues.

III.B.3. Metal Finishing

Surface finishing and related washing operations account for a large volume of wastes associated with automotive metal finishing. Metal plating and related waste account for the largest volumes of metal (e.g., cadmium, chromium, copper, lead, mercury, and nickel) and cyanide-bearing wastes.

Electroplating operations can result in solid and liquid wastestreams that contain constituents of concern. Liquid wastes result from workpiece rinses and process cleanup waters. Most surface finishing (and many surface preparation) operations result in liquid wastestreams. Centralized wastewater treatment systems are common, and can result in solid-phase wastewater treatment sludges. In addition to these wastes, spent process solutions and quench bathes are discarded periodically when the concentrations of contaminants inhibit proper function of the solution or bath. When discarded, process bathes usually consist of solid- and liquid-phase wastes that may contain high concentrations of the constituents of concern, especially cyanide (both free and complex).

Related operations, including all non-painting processes, can contribute wastes including scrap metals, cleaning wastewaters, and other solid materials. The nature of these wastes will depend on the specific process, the nature of the workpiece, and the composition of materials used in the process.

III.B.4. Motor Vehicle Assembly

Due to advances in technology, well designed operating procedures, and the implementation of strategies to limit waste from assembly, little hazardous waste is generated during the actual assembly of an automobile (with the exception of painting/finishing which is discussed in the following section).

The majority of wastes generated during assembly are solid wastes resulting from parts packaging. Parts packaging can be grouped into two categories - returnable and expendable. Returnable packaging (containers) is shipped back to the original suppliers once empty. It includes such items as: metal racks, metal skids, returnable bins, totes, and rigid plastic racks and dunnage. Expendable packaging is used once and recycled, for the most part. Examples include styrofoam peanuts, wood skids, plastic, corrugated boxes, metal barding, and shrink-wrap. Advances in packaging design, changes in purchasing, and the elimination of unneeded materials have greatly reduced the amount of expendable waste generated.

Additional wastes generated from assembly operations may be attributed to general plant operations, cleaning and maintenance, as well as the disposal of faulty equipment and parts.

III. B.5. Motor Vehicle Painting/Finishing

Many of the wastes generated during automotive production are the result of painting and finishing operations. These operations result in air emissions as well as the generation of solid and liquid wastes.

Air emissions, primarily VOCs, result from the painting and finishing application processes (paint storage, mixing, applications, and drying) as well as cleaning operations. These emissions are composed mainly of organic solvents which are used as carriers for the paint. Solvents are also used during cleanup processes to clean spray equipment between color changes, and to clean portions of the spray booth. The solvent utilized during cleaning is generally referred as "purge solvent" and is often composed of a mixture of dimethyl-benzene, 2-Pranone, 4-methyl-2-pentanone, butyl ester acetic acid, light aromatic solvent naphtha, ethyl benzene, hydrotreated heavy naphtha, 2-butanone, toluene, and 1-butanol.

Various solid and liquid wastes may be generated throughout painting operations and are usually the result of the following operations:

- Paint application - paint overspray caught by emissions control devices (e.g., paint booth collection systems, ventilation filters, etc.);
- Paint drying - ventilated emissions as paint carriers evaporate;
- Cleanup operations - cleaning of equipment and paint booth area; and
- Disposal - discarding of leftover and unused paint as well as containers used to hold paints, paint materials, and overspray.

Solid and liquid wastes may also contain metals from paint pigments and organic solvents.

III. C. Post Production Motor Vehicle Dismantling/Shredding

Dismantling operations involve both automotive fluids and solids. The fluids, such as engine oil, antifreeze, and air conditioning refrigerant, are recovered to the extent possible, reprocessed for reuse or sent to energy recovery facilities. Many solid parts, such as the radiator and catalytic converter, contain valuable metal materials which are removed for recycling or reuse. In addition, the dismantler will remove and recycle the battery, fuel tank, and tires to reduce shredder processing concerns. The shredder processes the remaining automotive hulk, along with other metallic goods (such as household appliances), into ferrous materials, non-ferrous materials, and shredder residue. The residue is a heterogeneous mix that may include plastics, glass, textiles, metal fines, and dirt. This material is predominantly landfilled.

III. D. Management of Chemicals in Wastestream

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 16 shows that the motor vehicle, bodies, parts and accessories industry managed about 333 million pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 66% was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 33% of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (25.7%), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has decreased and the portions treated or managed through energy recovery on-site have increased between 1992 and 1995 (projected).

Exhibit 16
Source Reduction and Recycling Activity for SIC 37

A	B	C	D	E	F	G	H	I	J
	Production Related Waste Volume	% Reported As Released and	On-Site			Off-Site			Remaining Releases and
Year	(10^6lbs.)	Transferred	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	Disposal
1992	333	65%	19.99%	0.26%	12.38%	36.54%	3.99%	2.27%	25.84%
1993	333	66%	18.42%	0.23%	14.75%	34.11%	3.82%	2.97%	25.71%
1994	317	—	14.47%	0.35%	16.54%	34.96%	3.97%	3.36%	26.36%
1995	337	—	15.60%	0.28%	15.81%	36.89%	3.92%	3.21%	24.48%

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Motor Vehicles and Motor Vehicle Equipment Industry

Exhibits 17-21 illustrate the TRI releases and transfers for the motor vehicles and motor vehicle equipment industry (SIC 37). Exhibit 18 shows the top TRI releasing transportation equipment facilities. As shown in Exhibit 19, the majority of TRI reporting facilities are located in Michigan, Ohio, Indiana, Illinois, and Tennessee. As mentioned earlier, these States, with the exception of Tennessee, have historically been the focal point of automobile manufacturing.

For the industry as a whole, solvents such as toluene, xylene, methyl ethyl ketone, and acetone, comprise the largest number of TRI releases. The large of quantity of solvent release, both fugitive and point source can be attributed to the solvent-intensive finishing processes employed by the industry. In addition to being used to clean equipment and metal parts, solvents are a component found in many of the coating and finishes applied to automobile during the assembly and painting/finishing operations.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear in Exhibit 17. Exhibit 18 contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, Exhibit 18 includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 17
Top 10 TRI Releasing Auto and Auto Parts Facilities (SIC 37)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	2,689,968	Ford Motor Co., Kansas City Assembly Plant	Claycomo	MO
2	2,519,315	Nissan Motor Mfg. Corp., USA Corp.	Smyrna	TN
3	1,820,840	Ford Motor Co., St. Louis Assembly Plant	Hazelwood	MO
4	1,733,637	Ford Motor Co., Michigan Truck Plant	Wayne	MI
5	1,693,900	GMC NATP Moraine Assembly Plant	Moraine	OH
6	1,669,603	Ford Electronics & Refrigeration Corp.	Connersville	IN
7	1,633,125	Cadillac Luxury Car Div., Detroit Hantranck Assembly	Detroit	MI
8	1,602,429	Ford Motor Co., Louisville Assembly Plant	Louisville	KY
9	1,523,625	North American Truck Platform, Pontiac E Assembly	Pontiac	MI
10	1,490,075	Purolator Prods, Inc.	Fayetteville	NC

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 18
Top 10 TRI Releasing Transportation Equipment Facilities (SIC 37)

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
3711, 3751	3,438,305	Honda of America Mfg., Inc.	Marysville	OH
3711, 3713	2,689,968	Ford Motor Co., Kansas City Assembly Plant	Claycono	ND
3711	2,519,315	Nissan Motor Mfg. Corp., USA Corp.	Smyrna	TN
3711	1,820,840	Ford Motor Co., St. Louis Assembly Plant	Hazelwood	MO
3711	1,733,637	Ford Motor Co., Michigan Truck Plant	Wayne	MI
3714, 3231	1,727,400	Harman Automotive, Inc.,	Bolivar	TN
3713	1,693,900	GMC NATP Moraine Assembly Plant	Moraine	OH
3714	1,669,603	Ford Electronics & Refrigeration Corp.	Commersville	IN
3711	1,633,125	Cadillac Luxury Car Div., Detroit Hantranck Assembly	Detroit	MI
3711	1,602,429	Ford Motor Co., Louisville Assembly Plant	Louisville	KY

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on these lists does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 19
TRI Reporting Auto and Auto Parts Facilities (SIC 37) by State

State	Number of Facilities	State	Number of Facilities
AL	11	NC	28
AR	10	ND	1
AZ	3	NE	5
CA	21	NH	1
CO	1	NJ	5
CT	4	NV	1
DE	2	NY	15
FL	6	OH	76
GA	14	OK	5
IA	12	OR	3
IL	31	PA	20
IN	63	PR	1
KS	9	RI	1
KY	24	SC	12
LA	1	SD	1
MA	2	TN	33
MD	4	TX	12
ME	1	UT	5
MI	101	VA	12
MN	7	WA	6
MO	22	WI	11
MS	6		

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 20
Releases for Auto and Auto Parts Facilities (SIC 37) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Inject-ion	Land Disposal	Total Releases	Average Releases per Facility
Toluene	154	1165126	5507143	13416	0	3978	6689663	43439
Sulfuric Acid	152	12783	46013	13000	0	0	71796	472
Xylene (Mixed Isomers)	150	1416695	21584687	23	0	0	23001405	153343
Copper	142	3423	9331	1261	0	4056	18071	127
Methyl Ethyl Ketone	125	1111122	3619253	13400	0	0	4743775	37950
Acetone	107	1149162	3422729	0	0	0	4571891	42728
Glycol Ethers	105	689599	6957693	7682	0	250	7655224	72907
Chromium	99	16632	9124	777	0	10	26543	268
Methanol	96	316128	2297245	0	0	0	2613373	27223
Ethylene Glycol	95	33573	163221	1052	0	415	198261	2087
Nickel	95	7746	2718	495	0	2233	13192	139
Zinc Compounds	95	31398	5906	3564	0	19528	60396	636
Manganese	85	4680	4710	614	0	0	10004	118
Phosphoric Acid	85	4826	13413	0	0	0	18239	215

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0076286

Exhibit 20 (cont'd)
Releases for Auto and Auto Parts Facilities (SIC 37) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Inject-ion	Land Disposal	Total Releases	Average Releases per Facility
Hydrochloric Acid	83	6480	911854	0	0	0	918334	11064
N-Butyl Alcohol	78	247976	4852404	0	0	0	5100380	65389
Methyl Isobutyl Ketone	73	657257	5664383	0	0	0	6321640	86598
Barium Compounds	71	16614	16858	602	0	1252720	1286794	18124
1,1,1-Trichloroethane	67	1688511	1451218	0	0	0	3139729	46862
Dichlorodifluoromethane	56	206893	5012	0	0	0	211905	3784
Ethylbenzene	56	195835	2332692	0	0	0	2528527	45152
Lead	53	712	4107	559	0	0	5378	101
Benzene	49	15678	10293	0	0	0	25971	530
Methylenebis (Phenylisocyanate)	48	7384	2816	0	0	0	10200	213
Nickel Compounds	48	760	2515	510	0	190	3975	83
Nitric Acid	48	3857	4147	0	0	0	8004	167
Manganese Compounds	45	1541	2106	1320	0	1800	6767	150
1,2,4-Trimethylbenzene	43	84346	1206168	5	0	0	1290519	30012
Chromium Compounds	37	877	3295	1046	0	0	5218	141
Lead Compounds	34	1034	1455	752	0	0	3241	95
Styrene	33	669058	787529	0	0	0	1456587	44139
Ammonia	32	6788	139153	30	0	0	145971	4562
Copper Compounds	29	1255	2487	284	0	0	4026	139
Trichloroethylene	29	935372	1834267	0	0	0	2769639	95505
Dichloromethane	24	402279	410601	0	0	0	812880	33870
Asbestos (Friable)	17	71	2144	0	0	0	2215	130
Diethanolamine	16	505	4405	0	0	0	4910	307
Phenol	16	25785	268220	0	0	50906	344911	21557
Di(2-Ethylhexyl) Phthalate	14	250	41665	0	0	0	41915	2994
Formaldehyde	14	12515	177775	0	0	15115	205405	14672
Tetrachloroethylene	13	69959	293383	0	0	0	363342	27949
Freon 113	12	160695	73286	0	0	0	233981	19498
Aluminum (Fume Or Dust)	10	6130	800971	0	0	0	807101	80710
Cyclohexane	10	1110	1321	0	0	0	2431	243
Cobalt	9	512	269	250	0	0	1031	115
Methyl Tert-Butyl Ether	9	6627	4860	0	0	0	11487	1276
Cumene	7	5841	67234	0	0	0	73075	10439
Chlorine	6	13816	278	0	0	0	14094	2349
Zinc (Fume Or Dust)	6	979	182	43	0	0	1204	201
Antimony Compounds	4	0	0	0	0	0	0	0
Butyl Benzyl Phthalate	4	0	10792	0	0	0	10792	2698
Cyanide Compounds	4	5	279	3	0	0	287	72
Hydrogen Fluoride	4	6	345	0	0	0	351	88
Propylene	4	350	110	0	0	0	460	115
Sec-Butyl Alcohol	4	15305	42250	764	0	0	58319	14580
Toluene-2,4-Diisocyanate	4	1652	5105	0	0	0	6757	1689
Toluene-2,6-Diisocyanate	4	490	1502	0	0	0	1992	498
Bis(2-Ethylhexyl) Adipate	3	0	90052	0	0	0	90052	30017
Naphthalene	3	702	2926	0	0	0	3628	1209
Phosphorus (Yellow Or White)	3	15	0	0	0	0	15	5
Trichlorofluoromethane	3	500	250	0	0	0	750	250

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0076287

Exhibit 20 (cont'd)
Releases for Auto and Auto Parts Facilities (SIC 37) in TRI, by Number of Facilities
(Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
2-Ethoxyethanol	3	3920	24300	0	0	0	28220	9407
4,4'-Isopropylidenediphenol	3	0	5	0	0	0	5	2
Chlorobenzene	2	12911	3230	0	0	0	16141	8071
Cobalt Compounds	2	250	250	0	0	0	500	250
Toluenediisocyanate (Mixed Isomers)	2	255	5	0	0	0	260	130
1,4-Dioxane	2	4000	250	0	0	0	4250	2125
Aluminum Oxide (Fibrous Form)	1	0	0	0	0	0	0	0
Antimony	1	0	0	0	0	0	0	0
Butyl Acrylate	1	880	9400	0	0	0	10280	10280
Carbon Tetrachloride	1	275509	826526	0	0	0	1102035	1102035
Cumene Hydroperoxide	1	250	5484	0	0	0	5734	5734
Dibutyl Phthalate	1	2	0	0	0	0	2	2
Diethyl Phthalate	1	750	60000	0	0	250	61000	61000
Ethylene Oxide	1	0	0	0	0	0	0	0
Isopropyl Alcohol (Manufacturing)	1	750	0	0	0	0	750	750
M-Xylene	1	0	8998	0	0	0	8998	8998
O-Xylene	1	0	0	0	0	0	0	0
Quinone	1	0	0	0	0	0	0	0
Total	----	**11,736,697**	**66,116,598**	**61,452**	**0**	**1,351,451**	**79,266,198**	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 21
Transfers for Auto and Auto Parts Facilities (SIC 37) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Toluene	154	954	21709	2540713	83965	1739857	4387448	28490
Sulfuric Acid	152	22	710	4800000	1067714	0	5868446	38608
Xylene (Mixed Isomers)	150	1801	192692	14495581	183599	4256914	19130587	127537
Copper	142	2729	260467	23058138	26472	267	23348073	164423
Methyl Ethyl Ketone	125	1899	15933	4839058	92419	1153386	6102695	48822
Acetone	107	17402	10415	4237359	76693	1534387	5876256	54918
Glycol Ethers	105	2652452	45884	943328	228100	498232	4367996	41600
Chromium	99	3915	446383	7966830	46368	36	8463532	85490
Methanol	96	6312	31276	334497	41293	285819	699197	7283
Ethylene Glycol	95	169438	17890	210618	391126	306410	1095482	11531
Nickel	95	4313	133121	3730134	6971	5	3874544	40785
Zinc Compounds	95	35127	750093	2502350	272103	24930	3584603	37733

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 21 (cont'd)
Transfers for Auto and Auto Parts Facilities (SIC 37) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Manganese	85	4167	232071	4698891	1689	2	4936820	58080
Phosphoric Acid	85	37205	84330	275	75444	0	197254	2321
Hydrochloric Acid	83	13855	20710	0	30375	0	64940	782
N-Butyl Alcohol	78	1885	43422	1017184	318581	372643	1753715	22484
Methyl Isobutyl Ketone	73	28787	5675	8971374	67282	1124723	10197841	139696
Barium Compounds	71	10860	3202950	55850	288758	2646	3561064	50156
1,1,1-Trichloroethane	67	867	7610	1113333	24921	65309	1212040	18090
Dichlorodifluoro-methane	56	0	225	45932	132	0	46289	827
Ethylbenzene	56	796	3491	2153976	5362	687526	2851151	50913
Lead	53	857	62803	2586617	59112	284	2709673	51126
Benzene	49	500	22	4215	578	5423	10738	219
Methylenebis (Phenylisocyanate)	48	5	36295	105801	15356	29161	186618	3888
Nickel Compounds	48	18060	162808	402186	82076	8	665138	13857
Nitric Acid	48	5	710	0	26895	0	27610	575
Manganese Compounds	45	17892	154918	2660652	35886	250	2869598	63769
1,2,4-Trimethylbenzene	43	26	40	323150	6012	182922	512150	11910
Chromium Compounds	37	4349	409788	637987	33227	1651	1087002	29378
Lead Compounds	34	7068	90442	824896	52401	675	975482	28691
Styrene	33	0	364260	1574	15750	41199	422783	12812
Ammonia	32	19330	0	0	210	258	19798	619
Copper Compounds	29	2913	183868	18303568	37197	630	18528176	638903
Trichloroethylene	29	565	5400	372186	71991	77401	587543	20260
Dichloromethane	24	9	0	128604	80182	261284	470079	19587
Asbestos (Friable)	17	0	1871982	0	250	0	1872232	110131
Diethanolamine	16	103572	555	105993	139	36200	246459	15404
Phenol	16	3366	187182	0	4132	7911	202591	12662
Di(2-Ethylhexyl) Phthalate	14	0	8120	0	2500	10925	21545	1539
Formaldehyde	14	937	15353	3602	301	3076	23269	1662
Tetrachloroethylene	13	1	2772	166884	32861	15000	217518	16732
Freon 113	12	0	0	155501	14524	25111	195136	16261
Aluminum (Fume Or Dust)	10	0	44377	731959	0	0	776336	77634
Cyclohexane	10	0		850	250	1550	2650	265
Cobalt	9	5	3865	231524	0	0	235394	26155
Methyl Tert-Butyl Ether	9	0	0	0	67	5849	5916	657
Cumene	7	0	0	2871	2	24829	27702	3957
Chlorine	6	21313	0	250			21563	3594
Zinc (Fume Or Dust)	6	48	99338	531602	51858	250	683096	113849
Antimony Compounds	4	1	3412	2400	513	0	6326	1582
Butyl Benzyl Phthalate	4	0	2894	0	1477	0	4371	1093
Cyanide Compounds	4	62	0	3400	38	0	3500	875
Hydrogen Fluoride	4	0	0	0	149	0	149	37
Propylene	4	0	0	0	0	0	0	0

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0076289

Exhibit 21 (cont'd)
Transfers for Auto and Auto Parts Facilities (SIC 37) in TRI, by Number of Facilities
(Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharges	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Sec-Butyl Alcohol	4	0	5627	0	745	7	6379	1595
Toluene-2,4-Diisocyanate	4	0	3900	32300	0	0	36200	9050
Toluene-2,6-Diisocyanate	4	0	980	8100	0	0	9080	2270
Bis(2-Ethylhexyl) Adipate	3	0	1540	0	0	0	1540	513
Naphthalene	3	0	0	0	0	653	653	218
Phosphorus (Yellow Or White)	3	0	250	80800	0	0	81050	27017
Trichlorofluoromethane	3	0	2702	0	1587	0	4289	1430
2-Ethoxyethanol	3	0	0	0	0	7200	7200	2400
4,4'-Isopropylidenedi-phenol	3	0	20401	0	0	0	20401	6800
Chlorobenzene	2	0	0	0	0	75	75	38
Cobalt Compounds	2	5	250	5570	5	0	5830	2915
Toluenediisocyanate (Mixed Isomers)	2	0	0	0	0	0	0	0
1,4-Dioxane	2	0	0	8140	0	1225	9365	4683
Aluminum Oxide (Fibrous Form)	1	0	19002	0	0	0	19002	19002
Antimony	1	0	5	56600	5	0	56610	56610
Butyl Acrylate	1	0	0	11	3	602	616	616
Carbon Tetrachloride	1	0	0	0	0	0	0	0
Cumene Hydroperoxide	1	0	0	0	0	516	516	516
Dibutyl Phthalate	1	0	0	0	0	173	173	173
Diethyl Phthalate	1	0	0	0	2375	0	2375	2375
Ethylene Oxide	1	0	1600		300	0	1900	1900
Isopropyl Alcohol (Manufacturing)	1	0	250	0	0	0	250	250
M-Xylene	1	0	0	0	0	2236	2236	2236
O-Xylene	1	0	0	0	0	9575	9575	9575
Quinone	1	0	0	0	0	0	0	0
Total	----	3,195,675	9,294,768	116,195,214	3,960,321	12,807,201	145,513,429	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the 1993 Toxics Release Inventory Public Data Release (EPA, 1994), and the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[1]. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

The top TRI release for the motor vehicles and motor vehicle equipment industry (SIC 37) as a whole are as follows: toluene, xylene, methyl ethyl ketone, acetone, glycol ethers, 1,1,1,-trichloroethane, styrene, trichloroethylene, dichloromethane, and methanol. Summaries for several of these chemicals are provided below.

Acetone

Toxicity. Acetone is irritating to the eyes, nose, and throat. Symptoms of exposure to large quantities of acetone may include headache, unsteadiness, confusion, lassitude, drowsiness, vomiting, and respiratory depression.

Reactions of acetone (see environmental fate) in the lower atmosphere contribute to the formation of ground-level ozone. Ozone (a major component of urban smog) can affect the respiratory system, especially in sensitive individuals such as asthmatics or allergy sufferers.

---

1 TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released into water, acetone will be degraded by microorganisms or will evaporate into the atmosphere. Degradation by microorganisms will be the primary removal mechanism.

Acetone is highly volatile, and once it reaches the troposphere (lower atmosphere), it will react with other gases, contributing to the formation of ground-level ozone and other air pollutants. EPA is reevaluating acetone's reactivity in the lower atmosphere to determine whether this contribution is significant.

Physical Properties. Acetone is a volatile and flammable organic chemical.

Note: Acetone was removed from the list of TRI chemicals on June 16, 1995 (60 FR 31643) and will not be reported for 1994 or subsequent years.

Glycol Ethers

Due to data limitations, data on diethylene glycol (glycol ether) are used to represent all glycol ethers.

Toxicity. Diethylene glycol is only a hazard to human health if concentrated vapors are generated through heating or vigorous agitation or if appreciable skin contact or ingestion occurs over an extended period of time. Under normal occupational and ambient exposures, diethylene glycol is low in oral toxicity, is not irritating to the eyes or skin, is not readily absorbed through the skin, and has a low vapor pressure so that toxic concentrations of the vapor can not occur in the air at room temperatures.

At high levels of exposure, diethylene glycol causes central nervous depression and liver and kidney damage. Symptoms of moderate diethylene glycol poisoning include nausea, vomiting, headache, diarrhea, abdominal pain, and damage to the pulmonary and cardiovascular systems. Sulfanilamide in diethylene glycol was once used therapeutically against bacterial infection; it was withdrawn from the market after causing over 100 deaths from acute kidney failure.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Diethylene glycol is a water-soluble, volatile organic chemical. It may enter the environment in liquid form via petrochemical plant effluents or as an unburned gas from combustion sources. Diethylene glycol typically does not occur in sufficient concentrations to pose a hazard to human health.

Methanol

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed 1 mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microorganisms in soils and surface waters.

Physical Properties. Methanol is highly flammable.

Methylene Chloride (Dichloromethane)

Toxicity. Short-term exposure to dichloromethane (DCM) is associated with central nervous system effects, including headache, giddiness, stupor, irritability, and numbness and tingling in the limbs. More severe neurological effects are reported from longer-term exposure, apparently due to increased carbon monoxide in the blood from the break down of DCM. Contact with DCM causes irritation of the eyes, skin, and respiratory tract.

Occupational exposure to DCM has also been linked to increased incidence of spontaneous abortions in women. Acute damage to the eyes and upper respiratory tract, unconsciousness, and death were reported in workers exposed to high concentrations of DCM. Phosgene (a degradation product of DCM) poisoning has been reported to occur in several cases where DCM was used in the presence of an open fire.

Populations at special risk from exposure to DCM include obese people (due to accumulation of DCM in fat), and people with impaired cardiovascular systems.

Carcinogenicity. DCM is a probable human carcinogen via both oral and inhalation exposure, based on inadequate human data and sufficient evidence in animals.

Environmental Fate. When spilled on land, DCM is rapidly lost from the soil surface through volatilization. The remainder leaches through the subsoil into the groundwater.

Biodegradation is possible in natural waters but will probably be very slow compared with evaporation. Little is known about bioconcentration in aquatic organisms or adsorption to sediments but these are not likely to be significant processes. Hydrolysis is not an important process under normal environmental conditions.

DCM released into the atmosphere degrades via contact with other gases with a half-life of several months. A small fraction of the chemical diffuses to the stratosphere where it rapidly degrades through exposure to ultraviolet radiation and contact with chlorine ions. Being a moderately soluble chemical, DCM is expected to partially return to earth in rain.

Methyl Ethyl Ketone

Toxicity. Breathing moderate amounts of methyl ethyl ketone (MEK) for short periods of time can cause adverse effects on the nervous system ranging from headaches, dizziness, nausea, and numbness in the fingers and toes to unconsciousness. Its vapors are irritating to the skin, eyes, nose, and throat and can damage the eyes. Repeated exposure to moderate to high amounts may cause liver and kidney effects.

Carcinogenicity. No agreement exists over the carcinogenicity of MEK. One source believes MEK is a possible carcinogen in humans based on limited animal evidence. Other sources believe that there is insufficient evidence to make any statements about possible carcinogenicity.

Environmental Fate. Most of the MEK released to the environment will end up in the atmosphere. MEK can contribute to the formation of air pollutants in the lower atmosphere. It can be degraded by microorganisms living in water and soil.

Physical Properties. Methyl ethyl ketone is a flammable liquid.

Toluene

Toxicity. Inhalation or ingestion of toluene can cause headaches, confusion, weakness, and memory loss. Toluene may also affect the way the kidneys and liver function.

Reactions of toluene (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Some studies have shown that unborn animals were harmed when high levels of toluene were inhaled by their mothers, although the same effects were not seen when the mothers were fed large quantities of toluene. Note that these results may reflect similar difficulties in humans.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases of toluene to land and water will evaporate. Toluene may also be degraded by microorganisms. Once volatized, toluene in the lower atmosphere will react with other atmospheric components contributing to the formation of ground-level ozone and other air pollutants.

Physical Properties. Toluene is a volatile organic chemical.

1,1,1-Trichloroethane

Toxicity. Repeated contact of 1,1,1-trichloroethane (TCE) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCE causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCE leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsions and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCE to surface water or land will almost entirely volatilize. Releases to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCE degrades very slowly by photooxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCE that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCE does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Trichloroethylene

Toxicity. Trichloroethylene was once used as an anesthetic, though its use caused several fatalities due to liver failure. Short term inhalation exposure to high levels of trichloroethylene may cause rapid coma followed by eventual death from liver, kidney, or heart failure. Short-term exposure to lower concentrations of trichloroethylene causes eye, skin, and respiratory tract irritation. Ingestion causes a burning sensation in the mouth, nausea, vomiting and abdominal pain. Delayed effects from short-term trichloroethylene poisoning include liver and kidney lesions, reversible nerve degeneration, and psychic disturbances. Long-term exposure can produce headache, dizziness, weight loss, nerve damage, heart damage, nausea, fatigue, insomnia, visual impairment, mood perturbation, sexual problems, dermatitis, and rarely jaundice. Degradation products of trichloroethylene (particularly phosgene) may cause rapid death due to respiratory collapse.

Carcinogenicity. Trichloroethylene is a probable human carcinogen via both oral and inhalation exposure, based on limited human evidence and sufficient animal evidence.

Environmental Fate. Trichloroethylene breaks down slowly in water in the presence of sunlight and bioconcentrates moderately in aquatic organisms. The main removal of trichloroethylene from water is via rapid evaporation.

Trichloroethylene does not photodegrade in the atmosphere, though it breaks down quickly under smog conditions, forming other pollutants such as phosgene, dichloroacetyl chloride, and formyl chloride. In addition, trichloroethylene vapors may be decomposed to toxic levels

R0076296

of phosgene in the presence of an intense heat source such as an open arc welder.

When spilled on the land, trichloroethylene rapidly volatilizes from surface soils. The remaining chemical leaches through the soil to groundwater.

Xylene (Mixed Isomers)

Toxicity. Xylenes are rapidly absorbed into the body after inhalation, ingestion, or skin contact. Short-term exposure of humans to high levels of xylenes can cause irritation of the skin, eyes, nose, and throat, difficulty in breathing, impaired lung function, impaired memory, and possible changes in the liver and kidneys. Both short- and long-term exposure to high concentrations can cause effects such as headaches, dizziness, confusion, and lack of muscle coordination. Reactions of xylenes (see environmental fate) in the atmosphere contribute to the formation of ozone in the lower atmosphere. Ozone can affect the respiratory system, especially in sensitive individuals such as asthma or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. The majority of releases to land and water will quickly evaporate, although some degradation by microorganisms will occur.

Xylenes are moderately mobile in soils and may leach into groundwater, where they may persist for several years.

Xylenes are volatile organic chemicals. As such, xylenes in the lower atmosphere will react with other atmospheric components, contributing to the formation of ground-level ozone and other air pollutants.

IV.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 22 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 22
Pollutant Releases (Short Tons/Years)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	**35,303**	**23,725**	**2,406**	**12,853**	**25,462**	**101,275**
Dry Cleaning	101	179	3	28	152	7,310

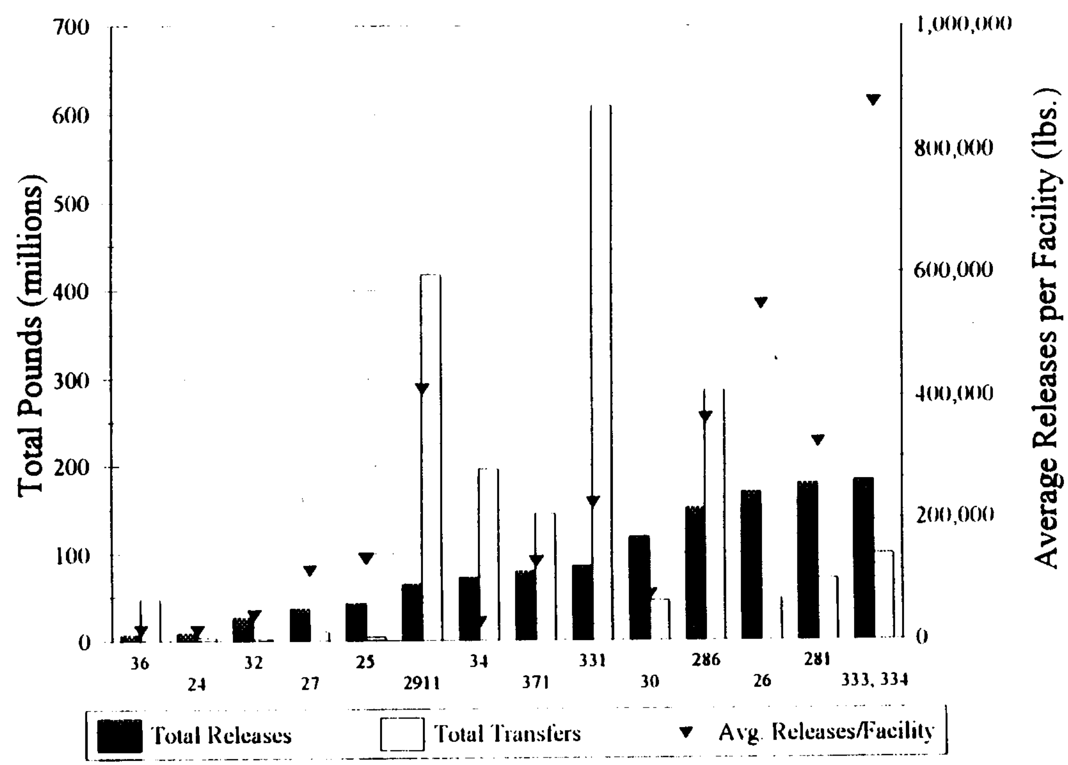
Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 23 is a graphical representation of a summary of the 1993 TRI data for the motor vehicles assembly industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 24 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the motor vehicles assembly industry, the 1993 TRI data presented here covers 609 facilities. These facilities listed SIC 37 (Motor Vehicles Assembly Industry) as a primary SIC code.

Exhibit 23: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accecessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0076300

Exhibit 24
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases: Total Releases (10⁶ pounds)	Releases: Average Releases per Facility (pounds)	Transfers: 1993 Total (10⁶ pounds)	Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (10⁶ pounds)	Average Release+ Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	24	491	8.4	17,036	3.5	7,228	11.9	24,000
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronics/Computers	36	406	6.7	16,520	47.1	115,917	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	**371**	**609**	**79.3**	**130,158**	**145.5**	**238,938**	**224.8**	**369,000**
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72.0	30,476	195.7	82,802	267.7	123,000
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,269	98.2	472,335	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the Motor Vehicles and Motor Vehicle Equipment industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

Much of the automotive industry is involved in exploring pollution prevention opportunities. The discussion which follows highlights some of the current pollution prevention activities undertaken by manufacturers involved in all stages of the automotive manufacturing process. This is just a sampling of the numerous pollution prevention/waste minimization efforts currently underway.

V.A. Motor Vehicle Equipment Manufacturing

Non-Production Material Screening

As part of its Non-Production Material approval system, Chrysler Corporation implemented pollution prevention practices to eliminate, substitute, or reduce, to the extent possible, regulated substances from both products supplied to Chrysler as well as those resulting from their manufacturing process. First implemented in April 1993, the environmental strategy focuses on avoiding the use of regulated substances and materials of concern whenever possible as part of an effort to eliminate "end-of-pipe" controls. One example of how this screening approach has been utilized was the refusal to approve a transmission fluid for Chrysler's new TE Van which contained 10 to 30 percent butyl benzyl phthalate. This was accomplished by working with suppliers and design teams to identify a substitute material. As part of the initiative, suppliers are being requested to certify their parts regarding the presence of Chrysler's identified materials of concern.

Other similar Chrysler successes include:

- Elimination of hexavalent chromium from all materials and processes;
- Reformulating paints and solvents to exclude the majority of listed toxic solvents;
- Reformulating new coatings to reduce odor; and
- Elimination of lead from all paints except electrocoat primer.

Used Oil Recycling

In an effort to reduce the waste oil produced at Chrysler stamping, machining, and engine plants, the automobile manufacturer has developed comprehensive recycling programs with outside suppliers. More than 800 million gallons of used oil is recycled annually. Other company efforts designed to reduce waste oil include:

- Recovering and remanufacturing waste oil on-site for return to the process;
- Reducing the amount used by replacing petroleum-based metal working fluids with longer lasting semi-synthetic materials; and
- Developing purchasing programs to promote the use of recycled oils.

Trichloroethylene Reduction

Trichloroethylene (TCE) is traditionally employed by the automotive industry as a degreaser to clean oil from very thin aluminum parts. Although vapor collection systems are used during the degreasing process to collect and recycle TCE, some TCE inevitably remains on the high-surface-area parts. The remaining TCE then evaporates. In order to reduce emissions of TCE, Ford Motor Company developed a detergent and aqueous solution which was comparable to TCE. The new water wash did not etch or damage aluminum parts and met brazing process requirements. With assistance from a supplier, Ford also designed an enclosed water spray system for the new degreasing operations. According to AAMA, after a 1992 pilot evaluation proved successful, Ford began to convert production processes using heat exchangers (e.g., radiators) to one relying on aqueous cleaning instead of TCE degreasing. As a result, TCE releases at one plant dropped by 250,000 pounds annually. Ford expects comparable further reductions worldwide as the remaining plants implement this process change.

Elimination of Chromium From Radiator Paint

In past years, radiators were spray painted with a coating containing chromium for protection purposes. This process resulted in overspray paint waste (sludge) that contained hazardous constituents. Wastes were collected and shipped to an approved hazardous waste disposal facility. In order to minimize the risk associated with the material constituents and resultant waste associated with coating containing chromium, Chrysler's Dayton Thermal Products Plant explored the use of new products which would meet performance specifications for the required surface coating. The result is a water-based material which is chromium as well as lead-free. The use of this new water-based material will eliminate approximately 18,000 gallons of paint waste per year that was previously landfilled, as well as reduce substantially VOC emissions.

Lead-Free Black Ceramic Paint

Ceramic black glaze paint (ink), used for aesthetic purposes as well as an ultraviolet (UV) light shield for the adhesive (adhesive is sensitive to UV light), is applied to glass where the interior trim abuts the window. Application of the ink, which contains lead, to the glass involves a silk-screening process. In an attempt to minimize both solid and liquid waste, McGraw Glass (supplier for Chrysler assembly plants), launched a program to develop, test, and approve a lead-free black ceramic glass paint. A suitable substitute, which was approved

R0076304

and in use by 1994, would eliminate approximately 700 drums of hazardous waste per year.

Recovering Lead From Wastewater

One of the waste streams associated with battery-making operations is wastewater which contains lead. Although in the past it was possible to remove lead from the wastewater, it had not been possible to recycle the lead. In 1990, Delco Remy, a GM supplier, developed a method which allows the lead to be recycled. The process involves a series of steps and the use of a proprietary chemical (identified through a cooperative effort between the plant personnel and a chemical vendor) which allows lead to settle to the bottom when tank contents are neutralized. After the lead has settled, wastewater is decanted and filtered through a sand filter to remove remaining lead. The remaining water and lead are agitated with air to put lead back into suspension before the mixture is pumped into a filter press where water is removed leaving behind the lead. The dried, lead-containing mixture is then sent to a secondary smelter. As a result of this lead removing process, approximately 125,000 pounds of lead are reclaimed and recycled each year.

PCB Elimination Program

Polychlorinated biphenyls (PCBs), which are utilized as a coolant and flame retardant fluid in closed system high voltage electrical equipment, are one of the most persistent toxics used in the automotive industry. In order to eliminate the use of PCBs in its facilities, Chrysler initiated a program that would eliminate the use of PCB containing equipment at its facilities by 1998. The program also plans to minimize the risk of Superfund liability through alternate disposal practices. Similar programs are in place at GM and Ford.

Solvent-Free Spray Adhesive For Interior Trim

General Motors Inland Fisher Guide plant in Livonia, MI produces soft trim for the interior of automobiles. In order to produce car door panels that offer a variety of colors, textures, and materials, an assembly process which glues together small pieces is used. In the past, the adhesive used to bind these parts together contained four percent methylene chloride; 30 percent methyl ethyl ketone; 30 percent hexane, and 14 percent toluene. The combination of VOCs resulted in approximately 20 tons of emissions a year. In order to eliminate the emissions associated with this adhesive, a water-based adhesive was identified. The new adhesive, which was implemented in the beginning of 1993, converted the waste stream from hazardous to non-hazardous.

Reducing Chlorofluorocarbon Use

Chlorofluorocarbons (CFCs) and 1,1,1-trichlorethane are chemical substances that deplete the ozone layer. Depletion of the ozone layer causes skin cancer, cataracts and has other human and environmental effects. Under the Montreal Protocol on Substances that Deplete the Ozone Layer and the Clean Air Act, production of these chemicals will be halted by January 1996. The automobile industry used CFC-12 as a refrigerant in air conditioning systems, CFC-11 as foam blowing agent for flexible seating foams, and CFC-113 and 1,1,1-trichloroethane (methyl chloroform) as a solvent in electronics manufacturing and metal cleaning. The automobile industry undertook voluntary and cooperative projects with EPA's Stratopheric Protection Division to reduce and eliminate each of these uses. As a result of these efforts, recycling was implemented and most uses were halted well before regulations took effect (Stratopheric Protection Division 1995). For example, in order to reduce the use of CFCs, GM's Lansing Automotive Division (LAD) Facilities Division decided to remove CFCs wherever possible from its operating procedures. The first step was to identify CFC containing materials that were approved for purchase and which departments were authorized to use them. Departments were then sent a letter asking whether a non-CFC material could be substituted. Results from the inquiries led to identification of acceptable and cost-effective alternatives. Since mid-1992, no CFC-containing products have been purchased by LAD plants. In addition, LAD found a substitute for a degreaser it had been using that has only about 12 percent of ozone-depletion potential of the Freons it replaced. According to the Stratopheric Protection Division, another example of technology and engineering excellence is that Ford joined with other companies under the auspices of the International Cooperative for Ozone Layer Protection (ICOLP) to develop inert gas wave and "no clean" soldering which replaces CFC-cleaning of printed wiring boards, (PWBs). Electronics are the key to meeting vehicle emissions safety and security. The new process was designed for environmental reasons, but Ford found it also improved the quality of the PWBs.

V.B. Motor Vehicle Assembly

Plants Switch To Clean-Burning Gas

In an effort to reduce air emissions from manufacturing facilities, Ford has converted from coal-fired boilers to natural gas. An estimated

R0076306

$500,000 to $600,000 is saved each year in operating costs for each plant that converts from coal to natural gas. The environmental benefits of the conversion include: a reduction in carbon monoxide emissions by one half; a reduction in sulfur dioxide emissions by approximately 3,000 tons per year system wide; and a reduction in nitrogen oxide emissions of approximately 1,100 tons per year. The switch has also reduced particulate emissions by over 500 tons a year for Ford system-wide, and by as much as 95 percent at some facilities. In addition, 8,000 tons of ash a year, from coal burning, and 4,100 tons of ash collected by emission collectors will no longer have to be disposed of in a landfill.

Solid Waste Recycling

As part of an effort to reduce the amount of waste generated from assembly operations, Chrysler is using durable returnable containers. By using these containers, the company has successfully eliminated 55 percent of its expendable packaging wastes and diverted significant volumes of paper, cardboard, plastic and wood from landfills. Chrysler has designed new product programs which plan to eliminate 95 percent of packaging waste. In addition, each year the company salvages 700,000 tons of scrap metal and recycles thousands of tons of wooden pallets and cardboard from its plants. Chrysler has also instituted one of the largest paper recycling programs in the U.S., recycling more than 800 tons of paper per year.

Ford also has a program to reduce solid waste. At Ford Casting and Forging, steel drums are recycled in the foundry's melting process. Ford's North American assembly plants are recycling 380 million pounds of waste each year. European and North American suppliers have been asked to ship components in reusable and returnable containers. Ford's Romeo Engine Plant receives over 90 percent of its parts in returnable containers. Also, Ford uses recycled plastic shrink wrap from its own manufacturing operations to make plastic seat covers to protect seats during car shipment to dealers.

V.C. Motor Vehicle Painting/Finishing

Facility Emission Controls

During the past 10 years, automobile companies have reduced the amount of emissions resulting from vehicle painting operations through more efficient paint application techniques, use of lower solvent content paints, and incineration of process emissions. In an attempt to lower emissions without jeopardizing quality, a paint

R0076307

development pilot plant has been established at the Ford Wixom, Michigan Assembly Plant.

Rescheduling Paint Booth Cleaning Reduces Solvent Use And VOC Emissions

One of the major factors in customer satisfaction is the quality of a car's paint job. To insure that each vehicle of a given color has a uniform and consistent coating, paint spraying equipment must be cleaned properly each time a color is changed. It is also important that the paint booth be cleaned properly to prevent stray drops or flakes of old paint from dropping onto subsequent paint jobs. The solvent used in these cleaning operations is generally referred to as "purge solvent." One of the disadvantages of using purge solvent is that it readily evaporates causing VOC emissions. In March 1993 the GM Fairfax Assembly Plant initiated a new booth-cleaning schedule which reduced the number of required cleanings. In addition to changing cleaning frequency, the company also monitored the amount of purge solvent used in production and cleaning operations. Information from these monitoring activities helped to identify the most efficient cleaning techniques. Implementation of these practices is expected to greatly lower emissions from purge solvent.

Surface Coating Toxics Reduction Program

Painting operations account for the majority of total releases attributed to automobile assembly. This is because painting and finishing operations result in VOC emissions from solvents used as carriers to apply solids to the vehicle. In order to reduce the amount of toxics generated during the painting/finishing process as well as eliminate future regulatory burden, the following projects are either underway or being planned at Chrysler:

- Evaluation of the feasibility of using coatings which eliminate or reduce VOCs/toxics; the goal is a 75 percent reduction in toxics by 1996. Various process changes and material reformulation will be required.

- Elimination of lead from surface coatings - lead has already been eliminated from all Chrysler color coats (basecoats). Further reductions in lead are being pursued for the electrodeposition primer (E-coat), with a goal of total removal by 1995. A lead-free E-coat is currently being tested.

- Elimination of hexavalent chromium phosphate pre-treatment - hexavalent chromium has already been eliminated from phosphate pre-treatment. Trivalent chromium remains in the final rinse that seals the phosphate at all but one of Chrysler's assembly plants; elimination of trivalent chromium is slated for 1995.

V.D. Motor Vehicle Dismantling/Shredding

Management Standards For Used Antifreeze

An article in the September/October 1994 edition of *Automotive Recycling* stated that The Coalition on Antifreeze and the Environment, in conjunction with Automotive Recyclers Association (ARA), has developed voluntary management standards for antifreeze. Management standards were developed, in part, to encourage the Federal and State governments to consider less restrictive regulations on recycling and disposal of antifreeze. Recent data show that antifreeze can become hazardous when handled and stored improperly. The voluntary management standards address the following:

- **Handling** - procedures for good housekeeping and proper handling of antifreeze
- **Storage** - guidelines for proper storage, such as the use of dedicated and well-labeled collection equipment
- **Education** - methods for educating employees on the importance of keeping collected, used antifreeze free from exposure to chemicals such as petroleum products, cleaning solvents, and other solvent-containing materials. Employees should also be taught not to use chlorinated solvents to clean antifreeze collection equipment.

V.E. Pollution Prevention Case Studies

Pollution Prevention at General Motors Corporation

General Motor's internal pollution prevention initiative - Waste Elimination and Cost Awareness Reward Everyone (WE CARE) - was piloted in 1990 at selected GM facilities. The initiative was then expanded to GM's operations throughout the U.S. and Canada in 1991 and was introduced to Mexican facilities in 1992. The foundation for this program is provided in the mission statement:

> *To minimize the impact of our operations, we will reduce emissions to air, water, and land by putting priority on waste prevention at the source, elimination or reduction of wasteful practices, and the utilization of recycling opportunities whenever available. The responsibility for achievement of this goal is primarily dependent on both management's support and actions of every employee to modify existing methods, procedures, and processes and to incorporate waste prevention into all new endeavors.*

WE CARE provides guidance to individual facilities for setting up a multi-discipline committee to direct pollution prevention efforts. These committee include representatives from the following departments: maintenance, quality control, materials management, production, engineering, purchasing, environmental affairs, as well as from the local union. In bringing together representatives from all aspects of the company, GM is making pollution prevention part of everyone's job. In 1992, GM encouraged employees to suggest ways to reduce the use of raw materials (especially toxics), reduce waste generation, and simple ways to benefit the environment.

GM has undertaken two broad-based initiatives to implement this philosophy; chemicals management and packaging reduction and recycling. Each is discussed below.

Chemicals Management

The automotive industry is a large consumer of chemicals including cleaners, machining fluids, hydraulic fluids, quenching fluids, water treatment chemicals, and solvents. These chemicals are known as indirect chemicals because they are not directly incorporated into the final product. Direct chemicals, which are incorporated into the final product, include automotive paints, vehicle lubricants, and fluids. GM aims to reduce chemical waste and save money by: (1) leveraging resources and expertise from other sources; and (2) reshaping the relation between the supplier and the customer. By developing and implementing an effective chemical management system, GM has reduced the amount of chemicals used at the source and reduced waste treatment and disposal costs.

Under the new chemical management program, GM no longer simply purchases chemicals from suppliers. Instead, they purchase a chemical service. The goal was to have one supplier for all of the indirect chemicals used at a facility. Since no one supplier can supply every chemical, the primary supplier is responsible for getting chemicals from secondary suppliers. Under the program, the primary supplier ultimately becomes a part of the production team by providing GM with chemical management, analysis, inventory control, and information management services. The benefits of this initiative include:

- Cost savings through the reduced number of suppliers, types and volumes of chemicals, and chemical inventories
- Better environmental control (waste treatment and disposal)
- Improved information management
- Improved chemical technology application
- Reduced purchase order processing
- Reduced freight.

The first assembly plant to implement this program went from having 35 different suppliers providing 348 chemicals, to 12 suppliers supplying 200 chemicals. This equates to a 66 percent reduction in the number of suppliers and a 43 percent reduction in the number of chemicals. Total savings were well over $750,000 per year.

Packaging Reduction and Recycling

One of the major waste streams associated with automotive assembly is solid waste. Solid waste is primarily the result of parts packaging from suppliers. The goal of GM's packaging reduction and recycling initiative was to reduce the amount of packaging coming into the plant and to ensure that packaging was easily recycled or returned.

Because GM has many different divisions and business units, one packaging strategy was not feasible. Therefore, each division was responsible for setting its own goals and strategies. Packaging guidelines and requirements were developed and communicated to suppliers. The guidelines, which were used throughout GM include:

- Eliminate packaging altogether, where possible
- Minimize the amount of material used in packaging
- Use packages that are returnable or refillable/reusable, where practical
- Use packaging that is recyclable and uses recycled material.

Requirements pertaining to expendable packaging (packaging which is used once and not recycled) were established for suppliers. These requirements pertained to package construction (easy to disassemble), the use of recycled material (use recyclable packaging), the use of lead and cadmium (do not use), and other provisions which reduce the amount of waste generated and facilitate recycling.

The GM Midsize Car Division has been able to reduce the amount of packaging waste going to landfill per vehicle manufactured by 75 percent in just two years as part of its "zero packaging-to-landfill" goal. As of September 1993, one GM assembly plant has been able to reduce the amount of waste to less than one pound of packaging per vehicle.

Ford's Manufacturing Environmental Leadership Strategy includes the objective and practice of increasing the use of returnable containers and recycling expendable packaging. Ford's North American assembly plants now use returnable packaging for over 87 percent of all parts shipped to the plants. These plants alone recycle more than 380 million pounds of waste each year. Many parts are shipped in returnable containers and packaging plastic is made into protective seat covers for use during car shipment.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

R0076313

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the

Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)).

These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain operating permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Regulations

Though production processes associated with the industries listed under SIC 37 have few specific regulatory requirements, the diverse and complex nature of the industry makes it one of the most heavily regulated industries in the manufacturing sector.

The large number of facilities engaged in activities covered by SIC 37, as well as the diversity of processes and products involved, make it difficult to provide a precise regulatory framework; the statutes and regulations governing a producer of a specific part which uses a specific manufacturing process will differ significantly from those affecting an integrated manufacturing plant performing foundry, metal finishing, and painting operations. Thus, the discussion which follows identifies those regulations that are of concern to the industry at large.

VI.B.1. Clean Water Act (CWA)

The Clean Water Act regulates the amount of chemicals/toxics released by industries via direct and indirect wastewater/effluent discharges. Regulations developed to implement this Act establish effluent guidelines and standards for different industries. These standards usually set concentration-based limits on the discharge of a given chemical by any one facility. If a facility is discharging directly into a body of water, it must obtain a National Pollution Discharge Elimination System (NPDES) permit. However, if a facility is discharging to a publicly owned treatment works (POTW), it must adhere to the specified pretreatment standards. (Information provided by Chrysler indicates that all of the company's manufacturing facilities discharge process wastewater to POTWs. Much of their water is treated at an on-site industrial wastewater treatment plant prior to discharge to the POTW.)

The following regulations are potentially applicable to various stages in the auto and auto parts manufacturing and assembly processes. Because so many regulations are potentially applicable to segments of the industry, we have divided the regulations into the following categories: foundry/metal forming operations; metal finishing operations; and painting operations.

Foundry/Metal Forming Operations

The following effluent guidelines and standards are applicable to the activities performed during the foundry/metal forming operations.

- Iron and Steel Manufacturing (40 CFR Part 420)
- Metal Molding and Casting (40 CFR Part 464)
- Aluminum Forming (40 CFR Part 467)
- Copper Forming (40 CFR Part 468)
- Nonferrous Forming (40 CFR Part 471)
- Lead-Tin-Bismuth Forming Category (40 CFR Part 471 Subpart A)
- Zinc Forming Subcategory (40 CFR Part 471, Subpart H).

Metal Finishing Operations

The following effluent guidelines and standards are applicable to metal finishing activities:

- Electroplating (40 CFR Part 413)
- Metal Finishing (40 CFR Part 433)
- Coil Coating (40 CFR Part 465).

The standards applicable to metal finishing regulate discharges resulting from numerous activities performed by manufacturers of autos and auto parts. The metal finishing and electroplating guidelines address discharges from the following six activities: (1) electroplating; (2) electroless plating; (3) anodizing; (4) coating; (5) chemical etching and milling; and (6) printed circuit board manufacturing. If one of these operations is performed, the metal finishing guidelines provide effluent standards for 40 additional operations, including machining; grinding; polishing; welding; soldering; and solvent degreasing.

VI.B.2. Clean Air Act (CAA)

Several existing regulations promulgated under the CAA are applicable to various stages in the automobile production process. These are discussed below.

The Standards of Performance for Automobile and Light Duty Truck Surface Coating Operations (40 CFR Part 60, subpart MM) are applicable to assembly plant operations where prime coats, guide coats, and topcoats are applied. These standards prohibit assembly plants that begin construction, modification, or reconstruction after October 5, 1979 from discharging VOC emissions in excess of:

- 0.16 kg of VOC per liter of applied coating solids from each prime coat,
- 1.40 kg of VOC per liter of applied coating solids from each guide coat operation, and/or
- 1.47 kg of VOC per liter of applied coating solids from each top coat.

The Standards of Performance for Metal Coil Surface Coating (40 CFR Part 60, subpart TT) may be relevant to some facilities in the automotive industry. This standard regulates the discharge of VOCs.

The Standards of Performance for Fossil-Fired Steam Generators for Which Construction Commenced after August 17, 1971 (40 CFR Part 60, subpart D) are applicable to motor vehicle plants which have fossil-fuel-fired steam generating units of more that 73 megawatts (MW) heat input rate and fossil-fuel and wood-residue-fired steam generating units capable of firing fossil fuel at a rate of more that 73 MW (though these standards do not apply to electric utility steam generating units).

The regulations set emissions standards for sulfur dioxide, particulate matter, and nitrogen oxides, and contain compliance, performance, emissions testing, and recordkeeping requirements.

The Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units (40 CFR Part 60 subpart Dc) apply to motor vehicle and motor vehicle equipment plants which have steam generating units for which construction, modification, or reconstruction is commenced after June 9, 1989 and that have a maximum design capacity of 29 MW input capacity or less, but greater than or equal to 2.9 MW.

These regulations set emissions standards for sulfur dioxide and particulate matter and require certain compliance, performance, emissions testing, and recordkeeping requirements.

National Emission Standards for Hazardous Air Pollutants for Industrial Process Cooling Towers (40 CFR Part 63, subpart Q) apply to motor vehicle and motor vehicle equipment plants that have industrial process cooling towers (IPCTs) that are operated with chromium-based water treatment chemicals and are either major sources or are integral parts of facilities that are major sources. Major sources are those sources that emit or have the potential to emit 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants.

The standards prohibit the use of chromium-based water treatment chemicals in:

- Existing IPCTs on or after March 8, 1996, and/or
- New IPCTs (IPCTs for which construction or reconstruction commenced after August 12, 1993) on or after September 8, 1994.

Chromium Electroplating

Human health studies suggest that various adverse effects result from acute, intermediate, and chronic exposure to chromium. As a result, in January 1995, EPA established National Emission Standards for Chromium Emissions From Hard and Decorative Chromium

Electroplating And Chromium Anodizing Tanks (40 CFR Part 9 and 63, Subpart N) The regulation is an MACT-based performance standard that sets limits on chromium and chromium compounds emissions based upon concentrations in the waste stream (e.g., mg of chromium/m^3 of air).

EPA holds that these performance standards allow a degree of flexibility since facilities may choose their own technology as long as the emissions limits (established by the MACT) are achieved. The standards differ according to the sources (e.g., old sources of chromium emissions will have different standards than new ones), further reducing the standards' rigidity.

VI.B.3. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA has had a much greater impact on the Big Three with facilities built before RCRA's enactment than it has had on the so-called transplant companies which have newer plants.

VI.B.4. Resource Conservation and Recovery Act (RCRA)

RCRA was passed in 1976, as an amendment to the Solid Waste Disposal Act, to ensure that solid wastes are managed in an environmentally sound manner. A material is classified under RCRA as a hazardous waste if the material meets the definition of solid waste (40 CFR 261.2), and that solid waste material exhibits one of the characteristics of a hazardous waste (40 CFR 261.20-24) or is specifically listed as a hazardous waste (40 CFR 261.31-33). A material defined as a hazardous waste is then subject to Subtitle C generator (40 CFR 262), transporter (40 CFR 263), treatment, storage, and disposal facility (40 CFR 254 and 265) and land disposal requirements (40 CFR 268). The motor vehicle and motor vehicle equipment manufacturing industry must be concerned with the regulations addressing all these. Most automobile and light truck assembly and component manufacturing facilities are not considered hazardous waste treatment, storage or disposal facilities requiring RCRA permits, although they may generate hazardous waste subject to RCRA management requirements.

The greatest quantities of RCRA listed waste and characteristically hazardous waste are identified in Exhibit 25. For more information on RCRA hazardous waste, refer to 40 CFR Part 261.

Exhibit 25
Hazardous Wastes Relevant to the Automotive Industry

EPA Hazardous Waste No.	Hazardous Waste
D001	Wastes which are hazardous due to the characterization of ignitibility
D002	Wastes which are hazardous due to the characteristic of corrosivity
D006 (cadmium) D007 (chromium) D008 (lead) D009 (mercury) D010 (selenium) D011 (silver) D035 (methyl ethyl ketone) D039 (tetrachloro-ethylene) D040 (trichloro-ethylene)	Wastes which are hazardous due to the characteristic of toxicity for each of the constituents.
F001	Halogenated solvents used in degreasing: tetrachloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10% or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	Spent halogenated solvents; tetrachloroethylene, methylene chloride, trichlorethylene, 1,1,1-trichloroethane chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, one or more of the above halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	Spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of 10% or more (by volume) of one of those solvents listed in F001, F002, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	Spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

Exhibit 25 (cont'd)
Hazardous Wastes Relevant to the Automotive Industry

EPA Hazardous Waste No.	Hazardous Waste
F005	Spent non-halogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures.
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.
F007	Spent cyanide plating bath solutions from electroplating operations.
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.
F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.
F012	Quenching waste water treatment sludges from metal heat treating operations where cyanides are used in the process.
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum except from zirconium phosphating in aluminum can washing when such phosphating is an exclusive conversion coating process.

Source: Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, EPA, OERR, June 1994.

VI.C. Pending and Proposed Regulatory Requirements

Numerous regulatory requirements which might affect the automotive industry are under consideration. Summaries of some of these potential future regulations are discussed below.

VI.C.1. Motor Vehicle Parts Manufacturing

Clean Water Act (CWA)

Although Congress did not reauthorize the Clean Water Act in 1994, future legislative requirements and/or reform may impact the motor vehicle manufacturer. Several of the regulations currently under

R0076330

consideration or development will have a significant impact on the automotive industry. The effluent guidelines and standards for Electroplaters (40 CFR Part 413) and Metal Finishers (40 CFR Part 433) are currently under review. EPA is also currently developing effluent guidelines and standards for the metal products and machinery industry (Phase II, 40 CFR Part 438), which are Scheduled to be finalized by December 1999. It is likely that EPA will integrate new regulatory options for metal finishing industry processes into this guideline.

The Effluent Guidelines and Standards for the Metal Products and Machinery Category, Phase II, will propose effluent limitation guidelines for facilities that generate wastewater while processing metal parts, metal products and machinery, including: manufacture, assembly, rebuilding, repair, and maintenance. The Phase II regulation will cover eight major industrial groups, including: motor vehicles, buses and trucks, household equipment, business equipment, instruments, precious and nonprecious metals, shipbuilding, and railroads. The court-ordered deadline is December 31, 1997.

Clean Air Act (CAA)

In addition to the CAA requirements discussed above, EPA is currently working on several regulations that will directly affect the metal finishing portion of the motor vehicle manufacturing industry. Many proposed standards will limit the air emissions from various industries by proposing Maximum Achievable Control Technology (MACT) based performance standards that will set limits on emissions based upon concentrations of pollutants in the waste stream. Various potential standards are described below.

Organic Solvent Degreasing/Cleaning

EPA has also proposed a NESHAP (58 FR 62566, November 19, 1993) for the source category of halogenated solvent degreasing/cleaning that will directly affect the metal finishing industry. This will apply to new and existing organic halogenated solvent emissions to a MACT-equivalent level, and will apply to new and existing organic halogenated solvent cleaners (degreasers) using any of the HAPs listed in the CAA Amendments. EPA is specifically targeting vapor degreasers that use the following HAPs: methylene chloride, perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and chloroform.

This NESHAP proposes to implement a MACT-based equipment and work practice compliance standard. This would require that a facility use a designated type of pollution prevention technology along with proper operating procedures. EPA has also provided an alternative compliance standard. Existing operations, which utilize performance-based standards, can continue if they reach the same limit as the equipment and work practice compliance standard.

Steel Pickling, HCl

Hydrochloric acid (HCl) and chlorine are among the pollutants listed as hazardous air pollutants in Section 112 of the Clean Air Act Amendments of 1990. Steel pickling processes that use HCl solution and HCl regeneration processes have been identified by the EPA as potentially significant sources of HCl and chlorine air emissions and, as such, a source category for which national emission standards may be warranted. EPA is required to promulgate national emission standards for 50 percent of the source categories listed in Section 112(e) by November 15, 1997. EPA plans to promulgate this standard by September 30, 1996.

VI.C.2. Motor Vehicle Painting/Finishing

Clean Air Act (CAA)

The 1990 CAAA identified a number of ozone non-attainment areas throughout the U.S. and gave those States most affected by high VOC emissions until November 1993 to develop implementation plans to combat the problem. The legislation further required that States reduce VOCs by 15 percent by 1996 and that States with extreme problems reduce emission an additional three percent each year following. Although State VOC limits have been established, national limits have not. A national rule on VOC limits is likely to come next year.

VOCs are one of the primary emissions from the automotive painting/finishing process and come from common paint solvents. Though no standards are currently proposed, industry officials are making their thoughts known. According to Ron Hilovsky, manager of regulatory affairs for PPG Fleet Finishes, as stated in an August 1994 article in Heavy Duty Trucking entitled "You Can Breath Easier, " national limits will effectively eliminate lacquer products and systems.

According to Heavy Duty Trucking, limits for paints and finishes are likely to be based on the pounds of VOCs released per gallon. Most topcoats have VOC levels of 5.5 lbs/gallon or more. New limits on VOCs are likely to be as follows:

- Pretreat/wash primer - 6.5 lbs./gallon

R0076332

- Primer/primer surfacer - 4.6 lbs./gallon
- Primer sealer - 4.6 lbs./gallon
- Topcoats (including single-stage solids and metallics and basecoat/clearcoat) - 5.0 lbs./gallon
- Tri and quad coat basecoat/clearcoat - 5.2 lbs./gallon
- Specialty coatings - 7.0 lbs./gallon.

VI.C.3. Motor Vehicle Dismantling/Shredding

According to AAMA, future U.S. regulatory activity affecting the vehicle recycling process, if it occurs at all, is likely to aim at improving the efficiency of the existing and already successful market infrastructure. For example, it may promote:

- Common definitions and terms
- Market incentives for the use of recycled materials, and
- Common standards for operating dismantling and shredding facilities

R0076333

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[2] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit,

---

2 EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

R0076335

compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100% because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Motor Vehicles and Motor Vehicle Equipment Compliance History

Exhibit 26 provides a Regional breakdown of the five year enforcement and compliance activities for the automobile industry. Of 2,734 total inspections performed during the five-year period, 1,255 (46 percent) were conducted in Region V. This large percentage is due to the concentration of automobile manufacturers in the Great Lakes Region.

Exhibit 26
Five Year Enforcement and Compliance Summary for the Motor Vehicle Assembly Industry

A	B	C	D	E	F	G	H	I	J
Motor Vehicle Assembly SIC 37	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	9	8	27	20	4	12	58%	42%	0.44
Region II	21	18	84	15	7	28	71%	29%	0.33
Region III	38	25	248	9	6	16	94%	6%	0.06
Region IV	131	91	619	13	13	65	97%	03%	0.11
Region V	284	182	977	17	34	69	75%	25%	0.07
Region VI	29	16	82	21	5	10	70%	30%	0.12
Region VII	47	34	144	20	7	23	62%	48%	0.16
Region VIII	8	4	9	53	1	1	100%	0%	0.11
Region IX	25	7	18	83	3	16	94%	6%	0.89
Region X	6	5	8	45	0	0	—	—	n/a
Total/Average	598	390	2216	16	81	240	80%	20%	0.11

R0076339

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 27-30 contain summaries of the one and five year enforcement and compliance activities for the motor vehicles and motor vehicle equipment industry, as well as for other industries. As shown in exhibits 27 and 28, the automotive industry has a moderately high enforcement to inspection rate when compared to other industries. Exhibits 29 and 30 provide a breakdown of inspection and enforcement activities by statute. Of all the automotive facilities inspected, approximately 54 percent were performed under RCRA and 33 percent under CAA. The large percentages of CAA and RCRA inspections for this industry are due to the high levels of VOC emissions released during solvent-intensive manufacturing processes. The low number of CWA inspections is fairly surprising due the large quantities of water used during metal finishing and painting/finishing processes.

Exhibit 27
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Motor Vehicle Assembly	**598**	**390**	**2,216**	**16**	**81**	**240**	**80%**	**20%**	**0.11**
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 28
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 29
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

Exhibit 30
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

R0076344

VII.C. Review of Major Legal Actions

As indicated in EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992,* and *FY 1993* publications, eight significant enforcement cases were resolved between 1991 and 1993 for the motor vehicle industry. Two of these cases involved CAA violations, two were comprised of CERCLA violations, while the other four involved one RCRA, one TSCA, one CWA, and one action involving violations of multiple statutes. The companies against which the cases were brought are primarily motor vehicle and motor vehicle parts manufacturers.

VII.C.1. Review of Major Cases

This section provides summary information about major cases that have affected this sector. Four of the eight cases resulted in the assessment of a civil penalty. Penalties ranged from $50,000 to $1,539,326, and the average civil penalty paid was $691,965. In three cases, the defendant was required to spend additional money to improve production processes or technologies, and to increase further compliance. For example, in U.S. v. General Motors Corporation (1991), a consent decree was entered requiring GM to install a coating system that reduces VOCs from its paint shop operations from approximately 3,400 tons per year to 750-800 tons per year. GM also paid a civil penalty of $1,539, 326.

A Supplemental Environmental Project (SEP) was required in one of the cases. The settlement in In the Matter of the Knapheido Manufacturing Co., includes SEPs to partially offset the $428,533 penalty. The initial SEP requires performance of an environmental compliance audit, which will identify and propose additional SEPs as binding commitments.

In U.S. v. Raymark Industries, Inc. (1991), the Department of Justice filed a civil complaint requesting that the court order the company to study and perform corrective action at its facility in Stratford, CT. Raymark had manufactured automobile brakes and friction products at this 34-acre facility and had disposed of its hazardous wastes (principally lead-asbestos wastes and dust) onsite. In some areas, this lead-asbestos fill is 17 feet deep. The complaint requests that the court order Raymark to comply with an administrative order issued by EPA in 1987, pursuant to §3031 of RCRA, which instructs the company to study its site in order to ascertain the nature and extent of the hazard created by the presence and release of hazardous waste. Raymark has failed to comply with the terms of the order. Based on the results of this study, the complaint also requests that Raymark be ordered to carry out a corrective action plan as approved by EPA.

In U.S. v. Chrysler Corporation et. al. (1993), the court entered a CERCLA consent decree under which the settling defendants will clean up the PCB contamination at the Cater Industrials Superfund site in Detroit, Michigan and pay about $3 million in past costs. The total cost of the cleanup is estimated to be $24 million Settling defendants include Chrysler, Ford, GM, Michigan's two public utilities, and the City of Detroit. Unusual features of the decree include provisions for EPA to perform some of the work, and a special covenant not to sue in accordance with §122(f)(2) of CERCLA.

VII.C.2. Supplemental Environmental Projects

Below is list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. Exhibit 31 contains a sample of the Regional responses addressing the automotive industry. The information contained in the chart is not comprehensive and provides only a sample of the types of SEPs developed for the automotive industry.

Exhibit 31
Supplemental Environmental Projects
Motor Vehicle Assembly Industry (SIC 37)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Ford Motor Company St. Paul, MN	5	TSCA	Pollution Reduction	$ 35,000	Remove and destroy a PCB transformer and replace it with a non-PCB transformer to reduce the risk of discharge of PCBs into the environment.	$ 26,000	$ 10,100

R0076347

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

The automotive industry is involved in numerous sector-related environmental activities. Some of these efforts are highlighted below.

Common Sense Initiative

The Common Sense Initiative (CSI), a partnership between EPA and private industry, aims to create environmental protection strategies that are cleaner for the environment and cheaper for industry and taxpayers. As part of CSI, representatives from Federal, State, and local governments; industry; community-based and national environmental organizations; environmental justice groups; and labor organizations, come together to examine the full range of environmental requirements affecting the following six selected industries: automobile manufacturing; computers and electronics, iron and steel, metal finishing, petroleum refining, and printing.

CSI participants are looking for solutions that:

- Focus on the industry as a whole rather than one pollutant
- Seek consensus-based solutions
- Focus on pollution prevention rather than end-of-pipe controls
- Are industry-specific.

The Common Sense Initiative Council (CSIC), chaired by EPA Administrator Browner, consists of a parent council and six subcommittees (one per industry sector). Each of the subcommittees have met and have identified issues and project areas for emphasis, and workgroups have been established to analyze and make recommendation on these issues.

EPA/Auto Protocol

Procedures for assessing compliance during automobile painting and finishing operations were first outlined in a December 1988 EPA publication entitled, Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations, (EPA-450/3-88-018). This document, which is referred to as the EPA/Auto Protocol, contains information on recordkeeping, testing, and compliance calculation procedures. The Protocol has been used to demonstrate compliance with emission limits for topcoat and spray primer/surface coating activities.

EPA and AAMA have discussed and hope to update the protocol. AAMA hopes to have an automotive spraybooth capture efficiency procedure as well as some acceptable spraybooth/oven split test modifications for in-plant simulation incorporated into the protocol as a technical update.

Research

The American Industry/Government Emissions Research Cooperative Research and Development Agreement (AIGER CRADA)

AIGER CRADA was officially launched in October 1992. The founding members - U.S. EPA, the California Air Resources Board, and USCAR's Environmental Research Consortium - came together to identify, encourage, evaluate, and develop the instrumentation and techniques needed to accurately and efficiently measure emissions from motor vehicles as required by the Clean Air Act and the California Health and Safety Code. This effort will help ensure that technologies are commercialized and available to emissions testing facilities.

Partnership For A New Generation Of Vehicles

Partnership For A New Generation Of Vehicles (PNGV), one of several research consortia under USCAR, is a partnership between domestic automotive manufacturers and the Federal government. The partnership is aimed at strengthening U.S. competitiveness by expanding the industry's technology base. Research will be performed in the following three areas:

- Advanced manufacturing techniques to make it easier to get new product ideas to the marketplace quickly;

R0076349

- Technologies leading to near-term improvements in automobile efficiency, safety, and emissions; and
- Research leading to production prototypes of a vehicle capable of up to three times current fuel efficiency.

President's Council on Sustainable Development - Eco-Efficiency Task Force

The purpose of the Eco-Efficiency Task Force is to develop and recommend to the President's Council on Sustainable Development a strategy for making eco-efficiency and sustainable development standard business practices in American industry. The Task Force will highlight how changes in economic, regulatory, statutory, and other policies will encourage industry to become more aware of the interdependence among environmental, economic, and social well-being, and recommend policies effective in promoting sustainable business practices. The Task Force is sub-divided into five Eco-Efficiency Task Force Teams: Autos Team; Chemicals Sector Team; Eco-Industrial Park Team; Policy Team; and Printers/Small Business Team. The three goals of the Auto Team are to recommend ways to:

- Improve the "eco-efficiency" of automobile manufacturing by making pollution prevention, waste reduction, and product stewardship standard business practices
- Improve the system of environmental policy and regulation affecting automobile manufacturing
- Improve the sustainability of road-based transportation.

As part of its efforts, the Auto Team is collecting information on the "life cycle" analysis of automobile painting operations at a GM assembly plant. The team is also collecting data from the paint and pigment industry, the steel, plastics, and aluminum manufacturing industries, as well as the auto repainting industry. The project will assess the environmental, energy, and economic implications of various auto body material/coating choices such as solvent, water, or powder. The Task Force is expected to deliver its findings in late 1995.

Outreach and Education Activity

Pollution Prevention and Waste Minimization in the Metal Finishing Industry Workshop

The University of Nebraska-Lincoln sponsored a *Pollution Prevention and Waste Minimization in the Metal Finishing Industry* workshop in 1993. The workshop was designed for managers and operators of electroplating and galvanizing operations; engineers; environmental consultants; waste management consultants; Federal, State, and local government officials; and individuals responsible for training in the area of metal finishing waste management. Topics covered:

- Saving money and reducing risk through pollution prevention and waste minimization;
- Incorporating pollution prevention into planning electroplating and galvanizing operations;
- Conducting waste minimization audits;
- Developing and analyzing options for pollution prevention/waste minimization; and
- Implementing a pollution prevention/waste minimization program.

For more information concerning this workshop, contact David Montage of the University of Nebraska at W348 Nebraska Hall, Lincoln, NE 68588-0531.

Hazardous Waste Management for Small Business Workshop

The University of Northern Iowa, with support from U.S. EPA, Des Moines Area Community College, Northeast Iowa Community College, Scott Community College, and Indiana Hills Community College, sponsored a *Hazardous Waste Management for Small Business* workshop. This workshop was geared for small businesses and was intended to provide practical answers to environmental regulatory questions. Small businesses covered by the workshop include: manufacturers, vehicle maintenance and repair shops, printers, machine shops, and other businesses that generate potentially hazardous waste. Topics covered included: hazardous waste determination, waste generator categories, management of specific common waste streams, including used oil and solvents, and pollution prevention. For more information regarding workshop, contact Duane McDonald (319) 273-6899.

Environmentally Conscious Painting Workshop

Kansas State University, NIST/Mid-America Manufacturing Technology Center, Kansas Department of Health & Environment, EPA Region VII, Allied Signal, Inc., Kansas City Plant, and the U.S. Department of Energy sponsored the *Environmentally Conscious Painting* workshop. This workshop covered topics such as upcoming regulations and the current regulatory climate, methods to cost-effectively reduce painting wastes and emissions, and alternative painting processes. For more information regarding this workshop, contact the Kansas State University Division of Continuing Education (913) 532-5566.

Pollution Prevention Workshop for the Electroplating Industry

Kansas State University Engineering Extension, EPA Region VII, Kansas Department of Health and Environment, and the University of Kansas sponsored the *Pollution Prevention Workshop for the Electroplating Industry*. The workshop described simple techniques for waste reduction in the electroplating industry, including: plating, rinsing processes and wastewater, wastewater management options, metals recovery options, waste treatment and management, and product substitutions and plating alternatives. For more information regarding this workshop, contact the Kansas State University Division of Continuing Education at (800) 432-8222.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who met their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

Sixty-six companies listed under SIC 37 (transportation) are currently participating in the 33/50 program. They account for approximately 20 percent of the 405 companies under SIC 37, which is slightly higher than the average for all industries of 14 percent participation. It should be noted, however, that the two digit SIC 37 covers a large number of small firms performing numerous manufacturing processes. (Contact: Mike Burns (202) 260-6394 or the 33/50 Program (202) 260-6907)

Exhibit 32 lists those companies participating in the 33/50 program that reported under SIC code 37 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to the motor vehicle assembly industry. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 32
Motor Vehicle Assembly Facilities Participating in the 33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
American Honda Motor Co., Inc.	Torrance	CA	3711	2	3,254,180	*
Chrysler Corporation	Highland Park	MI	3711	8	5,623,717	80
Ford Motor Company	Dearborn	MI	3465, 3711	19	15,368,032	15
General Motors Corporation	Detroit	MI	3711	23	16,751,198	*
Harsco Corporation	Camp Hill	PA	3711, 3713	1	415,574	**
Navistar International Corp.	Chicago	IL	3711	1	180,834	*
New United Motor Manufacturing	Fremont	CA	3711	1	420,125	**
Northrop Grumman Corp.	Los Angeles	CA	3711	1	2,357,844	35
Superior Coaches	Lima	OH	3711	1	87,900	44

*** = not quantifiable against 1988 data.**
**** = use reduction goal only.**
***** = no numerical goal.**

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director (202) 564-5081 or Robert Fentress (202) 564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at (202) 233-9065 or the Green Light/Energy Star Hotline at (202) 775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn (202) 260-0700 or the WasteWi$e Hotline at (800) 372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman (202) 260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and

R0076355

increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office (303) 275-4729)

VIII.C. Trade Associations/Industry Sponsored Activity

As one of the most highly regulated industries in the U.S., the automotive industry is constantly forced to identify and develop new ways to produce motor vehicles and motor vehicle parts more efficiently and with less waste. In an effort to pool resources, three manufacturers have formed a partnership to promote pollution prevention initiatives. Information is also provided on the various trade associations which support the industry.

VIII.C.1. Environmental Programs

Automobile Pollution Prevention Project (Auto Project)

Auto Project is a voluntary partnership between the Big Three automobile manufactures and the State of Michigan (on behalf of eight Great Lakes States and the U.S. EPA) to promote pollution prevention. Initiated on September 24, 1991, Auto Project is the first public/private initiative focused specifically on the environmental impacts resulting from automobile manufacturing. Auto Project is administered by the American Automobile Manufacturers Association (AAMA) and the Michigan Department of Natural Resources (MDNR). The purpose of the project is to:

- Identify Great Lakes Persistent Toxic (GLPT) substances and reduce their generation and release
- Advance pollution prevention within the auto industry and its supplier base
- Reduce releases of GLPT substances beyond regulatory requirements
- Address regulatory barriers that inhibit pollution prevention.

A progress report released in February 1994 states that significant accomplishments have been achieved in the last two years and that releases of the listed GLPT substances by auto companies have been cut by 20.2 percent in the first year of the Auto Project. Other accomplishments of Auto Project include:

- Developed criteria for identification of GLPT substances

- Identified 65 GLPT substances based on the criteria
- Provided highlights of historical pollution prevention efforts
- Established priorities and identified opportunities to reduce the generation and release of the listed substances
- Provided pollution prevention case study information for technology transfer to auto suppliers and other companies
- Established a pilot program to identify and reduce regulatory barriers to pollution prevention actions.

In October 1993 a comprehensive evaluation of the first two years of the Auto Project was conducted by members of the Great Lakes environmental community. Results of the evaluation were documented in a 1993 report entitled *So Much Promise, So Little Progress - An Evaluation of the State of Michigan/Auto Industry Great Lakes Pollution Prevention Initiative* written by the Ann Arbor, Michigan Ecology Center. The report concludes that although still promising, Auto Project has been mostly unsuccessful. The Great Lakes environmental groups claimed the following:

- Auto companies have not conducted the promised surveys of pollution generated by individual plants and manufacturing processes
- Auto companies have initiated few new pollution prevention projects
- Auto company suppliers, who account for more toxic releases than the auto companies themselves, have not been brought into the project
- Stakeholders (environmental groups and labor) have not had adequate opportunities to participate
- Auto companies have yet to establish clear goals or timetables for eliminating toxic substances from their processes.

VIII.C.2. Summary of Trade Associations

Trade Associations

Automotive Manufacturers

American Automobile Manufacturers Association (AAMA) 1401 H Street, NW, Suite 900 Washington, DC 20005 Phone: (202) 326-5500 Fax: (202) 326-5567	Members: 3 Staff: 100 Budget: $14,000,000 Contact: Andrew H. Card, Jr.

Founded in 1913, AAMA, formerly the Motor Vehicle Manufacturers Association, represents manufacturers of passenger and commercial cars, trucks, and buses to improve vehicle safety, reduce air pollution, and assist in long-term energy conservation objectives. This association compiles statistics, disseminates information, and conducts research programs and legislative monitoring on Federal and State levels. AAMA also maintains patents and communications libraries, and publishes the following annual documents: *Motor Vehicle Facts and Figures, Motor Vehicle Identification Manual,* and *World Motor Vehicle Data Book.*

Association of International Automobile Manufacturers (AIAM) 1001 19th Street, North, Suite 1200 Arlington, VA 22209 Phone: (703) 525-7788 Fax: (703) 525-3289	Members: 35 Budget: $4,200,000 Contact: Phillip Hutchinson

Founded in 1964, AIAM represents companies that manufacture automobiles or automotive equipment and that import into, or export from, the United States. This association acts as a clearinghouse for information, especially with regard to proposed State and Federal regulations in the automobile industry as they bear on imported automobiles, and reports proposed regulations by State or Federal governments pertaining to equipment standards, licensing, and other matters affecting members. AIAM publishes materials on State and Federal laws, regulations, and standards.

American Foundrymen's Society (AFS) 505 State Street Des Plaines, IL 60016 Phone: (708) 824-0181 Fax: (708) 824-7848	Members: 13,500 Staff: 52 Contact: Ezra L. Kotzin

Founded in 1896, AFS represents foundrymen, patternmakers, technologists, and educators and sponsors foundry training courses through the Cast Metals Institute on all subjects pertaining to the castings industry. The Society conducts educational and instructional activities on the foundry industry and sponsors ten regional foundry conferences and 400 local foundry technical meetings. AFS maintains the Technical Information Center, a literature search and document retrieval service, and the Metalcasting Abstract Service, which provides abstracts of the latest metal casting literature. In addition to providing environmental services and testing, AFS publishes *Modern Casting* (monthly), which covers current technology practices and other influences affecting the production and marketing of metal castings.

Automotive Presidents Council (APC) 1325 Pennsylvania Avenue, NW, 6th Floor Washington, D.C. 20004 Phone: (202) 393-6362 Fax: (202) 737-3742	Members: 50 Contact: Christopher Bates

Founded in 1966, APC represents presidents and chief executive officers of leading manufacturing companies producing automotive parts, equipment, accessories, tools, paint, and refinishing supplies. This council provides a forum in which chief executives can discuss areas of mutual interest or top management problems, share ideas, and exchange solutions.

Automotive Parts and Equipment

Automotive Parts and Accessories Association (APAA) 4600 East West Highway, Suite 300 Bethesda, MD 20814 Phone: (301) 654-6664 Fax: (301) 654-3299	Members: 2000 Staff: 26 Budget: $3,000,000 Contact: Lawrence Hecker

Founded in 1967, this association represents automotive parts and accessories retailers, distributors, manufacturers, and manufacturers' representatives. APAA conducts research, compiles statistics, conducts seminars, provides a specialized education program, and operates a speakers' bureau and placement service. This association publishes *APAA Frontlines* (bimonthly), *APAA Government Report* (periodic), *APAA Tech Service Report* (monthly), *APAA Who's Who* (annual), *APAA Membership Directory* (periodic), *Computer News for the Automotive Aftermarket* (monthly), and *Foreign Buyers Directory* (annual).

Motor and Equipment Manufacturers Association (MEMA) #10 Laboratory Drive P.O. Box 13966 Research Triangle Park, NC 27709-3966 Phone: (919) 549-4800 Fax: (919) 549-4824	Members: 750 Staff: 62 Budget: $3,500,000 Contact: Robert Miller

Founded in 1904, MEMA represents manufacturers of automotive and heavy-duty original equipment and replacement components, maintenance equipment, chemicals, accessories, refinishing supplies, tools, and service equipment. This organization provides the following manufacturer-oriented services: marketing consultation; Federal and State legal, safety, and legislative representation and consultation; personnel services; and manpower development workshops. In addition, MEMA conducts seminars on domestic and overseas marketing, Federal trade regulations, freight forwarding, and credit and collection. This association publishes the following documents: *Automotive Distributor Trends and Financial Analysis* (periodic), *Credit and Sales Reference Directory* (semiannual), *International Buyer's Guide of U.S. Automotive and Heavy Duty Products* (Biennial), *Marketing Insight* (quarterly), and *Autobody Supply and Equipment Market.*

Finishing and Dismantling

Paint, Body, and Equipment Association (PBEA) c/o Martin Fromm and Associates 9140 Ward Parkway, Suite 200 Kansas City, MO 64114 Phone: (816) 444-3500 Fax: (816) 444-0330	Members: 100 Staff: 6 Contact: Barbara Aubin

Founded in 1975, PBEA represents warehouse distributors and manufacturers specializing in the automotive paint, body, and equipment field. This organization conducts management seminars and publishes an annual *Membership Directory* and a bimonthly *Newsletter*.

R0076360

Automotive Recyclers Association (ARA) 3975 Fair Ridge Drive 320 Terrace Level North Fairfax, VA 22033 Phone: (703) 385-1001 Fax: (703) 385-1494	Members: 5,500 Staff: 12 Budget: $1,100,000 Contact: William Steinkuller

Founded in 1943, ADRA represents firms that sell used auto, truck, motorcycle, bus, farm, and construction equipment parts, as well as firms that supply equipment and services to the industry. This organization seeks to improve industry business practices and operating techniques through information exchange via meetings and publications, including *ADRA Newsletter* (monthly), *Automotive Recycling* (bimonthly), and *Industry Survey* (biennial).

IX. CONTACTS/ACKNOWLEDGMENTS/ RESOURCE MATERIALS/BIBLIOGRAPHY

General Profile

AAMA Motor Vehicle Facts & Figures '93, Government Affairs Division, The American Automobile Manufacturers Association, 1993.

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc., Detroit, Michigan, 1992.

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Industry & Trade Summary, Official Statistics of the U.S. Dept. of Commerce, USITC Publication 2751 "Certain Motor Vehicle Parts & Accessories" March 1994.

Metalcasting Makes America Strong, American Foundrymen's Society, Inc., 1994.

Recycling Old Vehicles: Its Everybody's Business, American Automobile Manufacturers Association.

The Real Climate of the Auto Industry, David E. Cole and Michael S. Flynn, *The Detroiter,* December 1992.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

UMTRI Research Review: Delphi VII - Forecast and Analysis of the North American Automotive Industry, University of Michigan Transportation Research Institute, Volume 24, Number 5, March-April 1994.

U.S. Industrial Outlook 1994, Department of Commerce.

U.S. Global Trade Outlook, 1995-2000, Towards the 21st Century. Department of Commerce. March 1995.

1987 Census of Manufacturers, Industry Series: Motor Vehicles and Equipment, Bureau of the Census, (MC87-I-37A).

1992 Census of Manufacturers, Industry Series: Motor Vehicles and Equipment Bureau of the Census. Bureau of the Census, (MC82-I-37A).

Process Description

Changing Casting Demands Shape Ford's New Foundry, David P. Kanicki, *Modern Casting,* September 1994.

Gene Prashan, American Automobile Manufacturers Association, October 1994.

Hot Dip Galvanized Coatings, American Society for Metals Committee on Hot Dip Galvanized Coatings, Metals Handbook, 9th Edition, Volume 5.

Machining, American Society for Metals, Metals Handbook: 9th Edition, Volume 16, 1989.

Making the Car, American Automobile Manufacturers Association, January 1992.

McGraw-Hill Encyclopedia of Science & Technology, 6th ed., vols. 5, 6, 11, 13, 14, 16, 18, 19, McGraw-Hill Book Company, New York, New York, 1987.

Properties and Selection: Stainless Steels, Tool Materials and Special Purpose Materials, American Society for Metals, Metals Handbook, 9th Edition, Volume 3, 1980.

Selection of Cleaning Process Metals, American Society for Metals Committee on Selection of Cleaning Process, Handbook, 9th Edition.

Surface Cleaning, Finishing, and Coating, American Society for Metals, Metals Handbook: 9th Edition, Volume 5, 1982.

Regulatory Profile

Environmental Regulation and Control in US Foundries, J.T. Radia, BCIRA International Conference, 1993.

EPA OPPTS Title III Section 313 Release Reporting Guidance: Estimating Chemical Releases from Electroplating Operations, 1988.

Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards, EPA/Effluent Guidelines Division and Permits Division, 1984.

The U.S. Auto Industry 2000: Plastic Application Issues from an Industry Perspective, Society of Plastic Engineers, 1992.

You Can Breath Easier, Andrew Ryder, *Heavy Duty Trucking,* August 1994.

Pollution Prevention

Automotive Pollution Prevention Progress Report, American Automobile Manufacturers Association and The State of Michigan, February 1994.

General Motors Environmental Report, 1994.

Minnesota Technical Assistance Program Checklists for Identifying Waste Reduction Opportunities.

Pollution Prevention at General Motors, Sandra S. Brewer, P.N. Mishra Ph.D., O. Warren Underwood, and Todd Williams, General Motors Corporation, Detroit, Michigan, 1995.

Pollution Prevention In Metal Manufacturing: Saving Money Through Pollution Prevention, EPA, OSW, October 1989.

Pollution Prevention Options In Metal Fabricated Products Industries: A Bibliographic Report, EPA, OPPT, January 1992.

So Much Promise, So Little Progress - An Evaluation of the State of Michigan/Auto Industry Great Lakes Pollution Prevention Initiative, Chanes Griffith and Rober Ginsburg Ph.D., On behalf of the Michigan Environmental Council, October 1993.

Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, EPA, OPPE, June 1994.

Toxic Chemical Release Inventory: Clarification and Guidance for the Metal Fabrication Industry, EPA, OTS, 1990.

Contacts

Contacts*	Organization	Telephone
Carol Kemker	Region IV	(404) 347-3555
John Lank	Region IV	(404) 347-7603

* Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Contacts*	Organization	Telephone
Paul Novak	Region V	(216) 522-7260
Kurt Hildebrandt	Region VII	(913) 551-7413
David Cole	University of Michigan Transportation Research Institute (UMTRI) Office for the Study of Automotive Transportation (OSAT)	(313) 764-2171
	Automotive Parts and Accessories Association (APAA)	(301) 654-6664
	Motor and Equipment Manufacturers Association (MEMA)	(919) 549-4824
	American Automobile Manufacturers Association (AAMA)	(313) 872-4311
Ellen Shapiro	AAMA	(202) 326-5549
Larry Slimack	AAMA	(313) 871-5340
Gene Praschan	AAMA	(919) 361-0210
	American Foundrymen's Society, Inc, (AFS)	(800) 537-4237
Ezra L. Kotzin	AFS	(708) 824-0181
Chris Richter	AFS	(202) 842-4864
David Carelson	Chrysler Corp.	(810) 576-4876
Connie Pell	Chrysler Corp.	(810) 476-5502
Sandy Brueher	General Motors Corp.	(313) 556-7625
Lee Hachigian	General Motors Corp.	(313) 556-7658
Mike Swartz	Ford Motor Corp.	(313) 594-2492
Amy Lilly	AIAM, Director of Plant. Operations	(703) 525-7788

* Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy!

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Order Processing Code:
* 3212

Qty.	Stock Number	**Published in 1995** Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	**Published in 1997** Title	Price Each	Total Price
	055–000–00570–2	Air Transportation Industry, 90 pages	$ 7.50	
	055–000–00571–1	Ground Transportation Industry, 130 pages	10.00	
	055–000–00572–9	Water Transportation Industry, 90 pages	7.50	
	055–000–00573–7	Metal Casting Industry, 150 pages	13.00	
	055–000–00574–5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055–000–00575–3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055–000–00576–1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055–000–00577–0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055–000–00578–8	Textile Industry, 130 pages	10.00	
	055–000–00579–6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account ______ – __

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0076367

EPA

United States
Environmental Protection Agency
(2221A)
Washington DC 20460

United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2221A)

EPA 310-R-95-010
September 1995

EPA

Profile Of The Nonferrous Metals Industry

SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-95-010

EPA Office of Compliance Sector Notebook Project

Profile of the Nonferrous Metals Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048277-1

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph courtesy of Reynolds Aluminum Recycling Company, Richmond, Virginia. Special thanks to Terry Olbrysh for providing photographs.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

NONFERROUS METAL INDUSTRIES
(SIC 333-334)
TABLE OF CONTENTS

Page

R0076374

NONFERROUS METAL INDUSTRIES
(SIC 333-334)
TABLE OF CONTENTS (CONT'D)

Page

R0076375

NONFERROUS METAL INDUSTRIES
(SIC 333-334)
TABLE OF CONTENTS (CONT'D)

Page

NONFERROUS METALS INDUSTRY (SIC 333-334) EXHIBITS INDEX

NONFERROUS METALS INDUSTRY
(SIC 333-334)
EXHIBITS INDEX (CONT'D)

NONFERROUS METALS INDUSTRY
(SIC 333-334)
LIST OF ACRONYMS

AFS - AIRS Facility Subsystem (CAA database)
AIRS - Aerometric Information Retrieval System (CAA database)
BIFs - Boilers and Industrial Furnaces (RCRA)
BOD - Biochemical Oxygen Demand
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CO - Carbon Monoxide
COD - Chemical Oxygen Demand
CSI - Common Sense Initiative
CWA - Clean Water Act
D&B - Dun and Bradstreet Marketing Index
ELP - Environmental Leadership Program
EPA - United States Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
HAPs - Hazardous Air Pollutants (CAA)
HSDB - Hazardous Substances Data Bank
IDEA - Integrated Data for Enforcement Analysis
LDR - Land Disposal Restrictions (RCRA)
LEPCs - Local Emergency Planning Committees
MACT - Maximum Achievable Control Technology (CAA)
MCLGs - Maximum Contaminant Level Goals
MCLs - Maximum Contaminant Levels
MEK - Methyl Ethyl Ketone
MSDSs - Material Safety Data Sheets
NAAQS - National Ambient Air Quality Standards (CAA)
NAFTA - North American Free Trade Agreement
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NEIC - National Enforcement Investigation Center
NESHAP - National Emission Standards for Hazardous Air Pollutants
NO_2 - Nitrogen Dioxide
NOV - Notice of Violation
NO_X - Nitrogen Oxide
NPDES - National Pollution Discharge Elimination System (CWA)

R0076379

NONFERROUS METALS INDUSTRY (SIC 333-334) LIST OF ACRONYMS (CONT'D)

NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)
OAR - Office of Air and Radiation
OECA - Office of Enforcement and Compliance Assurance
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SPL - Spent Potliner
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
TOC - Total Organic Carbon
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TCRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

NONFERROUS METALS INDUSTRY (SIC 333-334)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a

manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. Introduction to the Nonferrous Metals Industry

This section provides background information on the Nonferrous Metals Industry and the organization of this sector's notebook.

II.A. Introduction and Background of the Notebook

The Standard Industrial Classification (SIC) code 33 is composed of establishments that engage in: the primary and secondary smelting and refining of ferrous and nonferrous metal from ore or scrap; rolling, drawing, and alloying; and the manufacturing and casting of basic metal products such as nails, spikes, wire, and cable. Primary smelting and refining produces metals directly from ores, while secondary refining and smelting produces metals from scrap and process waste. Scrap is bits and pieces of metal parts, bars, turnings, sheets, and wire that are off-specification or worn-out but are capable of being recycled.

Two metal recovery technologies are generally used to produce refined metals. Pyrometallurgical technologies are processes that use heat to separate desired metals from other less or undesirable materials. These processes capitalize on the differences between constituent oxidation potential, melting point, vapor pressure, density, and/or miscibility when melted. Examples of pyrometallurgical processes include drying, calcining, roasting, sintering, retorting, and smelting. Hydrometallurgical technologies differ from pyrometallurgical processes in that the desired metals are separated from undesirables using techniques that capitalize on differences between constituent solubilities and/or electrochemical properties while in aqueous solutions. Examples of hydrometallurgical processes include leaching, chemical precipitation, electrolytic recovery, membrane separation, ion exchange, and solvent extraction.

During pyrometallic processing, an ore, after being concentrated by beneficiation (crushing, washing, and drying) is sintered, or combined by heat, with other materials such as baghouse dust and flux. The concentrate is then smelted, or melted, in a blast furnace in order to fuse the desired metals into an impure molten bullion. This bullion then undergoes a third pyrometallic process to refine the metal to the desired level of purity. Each time the ore or bullion is heated, waste materials are created. Air emissions such as dust may be captured in a baghouse and are either disposed of or returned to the process depending upon the residual metal content. Sulfur is also captured, and when concentrations are above four percent it can be turned into sulfuric acid, a component of fertilizers. Depending upon the origin of the ore and its residual metals content, various metals such as gold and silver may also be produced as by-products.

Production operations under this SIC code are subject to a number of regulations, including those imposed by the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and the Clean Air Act (CAA). A number of RCRA-listed hazardous wastes are produced during primary refining operations which require the heating of ores to remove impurities. Specific pretreatment standards under the CWA apply to the processes associated with copper and aluminum. Lastly, large amounts of sulfur are released during copper, lead, and zinc smelting operations which are regulated under the CAA.

The Department of Commerce classification codes divide this industry by production process. The two-digit SIC code is broken down as follows:

SIC 331	-	Steel Works, Blast Furnaces, and Rolling and Finishing Mills (covered in a separate profile)
SIC 332	-	Iron and Steel Foundries (covered in a separate profile)
SIC 333	-	Primary Smelting and Refining of Nonferrous Metals
SIC 334	-	Secondary Smelting and Refining of Nonferrous Metals
SIC 335	-	Rolling, Drawing, and Extruding of Nonferrous Metals (not covered in this profile)
SIC 336	-	Nonferrous Foundries (castings) (not covered in this profile)
SIC 339	-	Miscellaneous Primary Metal Products (not covered in this profile).

II.B. Organization of the Nonferrous Metals Notebook

SIC 33 is a diverse industrial area which is comprised of many different manufacturing processes. It is because of this diversity of processes and related pollutant issues that this notebook focuses only on SIC 333 and 334; Primary and Secondary Nonferrous Metals Processing. The metals aluminum, copper, lead, and zinc were chosen for inclusion in this profile because they are the four most widely used nonferrous metals in the United States. Where possible, information for the four metals is discussed separately. However, due to the SIC groupings, in many instances data for all four metals and other processes are intermingled. Every effort will be made to highlight where separate information is available and where information concerning more than one of the metals has been intermingled.

The notebook begins with a discussion of the primary and secondary aluminum industries. This discussion is comprised of economic and geographic characterizations of the industries and detailed discussions of the industrial processes involved, including production line raw material inputs and pollution outputs. The following three sections provide the same information for copper, lead, and zinc, respectively. The notebook continues with EPA Toxics Release Inventory data for the nonferrous metals industry. Much of this information is intermingled, but where possible has been separated. The notebook concludes with sections discussing pollution prevention opportunities, pending and proposed regulatory requirements, compliance and enforcement information, and compliance activities and initiatives.

III. PRIMARY AND SECONDARY ALUMINUM PROCESSING INDUSTRY

III.A. Characterization of Industry - Aluminum

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Aluminum Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

III.A.1. Industry Size and Geographic Distribution - Aluminum

The following discussion is based upon the following materials: "Aluminum Know the Facts, July 1994," the Aluminum Association; "Industry & Trade Summary - Aluminum," the U.S. Trade Commission; and "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

In 1993, the majority of primary aluminum producers (SIC 3334) in the U.S. were located either in the Northwest (39.1 percent of U.S. capacity) or the Ohio River Valley (31.1 percent of U.S. capacity), while most secondary aluminum smelters were located in Southern California and the Great Lakes Region. The reason for the difference in plant locations is due to the energy intensive nature of the primary aluminum smelting process and the cost of fuels. Primary smelters are located in the Northwest and Ohio River Valley to take advantage of the abundant supplies of hydroelectric and coal-based energy, while secondary smelters locate themselves near major industrial and consumer centers to take advantage of the large amounts of scrap generated. Secondary smelting uses 95 percent less energy to produce the same product than primary reduction. On the average, a third of primary production costs are attributable to the cost of energy.

The domestic primary aluminum smelting industry consists of 23 smelting facilities operated by 13 firms which employ approximately 20,000. Of the thirteen firms, four integrated producers, Alcoa, Alumax, Reynolds, and Kaiser, accounted for 63 percent of 1993's capacity. The secondary smelting industry operates an estimated 68 plants employing 3,600. These figures have remained stable since 1988 and reflect an industry that emerged strong and competitive following the contractions and restructuring of the early 1980's that were caused by worldwide price swings and supply/demand disequilibrium.

About 40 percent of the domestic supply of aluminum is recovered by secondary refiners (SIC 334) from both purchased new and old aluminum scrap. New scrap is material generated during the fabrication of aluminum products. Old scrap includes products such as aluminum pistons and other aluminum engine or body parts from junked cars, used aluminum beverage cans, doors and siding, and used aluminum foil. In 1993, 2.3 million metric tons (Mmt) of metal, valued at an estimated $3.5 billion, were recovered from both new and old aluminum scrap. Of this total, approximaterly 55 percent was recovered from old scrap. Recycling rates for aluminum beverage containers reached 63 percent (60 billion cans) in 1993, keeping more than two billion pounds of material out of landfills.

III.A.2. Product Characterization - Aluminum

The primary and secondary aluminum industry produces ingots of pure (greater than 99 percent) aluminum that serve as feedstock for other materials and processes. Within the U.S., the leading end-users of aluminum come from three industries; containers and packaging, transportation, and building and construction. In 1993, demand from the three industries accounted for an estimated 60 percent of the eight Mmt of aluminum ingot and semifabricated products produced, with containers and packaging alone accounting for more than 25 percent of total shipments. Examples of materials produced with aluminum are: sheet metal; aluminum plate and foil; rod, bar, and wire; beverage cans, automobiles, aircraft components, and window/door frames.

III.A.3. Economic Trends - Aluminum

The amount of aluminum a plant could produce if working at engineered (full) capacity held steady in 1993. This was due to two factors: reduced hydroelectric supplies in the Northwest and falling aluminum prices. Hydroelectric supplies were reduced in the Northwest due to drought. Prices for primary aluminum fell to record-lows in 1993 despite a slight global increase in demand, due in large part to a flood of exports from the former Soviet republics.

U.S. aluminum shipments increased 12 percent in 1994, based on increased demands in the beverage can stock and transportation sectors. At present, the automotive sector is the largest end-user. The next largest end-user is the beverage can stock.

R0076388

Automotive use of aluminum is expected to sky-rocket as the sector increases its use of aluminum to increase fuel efficiency. Chrysler Corporation may begin building an aluminum-intensive car in 1996, employing 600-700 pounds of aluminum per car. The reduction in weight for a midsize vehicle would cut gasoline consumption by one gallon for each 100 miles driven.

III.B. Industrial Process Description - Aluminum

This section describes the major industrial processes within the Primary and Secondary Aluminum industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section XII for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

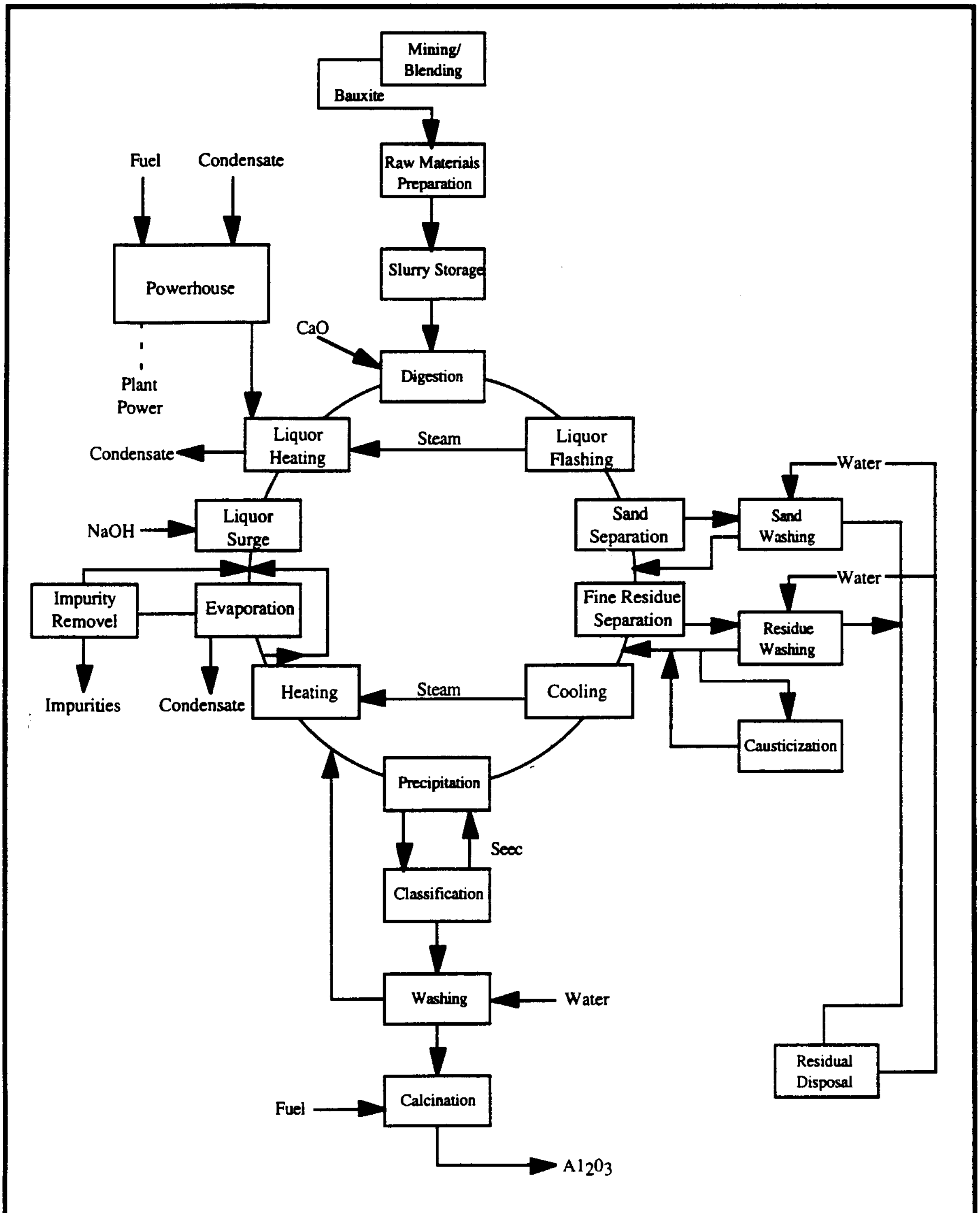
III.B.1. Industrial Processes in the Primary and Secondary Aluminum Industry

The following discussion is based in part upon the following documents: "Background Listing Document for K088," and AP42 from the U.S. Environmental Protection Agency, and materials provided by The Aluminum Association, Incorporated.

Primary Aluminum Processing

Primary aluminum producers generally employ a three step process to produce aluminum alloy ingots. First, alumina is extracted from bauxite ore using the Bayer process (See Exhibit 1). In the Bayer process, finely crushed bauxite is mixed with an aqueous sodium hydroxide (caustic soda) solution to form a slurry. The slurry is then reacted at a high temperature under steam pressure in a vessel known as a digester, and creates a mixture of dissolved aluminum oxides and bauxite residues. During the reaction a majority of the impurities such as silicon, iron, titanium, and calcium oxides drop to the bottom of the digester and form a sludge. The remaining sodium aluminate slurry is then flash cooled by evaporation and sent for clarification. During clarification, agents such as starch are added to help any fine impurities that remain in the slurry, such as sand, to drop out, further purifying the sodium aluminate solution. The solution is then fed into a precipitation tank to be crystallized. In the precipitator the solution is allowed to cool with the addition of a small amount of aluminum hydroxide "seed." The seed stimulates the precipitation of solid crystals of aluminum hydroxide and sodium hydroxide.

Exhibit 1 - Bayer Process (Alumina Refining)



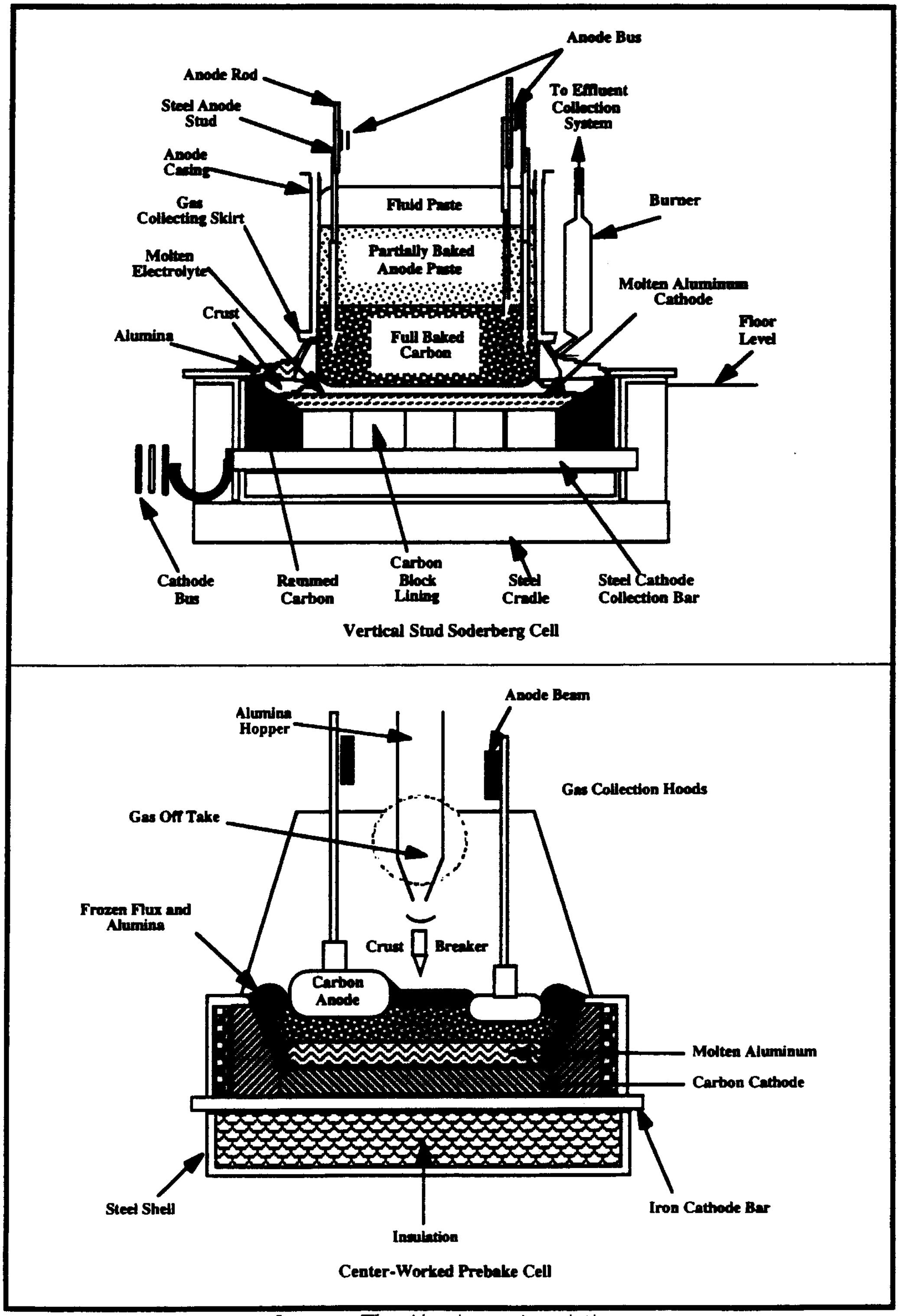
Source: *Air Pollution Engineering Manual*, *Anthony J. Buonicore and Wayne T. Davis, ed., Air & Waste Management Association, Van Norstrand Reinhold.*

R0076391

The aluminum hydroxide crystals settle to the tank bottom, and are removed. The crystals are then washed to remove any caustic soda residues, vacuum dewatered, and sent on for calcination. In the calciners (a type of rotating kiln) the aluminum hydroxide is roasted for further dewatering.

In the second step, the aluminum oxide (alumina) produced during the Bayer process is reduced to make pure molten aluminum. Alumina is a fine white powder, and consists of about equal weights of aluminum and oxygen. The strong chemical bond that exists between the aluminum and oxygen makes separating them difficult — pyrometallurgical separation requires a temperature of about 3600 degrees F. However, in 1866 it was discovered that alumina will dissolve when placed in the molten metal cryolite at around only 1742 degrees F. Once dissolved, the aluminum oxide is readily separated into aluminum and oxygen by electric current. The Hall-Heroult process, as this type of electrolytic reduction is known, begins with the placement of the alumina into electrolytic cells, or "pots," filled with molten cryolite (See Exhibit 2). Though the process requires large amounts of electricity (six or seven kilowatts of electricity per pound of aluminum produced), only a low voltage is needed. This allows the pots to be laid out in a series along one long electrical circuit to form what is known as a "potline." Within each pot a positive electric current is passed through the cryolite by means of a carbon anode submerged in the liquid cryolite. The oxygen atoms, separated from aluminum oxide, carry a negative electrical charge and are attracted to the carbon anodes. The carbon and the oxygen combine immediately to form carbon dioxide and carbon monoxide. These gases bubble free of the melt. The aluminum (which is more than 99 percent pure) collects at the bottom of the pot, is siphoned off, placed into crucibles, and then transferred to melting/holding furnaces.

Exhibit 2 - Aluminum Anodes



Source: The Aluminum Association.

R0076393

The third step consists of either mixing the molten aluminum with other metals to form alloys of specific characteristics, or casting the aluminum into ingots for transport to fabricating shops. Casting involves pouring molten aluminum into molds and cooling it with water. At some plants, the molten aluminum may be batch treated in furnaces to remove oxide, gaseous impurities and active metals such as sodium and magnesium before casting. Some plants add a flux of chloride and fluoride salts and then bubble chlorine gas, usually mixed with an inert gas, through the molten mixture. Chloride reacts with the impurities to form HCL, Al_2O_3, and metal chloride emissions. A dross forms to float on the molten aluminum and is removed before casting.

Two types of anodes may be used during the reduction process; either an anode paste or a pre-baked anode. Because the carbon is consumed during the refining process (about one-half pound of carbon is consumed for every pound of aluminum produced), if anode paste (Soderberg anode) is used, it needs to be continuously fed through an opening in the steel shell of the pot. The drawback to pre-baked anodes is that they require that a pre-baked anode fabricating plant be located nearby or on-site. Most aluminum reduction plants include their own facilities to manufacture anode paste and/or pre-baked anode blocks. These pre-baked blocks, each of which may weigh 600 or 700 pounds, must be replaced after 14 to 20 days of service.

One waste material produced during the primary production of aluminum are fluoride compounds. Fluoride compounds are principally produced during the reduction process. One reason that pre-baked anodes are favored is that the closure of the pots during smelting facilitates the capture of fluoride emissions, though many modern smelters employ other methods to capture and recycle fluorides and other emissions.

The pots used to hold the aluminum during smelting range in size from 30 to 50 feet long, 9 to 12 feet wide, and 3 to 4 feet high, and are lined with refractory brick and carbon. Eventually the carbon linings crack and must be removed and replaced. However, during the aluminum reduction process iron cyanide complexes form in the carbon portion of the liners. When the linings are removed they are "spent," and are considered to be RCRA listed hazardous waste K088.

Secondary Aluminum Processing

In the secondary production of aluminum, scrap is usually melted in gas- or oil-fired reverberatory furnaces of 30,000 to over 100,000 pounds capacity. The furnaces have one or two charging wells separated from the main bath by a refractory wall that permits only molten metal into the main bath. The principal processing of aluminum-base scrap involves the removal of magnesium by treating the molten bath with chlorine or with various fluxes such as aluminum chloride, aluminum fluoride, or mixtures of sodium and potassium chlorides and fluorides. To facilitate handling, a significant proportion of the old aluminum scrap, and in some cases new scrap, is simply melted to form sweated pig that must be processed further to make specification-grade ingot.

Another method of secondary aluminum recovery uses aluminum drosses as the charge instead of scrap. Traditionally, the term dross was defined as a thick liquid or solid phase that forms at the surface of molten aluminum, and is a by-product of melting operations. It is formed with or without fluxing and the free aluminum content of this by-product can vary considerably. Most people in the industry have generally referred to dross as being lower in aluminum content, while the material with a higher aluminum content is referred to as "skim," or "rich" or "white dross." If a salt flux is used in the melting process, the by-product is usually called a "black dross" or "salt cake." Drosses containing about 30 percent metallics are usually crushed and screened to bring the metallic content up to about 60 to 70 percent. They are then melted in a rotary furnace, where the molten aluminum metal collects on the bottom of the furnace and is tapped off. Salt slags containing less than 30 percent metallics may be leached with water to separate the metallics. In addition to this classic dross-recycling process, a new dross treatment process using a water-cooled plasma gas arc heater (plasma torch) installed in a specially-designed rotary furnace was patented recently. The new process eliminates the use of salt flux in the conventional dross treatment process, and reports recovery efficiencies of 85 to 95 percent.

III.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary aluminum processing are presented by media in Exhibit 3.

Exhibit 3
Process Materials Inputs/Pollution Outputs - Aluminum

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Bauxite Refining	Bauxite, sodium hydroxide	Particulates		Residue containing silicon, iron, titanium, calcium oxides, and caustic
Alumina Clarification and Precipitation	Alumina slurry, starch, water		Wastewater containing starch, sand, and caustic	
Alumina Calcination	Aluminum hydrate	Particulates and water vapor		
Primary Electrolytic Aluminum Smelting	Alumina, carbon anodes, electrolytic cells, cryolite	Fluoride, both gaseous and particulates, carbon dioxide, sulfur dioxide, carbon monoxide, C_2F_6, CF_4, and perflourinated carbons (PFC)		Spent potliners, K088
Secondary Scrap Aluminum Smelting	Aluminum scrap, oil or gas, chlorine or other fluxes (aluminum chloride, aluminum fluoride, sodium and potassium chlorides, and fluorides)	Particulates and HCL/Cl_2		Slag containing magnesium and chlorides
Secondary Aluminum Dross Recycling	Aluminum dross, water	Particulates	Wastewater, salts	

Primary Aluminum Processing

Primary aluminum processing activities result in air emissions, proccess wastes, and other solid-phase wastes. Large amounts of particulates are generated during the calcining of hydrated aluminum oxide, but the economic value of this dust for reuse in the process is such that extensive controls are used to reduce emissions to relatively small quantities. Small amounts of particulates are emitted from the bauxite grinding and materials handling processes. Emissions from aluminum reduction processes are primarily gaseous hydrogen fluoride and particulate fluorides, alumina, carbon monoxide, volatile organics, and sulfur dioxide from the reduction cells; and fluorides, vaporized organics and sulfur dioxide from the anode baking furnaces. A variety of control devices such as wet scrubbers are used to abate emissions from reduction cells and anode baking furnaces.

Wastewaters generated from primary aluminum processing are produced during clarification and precipitation though much of this water is fed back into the process to be reused.

Solid-phase wastes are generated at two stages in the primary aluminum process; red mud produced during bauxite refining, and spent potliners from the reduction process. Red mud normally contains significant amounts of iron, aluminum, silicon, calcium, and sodium. The types and concentrations of minerals present in the mud depends on the composition of the ore and the operating conditions in the digesters. Red mud is managed on site in surface impoundments, and has not been found to exhibit any of the characteristics of hazardous waste (1990 Report to Congress on Special Wastes from Mineral Processing). The process does however, generate hazardous waste. The carbon potliners used to hold the alumina/cryolite solution during electrolytic aluminum reduction process eventually crack and need to be removed and replaced. When the liners are removed they are "spent," and are considered to be RCRA listed hazardous waste K088.

Secondary Aluminum Processing

Secondary aluminum processing also results in air emissions, wastewaters, and solid wastes. Atmospheric emissions from reverberatory (chlorine) smelting/refining represent a significant fraction of the total particulate and gaseous effluents generated in the secondary aluminum industry. Typical furnace effluent gases contain combustion products, chlorine, hydrogen chloride and metal chlorides of zinc, magnesium, and aluminum, aluminum oxide and various metals and metal compounds, depending on the quality of scrap charges. Emissions from reverberatory (fluorine) smelting/refining are similar to those from reverberatory (chlorine) smelting/refining. The use of AlF_3 rather than chlorine in the demagging step reduces demagging emissions. Fluorides are emitted as gaseous fluorides or as dusts. Baghouse scrubbers are usually used for fluoride emission control.

Solid-phase wastes are also generated during secondary scrap aluminum smelting. The slag generated during smelting contains chlorides resulting from the use of fluxes and magnesium. Waste waters are also generated during secondary aluminum processing when water is added to the smelting slags to aid in the separation of metallics. The waste waters are also likely to be contaminated with salt from the various fluxes used.

IV. PRIMARY AND SECONDARY COPPER PROCESSING INDUSTRY

IV.A. Characterization of the Industry - Copper

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Copper Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

IV.A.1. Industry Size and Geographic Distribution - Copper

The following discussion is based in part upon the following documents: "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce, and information provided by the U.S. Department of the Interior, Bureau of Mines.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Copper ore is mined in both the Northern and Southern Hemispheres but is primarily processed and consumed by countries in the Northern Hemisphere. The U.S., is both a major producer (second only to Chile) and consumer of copper.

The domestic primary unwrought, or unworked, integrated copper industry consists of mines, concentrators, smelters, refineries, and electrowinning plants (SIC 3331 encompasses facilities engaging in primary smelting and refining, but not mining). The number of operating mines producing copper has decreased from 68 mines in 1989 to 65 mines in 1992. Of the 65 mines actively producing copper in the U.S., 33 list copper as the primary product. The remaining 32 mines produce copper either as a byproduct or co-product of gold, lead, zinc, or silver (U.S. DOI, Bureau of Mines). Nineteen of the 33 active mines that primarily produce copper are located in Arizona, which accounts for 65 percent of domestically mined copper ore. The remaining mines are located throughout New Mexico and Utah, which together account for 28 percent of domestic production, and Michigan, Montana, and Missouri account for the remainder (U.S. DOI, Bureau of Mines). Five integrated producers, Phelps Dodge Corp., Magma Copper Co., ASARCO Incorporated, Kennecott Corp., and Cyprus-AMAX Minerals Co., produce over 90 percent of domestic primary copper.

In 1988, there were 17 copper mines in the U.S. using leaching methods, with total production of approximately 227,000 metric tons of electrowon copper (U.S. EPA; U.S. DOI, Bureau of Mines). According to the U.S. Bureau of Mines, in 1991 441,000 metric tons of copper (an increase of 94 percent in three years) were recovered by leaching/electrowinning methods (U.S. DOI, Bureau of Mines). While solution operations are conducted throughout the Southwestern U.S., almost 75 percent of the facilities (14) are located in Arizona. There are two facilities in New Mexico, one in Utah, and one in Nevada.

In 1991, the consumption of refined copper in the U.S. decreased by four percent from 1990 levels. In 1992, refined copper was consumed at approximately 20 wire-rod mills, 41 brass mills, and 750 foundries, chemical plants, and other manufacturers. According to the Bureau of Mines, in 1992 U.S. consumption of copper was about 2.2 million tons. Consumption in 1993 and 1994 rose sharply to almost 2.7 million tons.

Fifty-six percent of recycled, or secondary copper, is derived from new scrap, while 44 percent comes from old scrap. Domestically, the secondary copper smelting industry is led by four producers: Franklin, Southwire Co., Chemetco., and Cerro Copper Co. Like the secondary aluminum industry, these producers buy the scrap they recycle on the open market, in addition to using scrap generated in their own downstream productions. The secondary copper industry is concentrated in Georgia, South Carolina, Illinois, and Missouri.

IV.A.2. Product Characterization - Copper

Because of its superior electrical conductivity, the leading domestic consumer of refined copper is wire mills, accounting for 75 percent of refined copper consumption. Brass mills producing copper and copper alloy semi-fabricated shapes are the other dominant domestic consumers at 23 percent. The dominant end-users of copper and copper alloy are the construction and electronic products industries, accounting for 65 percent of copper end-usage. Transportation equipment such as radiators also account for a fair amount of copper end-usage at 11.6 percent. Copper and copper alloys powders are used for brake linings and bands, bushings, instruments, and filters in the automotive and aerospace industries, for electrical and electronic applications, for anti-fouling paints and coatings, and for various chemical and medical purposes. Copper chemicals, principally copper sulfate and the cupric and cuprous oxides, are widely used as algaecides, fungicides, wood preservatives, copper plating, pigments, electronic applications, and numerous special applications.

IV.A.3. Economic Trends - Copper

Conditions in the U.S. copper industry continued to improve during 1993, and refined copper production increased approximately seven percent by mid-year as compared to the first half of 1992. U.S. copper consumption is estimated to grow by approximately 1.5 to 7 percent through 2000, while global consumption is expected to increase approximately two percent through the same period. The foreign market, particularly the Asian Pacific region, is expected to be a growing market because of its strong automobile, air conditioning, and consumer electronics industries. China is expected to see the largest increase in demand if economic reforms continue.

IV.B. Industrial Process Description - Copper

This section describes the major industrial processes within the Primary and Secondary Copper Processing industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

IV.B.1. Industrial Processes in the Primary and Secondary Copper Processing Industry

The following discussion is based upon materials provided by the International Copper Association, Ltd., and the following documents: "Copper Technology and Competitiveness," Congress of the United States, Office of Technology Assessment and

"Compilation of Air Pollutant Emission Factors (AP42)," the U.S. Environmental Protection Agency.

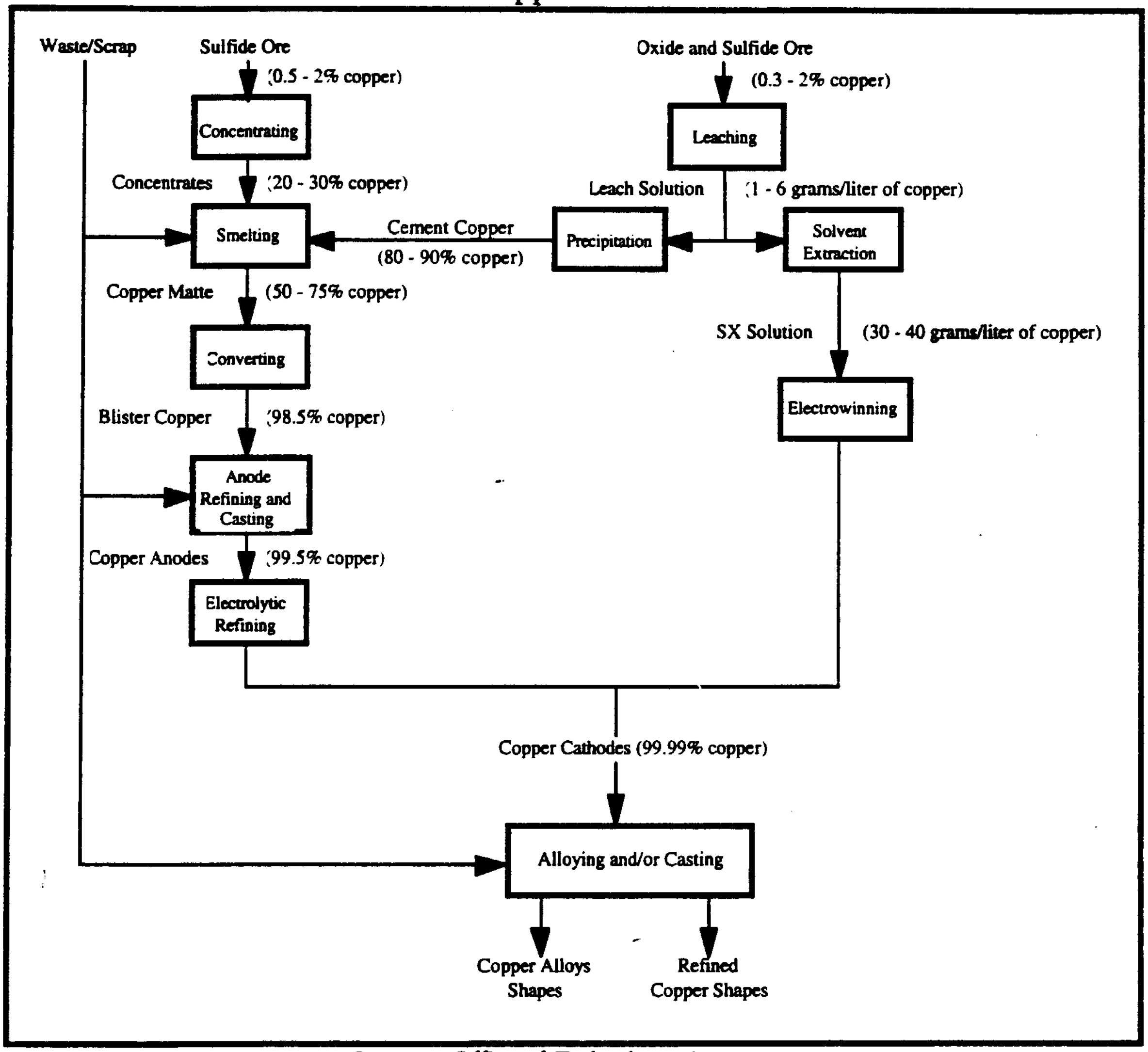
Primary Copper Processing

Copper is mined in both open pits and underground mines, depending upon the ore grade and the nature of the ore deposit. Copper ore typically contains less that one percent copper and is in the form of sulfide minerals. Once the ore is delivered above the ground, it is crushed and ground to a powdery fineness, after which it is concentrated for further processing. In the concentration process, ground ore is slurried with water, chemical reagents are added, and air is blown through the slurry. The air bubbles attach themselves to the copper minerals and are then skimmed off of the top of the flotation cells. The concentrate contains between 20 and 30 percent copper. The "tailings," or gangue minerals, from the ore fall to the bottom of the cells and are removed, dewatered by "thickeners," and transported as a slurry to a tailings pond for disposal. All water used in this operation, from dewatering thickeners and the tailings pond, is recovered and recycled back into the process.

Copper can be produced either pyrometallurgically or hydrometallurgically depending upon the ore-type used as a charge. The ore concentrates, which contain copper sulfide and iron sulfide minerals, are treated by pyrometallurgical processes to yield high purity copper products. Oxide ores, that contain copper oxide minerals which may occur in other parts of the mine, together with other oxidized waste materials, are treated by hydrometallurgical processes to yield high purity copper products. Both processes are illustrated in Exhibit 4.

Copper conversion is accomplished by a pyrometallurgical process known as "smelting." During smelting the concentrates are dried and fed into one of several different types of furnaces. There the sulfide minerals are partially oxidized and melted to yield a layer of "matte," a mixed copper-iron sulfide, and "slag," an upper layer of waste.

Exhibit 4 - Copper Production Process



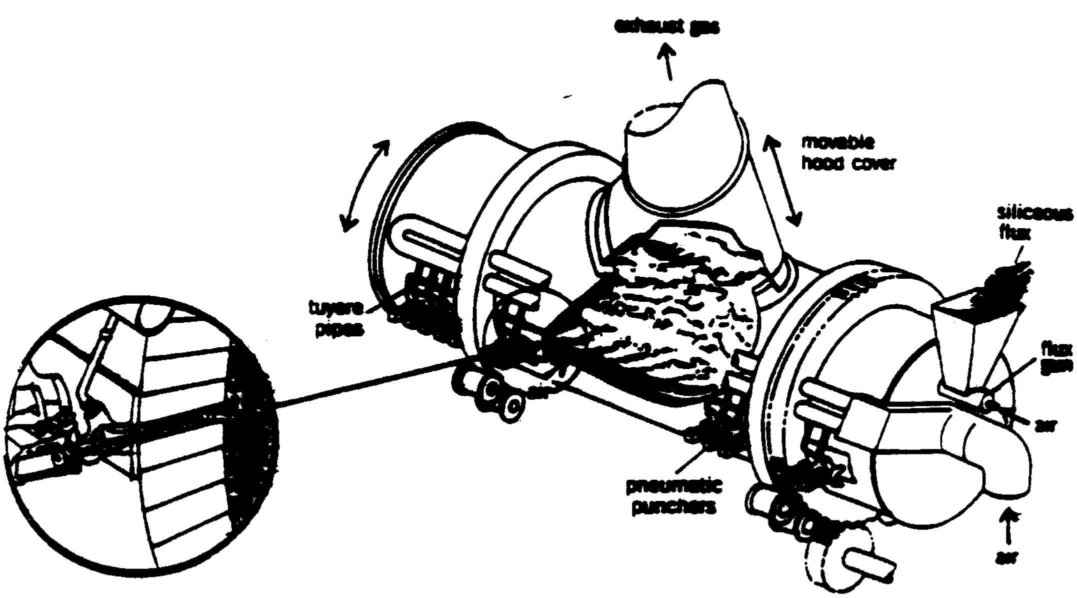
Source: Office of Technology Assessment.

R0076403

The matte is further processed by a process known as "converting." The slag is tapped from the furnace and stored or discarded in slag piles on site. A small amount of slag is sold for railroad ballast and for sand blasting grit. A third product of the smelting process is sulfur dioxide, a gas which is collected, purified, and made into sulfuric acid for sale or for use in hydrometallurgical leaching operations.

Following smelting, the copper matte is fed into a converter. During this process the copper matte is poured into a horizontal cylindrical vessel (approximately 30 x 13 feet) fitted with a row of pipes (See Exhibit 5). The pipes, known as "tuyeres," project into the cylinder and are used to introduce air into the converter. Lime and silica are added to the copper matte to react with the iron oxide produced in the process to form slag. Scrap copper may also be added to the converter. The furnace is rotated so that the tuyeres are submerged, and air is blown into the molten matte causing the remainder of the iron sulfide to react with oxygen to form iron oxide and sulfur dioxide. Following the "blow," the converter is rotated to pour off the iron silicate slag.

Exhibit 5
Cutaway View of a Pierce-Smith Converter for Producing Blister Copper from Matte



Source: *Extractive Metallurgy of Copper, A. K. Biswas and W. D. Davenport, Pergamon Press.*

R0076404

Once all of the iron is removed, the converter is rotated back and given a second blow during which the remainder of the sulfur is oxidized and removed from the copper sulfide. The converter is then rotated to pour off the molten copper, which at this point is called "blister" copper (so named because if allowed to solidify at this point, it will have a bumpy surface due to the presence of gaseous oxygen and sulfur). Sulfur dioxide from the converters is collected and fed into the gas purification system together with that from the smelting furnace and made into sulfuric acid. Due to its residual copper content, slag is recycled back to the smelting furnace.

Blister copper, containing a minimum of 98.5 percent copper, is refined to high purity copper in two steps. The first step is "fire refining," in which the molten blister copper is poured into a cylindrical furnace, similar in appearance to a converter, where first air and then natural gas or propane are blown through the melt to remove the last of the sulfur and any residual oxygen from the copper. The molten copper is then poured into a casting wheel to form anodes pure enough for "electrorefining."

In electrorefining, the copper anodes are loaded into electrolytic cells and interspaced with copper "starting sheets," or cathodes, in a bath of copper sulfate solution. When a DC current is passed through the cell the copper is dissolved from the anode, transported through the electrolyte, and re-deposited on the cathode starting sheets. When the cathodes have built-up to sufficient thickness they are removed from the electrolytic cell and a new set of starting sheets is put in their place. Solid impurities in the anodes fall to the bottom of the cell as a sludge where they are ultimately collected and processed for the recovery of precious metals such as gold and silver. This material is known as "anode slime."

The cathodes removed from the electrolytic cell are the primary product of the copper producer and contain 99.99+ percent copper. These may be sold to wire-rod mills as cathodes or processed further to a product called "rod." In manufacturing rod, cathodes are melted in a shaft furnace and the molten copper is poured onto a casting wheel to form a bar suitable for rolling into a 3/8-inch diameter continuous rod. This rod product is shipped to wire mills where it is extruded into various sizes of copper wire.

In the hydrometallurgical process, the oxidized ores and waste materials are leached with sulfuric acid from the smelting process. Leaching is performed *in situ*, or in specially prepared piles by distributing acid across the top and allowing it to percolate down through the material where it is collected. The ground under the leach pads is lined with an acid proof, impermeable plastic material to prevent leach liquor from contaminating groundwater. Once the copper-rich solutions are collected they can be processed by either of two processes - the "cementation" process or the "solvent extraction/electrowinning" process (SXEW). In the cementation process (which is rarely used today), the copper in the acidic solution is deposited on the surface of scrap iron in exchange for the iron. When sufficient copper has been "cemented out" the copper-rich iron is put into the smelter together with the ore concentrates, for copper recovery via the pyrometallurgical route.

In the SXEW process, the pregnant leach solution (PLS) is concentrated by solvent extraction. In solvent extraction, an organic chemical that extracts copper but not impurity metals (iron and other impurities) is mixed with the PLS. The copper-laden organic solution is then separated from the leachate in a settling tank. Sulfuric acid is added to the pregnant organic mixture, which strips the copper into an electrolytic solution. The stripped leachate, containing the iron and other impurities, is returned to the leaching operation where its acid is used for further leaching. The copper-rich strip solution is passed into an electrolytic cell known as an "electrowinning" cell. An electrowinning cell differs from an electrorefining cell in that it uses a permanent, insoluble anode. The copper in solution is then plated onto a starting sheet cathode in much the same manner as it is on the cathode in an electrorefining cell. The copper-depleted electrolyte is returned to the solvent extraction process where it is used to strip more copper from the organic. The cathodes produced from the electrowinning process are then sold or made into rod in the same manner as those produced from the electrorefining process.

Electrowinning cells are used also for the preparation of starting sheets for both the electrorefining and electrowinning processes. Here copper is plated onto either stainless steel or titanium cathodes. When sufficient thickness has built-up, the cathodes are removed and the copper plating on both sides of the stainless steel or titanium is stripped off. After straightening and flattening, these copper sheets are fabricated into starting sheet cathodes by mechanically attaching copper strips to be used as hangers when they are in the electrolytic cell. Both the starting sheet and the strips become part of the final product. The same care in achieving and maintaining purity must be maintained with these materials as is practiced for the electrodeposited copper.

An activity that is carried out concurrently with the primary copper production is sulfur fixation. As mentioned above, in the pyrometallurgical process most of the sulfur in the ore is transformed into sulfur dioxide (though a portion is discarded in the slag). The copper smelting and converting processes typically generate over half a ton of sulfur dioxide per ton of copper concentrate. In order to meet CAA emission standards, sulfur dioxide releases must be controlled. This is accomplished by elaborate gas collection and filtration systems after which the sulfur dioxide contained in the off-gases is made into sulfuric acid. In general, if the sulfur dioxide concentration exceeds four percent it will be converted into sulfuric acid, an ingredient in fertilizer. Fugitive gases containing less than four percent sulfuric acid are either released to the atmosphere or scrubbed to remove the sulfur dioxide. The sulfur recovery process requires the emissions to flow through a filtering material in the air emissions scrubber to capture the sulfur. A blowdown slurry is formed from the mixture of the filtering material and sulfur emissions. This slurry contains not only sulfur, but cadmium and lead, metals that are present in copper ore. The acid plant blowdown slurry/sludge that results from thickening of blowdown slurry at primary copper facilities is regulated by RCRA as hazardous waste K064.

Secondary Copper Processing

The primary processes involved in secondary copper recovery are scrap metal pretreatment and smelting. Pretreatment includes cleaning and concentration to prepare the material for the smelting furnace. Pretreatment of the feed material can be accomplished using several different procedures, either separately or in combination. Feed scrap is concentrated by manual and mechanical methods such as sorting, stripping, shredding, and magnetic separation. Feed scrap is sometimes briquetted in a hydraulic press. Pyrometallurgical pretreatment may include sweating, burning of insulation (especially from scrap wire), and drying (burning off oil and volatiles) in rotary kilns. Hydrometallurgical methods include flotation and leaching with chemical recovery.

After pretreatment the scrap is ready for smelting. Though the type and quality of the feed material determines the processes the smelter will use, the general fire-refining process is essentially the same as for the primary copper smelting industry.

IV.B.2. <u>Raw Material Inputs and Pollution Outputs</u>

The material inputs and pollution outputs resulting from primary and secondary copper processing are presented by media in Exhibit 6.

Exhibit 6
Process Materials Inputs/Pollution Outputs - Copper

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Copper Concentration	Copper ore, water, chemical reagents, thickeners		Flotation wastewaters	Tailings containing waste minerals such as limestone, and quartz
Copper Leaching	Copper concentrate, sulfuric acid		Uncontrolled leachate	Heap leach waste
Copper Smelting	Copper concentrate, siliceous flux,	Sulfur dioxide, particulate matter containing arsenic, antimony, cadmium, lead, mercury, and zinc		Acid plant blowdown slurry/sludge (K064), slag containing iron sulfides, silica
Copper Conversion	Copper matte, scrap copper, siliceous flux	Sulfur dioxide, particulate matter containing arsenic, antimony, cadmium, lead, mercury, and zinc		Acid plant blowdown slurry/sludge (K064), slag containing iron sulfides, silica
Electrolytic Copper Refining	Blister copper		Process wastewater	Slimes containing impurities such as gold, silver, antimony, arsenic, bismuth, iron, lead, nickel, selenium, sulfur, and zinc
Secondary Copper Processing		Particulates	Slag granulation waste	Slag

Primary Copper Processing

Primary copper processing results in air emissions, process wastes, and other solid-phase wastes. Particulate matter and sulfur dioxide are the principal air contaminants emitted by primary copper smelters. Copper and iron oxides are the primary constituents of the particulate matter, but other oxides, such as arsenic, antimony, cadmium, lead, mercury and zinc, may also be present, with metallic sulfates and sulfuric acid mist. Single stage electrostatic precipitators are widely used in the primary copper industry to control these particulate emissions. Sulfur oxides contained in the off-gases are collected, filtered, and made into sulfuric acid.

Large amounts of water are used in the copper concentration process though disposal of liquid wastes is rarely a problem because the vast majority of the water is recycled back into the process. Once the wastewater exits the flotation process it is sent to a sediment control pond where it is held long enough for most of the sediment to settle.

The seepage and leaking of sulfuric acid solutions used in leaching can also produce liquid wastes, however this potential is off-set by the copper producer's interest to collect as much of the copper-bearing leachate as possible. Older operations generally do not have protective liners under the piles, and experience some loss of leachate. New leaching operations use impermeable membranes to confine leach solutions and channel them to collection ponds.

Electrolytic refining does produce wastewaters that must be treated and discharged, reused, or disposed in some manner. Many facilities use a wastewater treatment operation to treat these wastes.

Primary copper processing primarily generates two solid-phase wastes; slag and blowdown slurry/sludge. Slag is generated during the smelting, converting, fire refining, and electrolytic refining stages. Slag from smelting furnaces is higher in copper content than the original ores taken from the mines. These slags therefore, may be sent to a concentrator and the concentrate returned to the smelter. This slag processing operation results in slag tailings. Slag resulting from converting and fire refining also is normally returned to the process to capture any remaining mineral values. Blowdown slurry/sludge that results from the sulfur recovery process is regulated by RCRA as hazardous waste K064.

Secondary Copper Processing

Secondary copper processing produces the same types of wastes as primary pyrometallurgical copper processing. One type of secondary processing pollutant that differs from primary processing is the air emissions. Air pollutants are generated during the drying of chips and borings to remove excess oils and cuttings fluids and causes discharges of large amounts of dense smoke containing soot and unburned hydrocarbons. These emissions can be controlled by baghouses and/or direct-flame afterburners.

V. PRIMARY AND SECONDARY LEAD PROCESSING INDUSTRY

V.A. Characterization of the Industry - Lead

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Lead Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

V.A.1. Industry Size and Geographic Distribution - Lead

The following discussion is based upon "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce, and information provided by the U.S. Department of the Interior, Bureau of Mines.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

The U.S. is the world's third largest primary lead producer with 1/7 of all production reserves. Over 80 percent of the lead ore mined domestically comes from Missouri. The mines with the largest ore capacity are owned by Asarco Inc., The Doe Run Co., and Cominco American Inc., the first two of which are also integrated producers of refined lead materials. The majority of lead ores mined in the U.S. are smelted in conventional blast furnaces and are refined using pyrometallurgical methods.

In 1993, the lead industry employed 600 workers at primary smelters and refineries, and 1,700 at secondary smelters and refineries. Primary and secondary smelter and refinery employment was not expected to change in 1994 (U.S. DOI, Bureau of Mines, 1995).

The U.S. is the world's largest recycler of lead scrap and is able to meet about 72 percent of its total refined lead production needs from scrap recycling. At the end of 1991, the secondary lead industry consisted of 16 companies that operated 23 battery breakers-smelters with capacities of between 10,000 and 120,000 metric tons a year (mt/y); five smaller operations with capacities between 6,000 and 10,000 mt/y; and 15 smaller plants that produced mainly specialty alloys for solders, brass and bronze ingots, and miscellaneous uses. Sanders Lead Co., East Penn Mfg. Co., and Schuylkill Metals Corp. are some of the larger secondary lead producers in the United States.

V.A.2. Product Characterization - Lead

Within the U.S., the power storage battery industry is the largest end-user of lead, accounting for 83 percent of the estimated 1.357 Mmt domestically consumed in 1993. Demand for lead by the lead-acid battery industry rose 12 percent to 1.12 Mmt in 1993 due to a significant increase in consumer need for batteries. Industrial demand for batteries rose as well, due both to the growth in demand for stationary batteries used in telecommunications and back-up power systems for computers, lighting, and security systems, as well as an increased need for mobile batteries used in fork lifts and other battery-powered vehicles. Additional lead end-uses and users of consequence are ammunition, consumers of lead oxides used in television glass and computers, construction (including radiation shielding) and protective coatings, and miscellaneous uses such as ballasts, ceramics, and crystal glass.

V.A.3. Economic Trends - Lead

In 1994, domestic consumption of lead is expected to increase seven percent to 1.5 Mmt. This increase is based in part on expected increased demand from the automobile sector for both original and replacement equipment batteries. This increased consumption should continue to be met by the secondary lead industry, which is expected to continue to supply approximately 72 percent of total domestic production. Through 1998, production of unwrought lead is expected to grow 1.4 percent to 1.3 Mmt, while U.S. consumption is estimated to increase 1.4 percent to 1.6 Mmt.

Power storage batteries, both industrial and automotive, will continue to be the largest end-users. Demand for power storage batteries may be greater than initially expected due to several factors. California and nine Northeastern States have recently passed laws requiring the production, but not the consumer use of, electric vehicles. Other innovative uses of lead include lead-acid batteries for load-leveling of electricity. Using batteries for load-leveling reduces the total installed generating capacity needed by charging the battery at times of low demand for electricity, then discharging it to level the power supply at times of peak demand. A pilot facility in Chino, CA has already come on line with a battery which uses 2,000 pounds of lead and has a capacity of 40 megawatt hours. Another potential use for refined lead is the containment of high-level radioactive waste. Argentina and Sweden already employ it for this purpose and this use is being considered elsewhere, including the United States. A final innovative application being tested for lead is its use as a road paving stabilizer.

R0076411

Tests have shown that certain lead compounds can double the life of asphalt while only adding four to five percent to production costs.

V.B. Industrial Process Description - Lead

This section describes the major industrial processes within the Primary and Secondary Lead Processing industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

V.B.1. Industrial Processes in the Primary and Secondary Lead Processing Industry

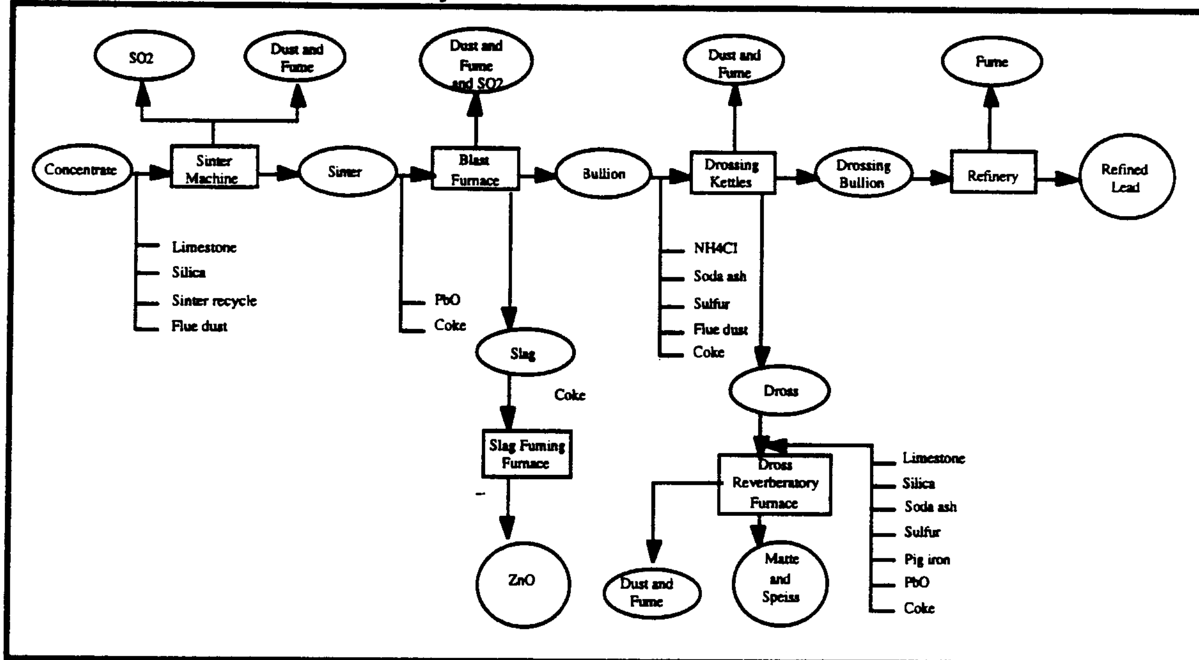
The following discussion is based upon the following documents: "Compilation of Air Pollutant Emission Factors (AP42)," "Background Listing Document for K065," "1990 Report to Congress on Special Wastes From Mineral Processing," published by the U.S. Environmental Protection Agency, and "Recycled Metals in The United States, A Sustainable Resource," published by U.S. Department of the Interior, Bureau of Mines.

Primary Lead Processing

The primary lead production process consists of four steps: sintering, smelting, drossing, and pyrometallurgical refining (See Exhibit 7). To begin, a feedstock comprised mainly of lead concentrate is fed into a sintering machine. Other raw materials may be added including iron, silica, limestone flux, coke, soda, ash, pyrite, zinc, caustic, and particulates gathered from pollution control devices. In the sintering machine the lead feedstock is subjected to blasts of hot air which burn off the sulfur, creating sulfur dioxide. The lead material existing after this process contains about nine percent of its weight in carbon. The sinter is then fed along with coke, various recycled and cleanup materials, limestone, and other fluxing agents into a blast furnace for reducing, where the carbon acts as a fuel and smelts or melts the lead material. The molten lead flows to the bottom of the furnace where four layers form: "speiss" (the lightest material, basically arsenic and antimony); "matte" (copper sulfide and other metal sulfides); blast furnace slag (primarily silicates); and lead bullion (98 weight percent lead). All layers are then drained off. The speiss and matte are sold to copper smelters for recovery of copper and precious metals. The blast furnace slag which contains zinc, iron, silica, and lime is stored in piles and partially recycled. Sulfur oxide emissions are generated in blast furnaces from small quantities of residual lead sulfide and lead sulfates in the sinter feed.

Rough lead bullion from the blast furnace usually requires preliminary treatment in kettles before undergoing refining operations. During drossing the bullion is agitated in a drossing kettle and cooled to just above its freezing point (700 to 800 degrees F). A dross, which is composed of lead oxide, along with copper, antimony, and other elements, floats to the top and solidifies above the molten lead.

Exhibit 7 - Primary Lead Production Process



Source: Air Pollution Engineering Manual, Anthony J. Buonicore and Wayne T. Davis, ed., Air & Waste Management Association, Van Norstrand Reinhold.

The dross is removed and fed into a dross furnace for recovery of the non-lead mineral values. To enhance copper recovery, drossed lead bullion is treated by adding sulfur bearing materials, zinc, and/or aluminum, lowering the copper content to approximately 0.01 percent.

During the fourth step the lead bullion is refined using pyrometallurgical methods to remove any remaining non-lead saleable materials (e.g., gold, silver, bismuth, zinc, and metal oxides such as antimony, arsenic, tin, and copper oxide). The lead is refined in a cast iron kettle during five stages. Antimony, tin, and arsenic are removed first. Then gold and silver are removed by adding zinc. Next, the lead is refined by vacuum removal of zinc. Refining continues with the addition of calcium and magnesium. These two materials combine with bismuth to form an insoluble compound that is skimmed from the kettle. In the final step caustic soda and/or nitrates may be added to the lead to remove any remaining traces of metal impurities. The refined lead will have a purity of 99.90 to 99.99 percent, and may be mixed with other metals to form alloys or it may directly be cast into shapes.

The processes used in the primary production of lead produce several waste streams of concern under different regulatory scenarios. The listed RCRA hazardous wastes include smelting plant wastes that are sent to surface impoundments to settle. The impoundments are used to collect solids from miscellaneous slurries, such as acid plant blowdown, slag granulation water, and plant washings. Acid plant blowdown is generated during the production of lead the same way it is produced at a copper plant; during the recovery of sulfur dioxide emissions. Slag granulation water is produced when hot slag from the process is sprayed with water to be cooled and granulated before transport to a slag pile. Plant washing is a housekeeping process and the washdown normally contains a substantial amount of lead and other process materials. When these materials accumulate in a surface impoundment or are dredged from the surface impoundment they are regulated as hazardous waste K065.

Secondary Lead Processing

The secondary production of lead begins with the recovery of old scrap from worn-out, damaged, or obsolete products and new scrap that is made of product wastes and smelter-refinery drosses, residues, and slags. The chief source of old scrap in the U.S. is lead-acid batteries, though cable coverings, pipe, sheet, and terne bearing metals also serve as a source of scrap. Solder, a tin-based alloy, may also be recovered from the processing of circuit boards for use as lead charge.

While some secondary lead is recovered directly for specialty products like babbitt metal, solder, re-melt, and copper-base alloys, about 97 percent of secondary lead is recovered at secondary lead smelters and refineries as either soft (unalloyed) or antimonial lead, most of which is recycled directly back into the manufacture of new batteries. Unlike copper and zinc, where scrap processing varies tremendously by scrap type and ultimate use, the dominance of lead battery scrap allows for a more standard secondary recovery process. Prior to smelting, batteries must be broken by one of several techniques, and classified into their constituent products. The modern battery breaking process classifies the lead into metallics, oxides and sulfate fragments, and organics into separate casing and plate separator fractions. Cleaned polypropylene case fragments are recycled back into battery cases or other products. The dilute sulfuric acid is either neutralized for disposal, or recycled into the local acid market. One of three main smelting processes is then used to reduce the lead fractions to produce lead bullion.

The majority of domestic battery scrap is processed in blast furnaces or rotary reverberatory furnaces. Used to produce a semisoft lead, a reverberatory furnace is more suitable for processing fine particles and may be operated in conjunction with a blast furnace. The reverberatory furnace is a rectangular shell lined with refractory brick, and is fired directly with oil or gas to a temperature of 2300 degrees F. The material is heated by direct contact with combustion gases. The average furnace can process about 50 tons per day. About 47 percent of the charge is recovered as lead product and is periodically tapped into mold or holding pots. Forty-six percent of the charge is removed as slag and later processed in blast furnaces. The remaining seven percent of the furnace charge escapes as dust or fume. Short (batch) or long (continuous) rotary furnaces may be used. Slags from reverberatory furnaces are processed through the blast furnace for recovery of alloying elements.

Blast furnaces produce hard lead from charges containing siliceous slag from previous runs (about 4.5 percent of the charge), scrap iron (about 4.5 percent), limestone (about 3 percent), and coke (about 5.5 percent). The remaining 82.5 percent of the charge is comprised of oxides, pot furnace refining drosses, and reverberatory slag. The proportions of rerun slags, limestone, and coke, respectively vary to as high as eight percent, ten percent, and eight percent of the charge. Processing capacity of the blast furnace ranges from 20 to 80 tons per day. Similar to iron cupolas, the blast furnace is a vertical steel cylinder lined with refractory brick. Combustion air at 0.5 to 0.75 pounds per square inch is introduced through tuyeres (pipes) at the bottom of the furnace. Some of the coke combusts to melt the charge, while the remainder reduces lead oxides to elemental lead.

As the lead charge melts, limestone and iron float to the top of the molten bath and form a flux that retards oxidation of the product lead. The molten lead flows from the furnace into a holding pot at a nearly continuous rate. The product lead constitutes roughly 70 percent of the charge. From the holding pot, the lead is usually cast into large ingots, called pigs or sows. About 18 percent of the charge is recovered as slag, with about 60 percent of this being matte. Roughly five percent of the charge is retained for reuse, and the remaining seven percent of the charge escapes as dust or fume.

Refining/casting is the use of kettle type furnaces for re-melting, alloying, refining, and oxidizing processes. Materials charged for re-melting are usually lead alloy ingots that require no further processing before casting. Alloying furnaces simply melt and mix ingots of lead and alloy materials. Antimony, tin, arsenic, copper, and nickel are the most common alloying materials. Refining furnaces, as in primary lead production, are used either to remove copper and antimony to produce soft lead, or to remove arsenic, copper, and nickel for hard lead production.

Newer secondary recovery plants use lead paste desulfurization to reduce sulfur dioxide emissions and waste sludge generation during smelting. At the Doe Run Resource Recycling Facility, battery paste containing lead sulfate and lead oxide is desulfurized with soda ash to produce market grade sodium sulfate solution. The desulfurized paste is processed in a reverberatory furnace. The lead carbonate product may then be treated in a short rotary furnace. The battery grids and posts are processed separately in a rotary smelter.

V.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary lead processing are presented by media in Exhibit 8.

Exhibit 8
Process Materials Inputs/Pollution Outputs - Lead

Process	Material Input -	Air Emissions	Process Wastes	Other Wastes
Lead Sintering	Lead ore, iron, silica, limestone flux, coke, soda, ash, pyrite, zinc, caustic, and baghouse dust	Sulfur dioxide, particulate matter containing cadmium and lead		
Lead Smelting	Lead sinter, coke	Sulfur dioxide, particulate matter containing cadmium and lead	Plant washdown wastewater, slag granulation water	Slag containing impurities such as zinc, iron, silica, and lime, surface impoundment solids (K065)
Lead Drossing	Lead bullion, soda ash, sulfur, baghouse dust, coke			Slag containing such impurities as copper, surface impoundment solids (K065)
Lead Refining	Lead drossing bullion			
Lead-acid Battery Breaking	Lead-acid batteries			Polypropylene case fragments, dilute sulfuric acid
Secondary Lead Smelting	Battery scrap, rerun slag, drosses, oxides, iron, limestone, and coke	Sulfur dioxide, particulate matter containing cadmium and lead		Slag, emission control dust (K069)

Primary Lead Processing

Primary lead processing activities usually result in air emissions, process wastes, and other solid-phase wastes. The primary air emissions from lead processing are substantial quantities of SO_2 and/or particulates. Nearly 85 percent of the sulfur present in the lead ore concentrate is eliminated in the sintering operation. The offgas

R0076417

containing a strong stream of SO_2 (five to seven percent SO_2) is sent to a sulfuric acid plant, while the weak stream (less than 0.5 percent SO_2) is vented to the atmosphere after removal of particulates. Particulate emissions from sinter machines range from five to 20 percent of the concentrated ore feed. Approximately 15 percent of the sulfur in the ore concentrate fed to the sinter machine is eliminated in the blast furnace. However, only half of this amount, about seven percent of the total sulfur in the ore, is emitted as SO_2. Particulate emissions from blast furnaces contain many different kinds of material, including a range of lead oxides, quartz, limestone, iron pyrites, iron-limestone-silicate slag, arsenic, and other metallic compounds associated with lead ores. The emission controls most commonly employed are fabric filters and electrostatic precipitators.

As mentioned above, approximately seven percent of the total sulfur present in lead ore is emitted as SO_2. The remainder is captured by the blast furnace slag. The blast furnace slag is composed primarily of iron and silicon oxides, as well as aluminum and calcium oxides. Other metals may also be present in smaller amounts including antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, silver, and zinc. This blast furnace slag is either recycled back into the process or disposed of in piles on site. About 50-60 percent of the recovery furnace output is slag and residual lead that are both returned to the blast furnace. The remainder of this dross furnace output is sold to copper smelters for recovery of the copper and other precious metals.

Slag from the primary processing of lead that is not recycled was retained within the Bevill exemption and addressed in the 1990 Report to Congress. In the subsequent regulatory determination (56 FR 27300), EPA determined that regulation of this waste under Subtitle C was not warranted.

The smelting of primary lead produces a number of wastewaters and slurries, including acid plant blowdown, slag granulation water, and plant washdown water. Slag granulation water is generated when slag is disposed. It can either be sent directly to a slag pile or granulated in a water jet before being transported to the slag pile. The granulation process cools newly generated hot slag with a water spray. Slag granulation water is often transported to surface impoundments for settling. Plant washdown water results from plant housekeeping and normally contains a substantial amount of lead and other process materials. Acid plant blowdown results from the conversion of SO_2 to sulfuric acid. All of these materials are included in the definition of hazardous waste K065.

Secondary Lead Processing

Secondary lead processing results in the generation of air emissions and solid-phase wastes. As with primary lead processing, reverberatory and blast furnaces used in smelting account for the vast majority of the total lead emissions. Other emissions from secondary smelting include oxides of sulfur and nitrogen, antimony, arsenic, copper, and tin. Smelting emissions are generally controlled with a settling and cooling chamber, followed by a baghouse. Other air emissions are generated during battery breaking. Emissions from battery breaking are mainly sulfuric acid and dusts containing dirt, battery case material, and lead compounds. Emissions from crushing are also mainly dusts.

The solid-phase wastes generated by secondary processing are emission control dust and slag. Slag is generated from smelting, and the emission control dust, when captured and disposed of, is considered to be hazardous waste K069.

VI. PRIMARY AND SECONDARY ZINC PROCESSING

VI.A. Characterization of the Industry - Zinc

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Zinc Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

VI.A.1. Industry Size and Geographic Distribution - Zinc

The following discussion is based upon "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce, and information provided by the U.S. Department of the Interior, Bureau of Mines.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Zinc is the fourth most widely used metal after iron, aluminum, and copper (lead is fifth). In abundant supply world-wide, zinc is mined and produced mainly in Canada, the former Soviet Union, Australia, Peru, Mexico, and the United States. Historically, in the U.S. recoverable zinc has been mined in 19 States: Alaska, Arizona, Colorado, Idaho, Illinois, Kansas, Missouri, Montana, Nevada, New Jersey, New Mexico, New York, Oklahoma, Pennsylvania, Tennessee, Utah, Virginia, Washington, and Wisconsin. In 1993, nearly 50 percent of all domestic zinc was produced in Alaska. Except for Missouri (eight percent) other exact state production figures were withheld to protect company proprietary data. Other top producing states in order of output were Tennessee, New York, and Missouri.

In 1993, the zinc industry employed 22,250 workers at mines and mills and 1,400 at primary smelters. For 1994, mine and mill employment was expected to stay at 2,200 and employment at zinc smelters was expected to decrease to 1,100 (U.S. DOI, Bureau of Mines, 1995). Employment decreases for primary smelters was attributed to the indefinite closures of a smelter in Oklahoma in later 1993. The four primary zinc smelters in the U.S., are located in Illinois, Oklahoma, Tennessee and Pennsylvania. There are currently 10 secondary zinc recovery plants in the U.S. (U.S. EPA, AP42, 1993).

VI.A.2. Product Characterization - Zinc

The U.S. accounts for almost one-quarter of worldwide slab zinc consumption and is the world's single largest market. About 80 percent of zinc is used in metal form while the rest is used in compound form. Ninety percent of zinc metal is used for galvanizing steel (a form of corrosion protection) and for alloys, and is used in a wide variety of materials in the automotive, construction, electrical, and machinery sectors of the economy. Zinc compound use also varies widely, but is mainly found in the agricultural, chemical, paint, pharmaceutical, and rubber sectors of the economy.

VI.A.3. Economic Trends - Zinc

In 1993, both domestic mine and slab zinc production were down, with slab zinc production down 4.75 percent to .381 Mmt. This production slump was off-set by domestic consumption which increased significantly in 1993, up eight percent, to 1.15 Mmt due to a surge in galvanized steel shipments. Strong growth in automobile demand and continued improvement in the construction industry led to increased consumption along with increased zinc die casting consumption. Consumption of zinc compounds also increased, especially of zinc oxide which increased over 27 percent. More than half of domestic zinc oxide production went to the rubber industry, primarily for use in producing tires (zinc is used in the compounding of rubber before it is cured).

In 1994, domestic refined zinc production is expected to continue its downward trend and drop 3.5 percent from .381 to .370 Mmt. However, domestic demand for zinc is expected to grow 4.2 percent in 1994 to 1.22 Mmt due to increases in all end uses except for nonresidential construction. This increased domestic demand should be met in large part by imports from Canada and Mexico. Imports of slab zinc mainly from these two countries in 1993 made up for almost 65 percent of domestic consumption. Zinc alloy was given preferential status in the Generalized System of Preferences 1990, which allows Mexico and member countries to export zinc alloys to the U.S. duty free. Tariffs on zinc from Canada will be phased out by 1998 due to the U.S.-Canada Free Trade Agreement. Zinc from the former Soviet Union is not expected to be used for U.S. consumption though its production is expected to negatively affect the U.S. market. This situation is similar to that for other metals in that over-production by former eastern bloc countries causes world prices to drop as London Metal Exchange warehouse supplies increase.

Domestically, the long-term demand for zinc is expected to increase, with consumption rising about 2.2 percent a year to reach 1.27 Mmt by 1998. Galvanization using zinc is expected to continue as the largest end-user of zinc, and it is predicted that by 1995 virtually all automobiles sold in the U.S. will be made from two-sided steel, enabling these vehicles to last at least ten years without any perforation damage. Zinc die-casting is also expected to increase in use as new applications are put into use.

VI.B. Industrial Process Description

This section describes the major industrial processes within the Primary and Secondary Zinc Processing industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

VI.B.1. Industrial Processes in the Primary and Secondary Zinc Processing Industry

The following discussion is based upon the following documents: "Compilation of Air Pollutant Emission Factors(AP42), " "Background Listing Document for K065," "1990 Report to Congress on Special Wastes from Mineral Processing," published by the U.S. Environmental Protection Agency, and "Recycled Metals in the United States, A Sustainable Resource," published by U.S. Department of the Interior, Bureau of Mines.

Primary Zinc Processing

The primary production of zinc begins with the reduction of zinc concentrates to metal (the zinc concentration process consists of separating the ore, which may be as little as two percent zinc, from waste rock by crushing and flotation, a process normally performed at the mining site and discussed in more detail in the Metal Mining Profile). Zinc reduction is accomplished in one of two ways: either pyrometallurgically by distillation (retorting in a furnace) or hydrometallurgically by electrowinning. Because hydrometallurgical refining accounts for approximately 80 percent of total zinc refining, pyrometallurgical zinc refining will not be discussed in detail in this profile.

Four processing stages are generally used in hydrometallurgic zinc refining: calcining, leaching, purification, and electrowinning. Calcining, or roasting, is common to both pyrometallic and electrolytic (a form of hydrometallurgy) zinc refining, and is performed to eliminate sulfur and form leachable zinc oxide. Roasting is a high-temperature process that converts zinc sulfide concentrate to an impure zinc oxide called calcine. Roaster types include multiple-hearth, suspension, or fluidized-bed. In general, calcining begins with the mixing of zinc-containing materials with coal. This mixture is then heated, or roasted, to vaporize the zinc oxide which is then moved out of the reaction chamber with the resulting gas stream. The gas stream is directed to the bag-house (filter) area where the zinc oxide is captured in bag-house dust.

In a multiple-hearth roaster, the concentrate drops through a series of nine or more hearths stacked inside a brick-lined cylindrical column. As the feed concentrate drops through the furnace, it is first dried by the hot gases passing through the hearths and then oxidized to produce calcine. Multiple hearth roasters are unpressurized and operate at approximately 1,300 degrees F.

In a suspension roaster, the concentrates are blown into a combustion chamber. The roaster consists of a refractory-lined cylindrical shell, with a large combustion space at the top and two to four hearths in the lower portion. Additional grinding, beyond that required for a multiple hearth furnace, is normally required to assure that heat transfer to the material is sufficiently rapid for desulfurization and oxidation reaction to occur in the furnace chamber. Suspension roasters are also unpressurized and operate at about 1,800 degrees F.

Fluidized bed roasters require that the sulfide concentrates be finely ground. The concentrates are then suspended and oxidized on a feedstock bed supported on an air column. As in the suspension bed roaster, the reduction rates for desulfurization are more rapid than in the older multiple-hearth processes. Fluidized-bed roasters operate under a pressure slightly lower than atmospheric and at temperatures averaging 1,800 degrees F. In the fluidized-bed process, no additional fuel is required after ignition has been achieved. The major advantages of this roaster are greater throughput capacities and greater sulfur removal capabilities. All of the above calcining processes generate sulfur dioxide, which is controlled and converted to sulfuric acid as a marketable process by-product.

Electrolytic processing of desulfurized calcine consists of three basic steps; leaching, purification, and electrolysis. Leaching refers to the dissolving of the captured calcine in a solution of sulfuric acid to form a zinc sulfate solution. The calcine may be leached once or twice. In the double-leach method, the calcine is dissolved in a slightly acidic solution to remove the sulfates. The calcine is then leached a second time in a stronger solution which dissolves the zinc. This second leaching step is actually the beginning of the third step of purification because many of the iron impurities (such as goethite and hematite) drop out of the solution as well as the zinc.

After leaching, the solution is purified in two or more stages by adding zinc dust. The solution is purified as the dust forces deleterious elements to precipitate so that they can be filtered out. Purification is usually conducted in large agitation tanks. The process takes place at temperatures ranging from 104 to 185 degrees F, and pressures ranging from atmospheric to 2.4 atmospheres. The elements recovered during purification include copper as a cake and cadmium as a metal. After purification the solution is ready for the final step; electrowinning.

Zinc electrowinning takes place in an electrolytic cell and involves running an electric current from a lead-silver alloy anode through the aqueous zinc solution. This process charges the suspended zinc and forces it to deposit onto an aluminum cathode (a plate with an opposite charge) which is immersed in the solution. Every 24 to 48 hours, each cell is shut down, the zinc-coated cathodes removed and rinsed, and the zinc mechanically stripped from the aluminum plates. The zinc concentrate is then melted and cast into ingots, and is often as high as 99.995 percent pure.

Electrolytic zinc smelters contain as many as several hundred cells. A portion of the electrical energy is converted into heat, which increases the temperature of the electrolyte. Electrolytic cells operate at temperature ranges from 86 to 95 degrees F at atmospheric temperature. During electrowinning a portion of the electrolyte passes through cooling towers to decrease its temperature and to evaporate the water it collects during the process.

Sulfur dioxide is generated in large quantities during the primary zinc refining process and sulfur fixation is carried out concurrently with the primary production process in order to meet CAA emission standards. Concentrations of sulfur dioxide in the off-gas vary with the type of roaster operation. Typical concentrations for multiple hearth, suspension, and fluidized bed roasters are 4.5 to 6.5 percent, 10 to 13 percent, and 7 to 12 percent respectively. This sulfur dioxide is then converted into sulfuric acid.

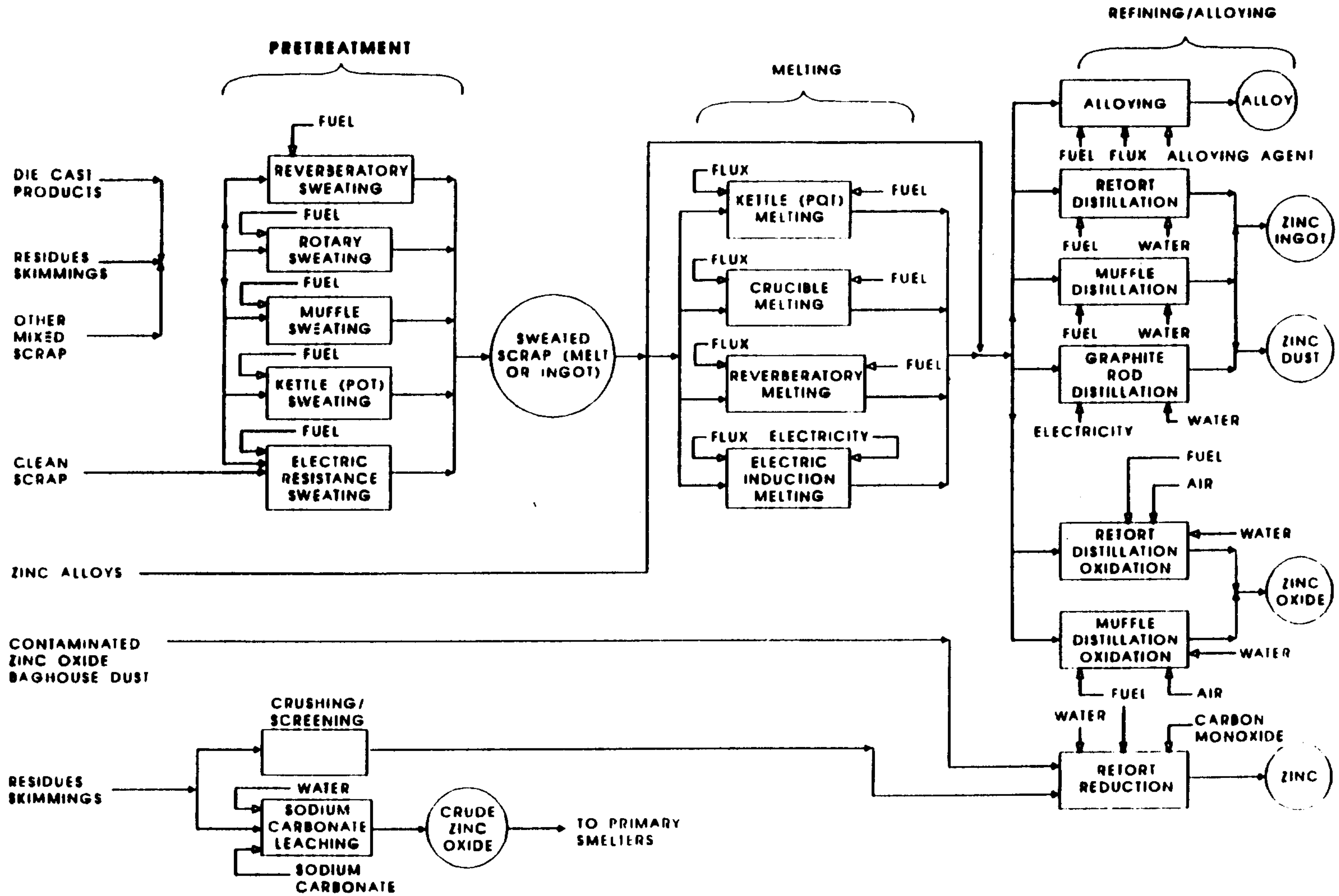
The sulfur recovery process requires that the emissions from the zinc calcining, or roasting process, where over 90 percent of potential sulfur dioxide is generated during primary zinc refining, flow through a filtering material in the air emissions scrubber to capture the sulfur. A blowdown slurry is formed from the mixture of the filtering material and sulfur emissions. This slurry contains not only sulfur, but cadmium and lead, materials that are always present in zinc ore. The acid plant blowdown slurry/sludge that results from thickening of blowdown slurry at primary zinc facilities is regulated by RCRA as hazardous waste K066.

During the electrolytic refining of zinc, solid materials in the electrolytic solution that are not captured previously during purification may precipitate out in the electrolytic cell. When the cells undergo their periodic shutdown to recover zinc, this precipitated waste (known as anode slimes/sludges) is collected during cell cleaning. Once collected it is sent to a waste water treatment plant and the resulting sludges are also regulated by RCRA as hazardous waste K066.

Secondary Zinc Processing

The secondary zinc industry processes scrap metals for the recovery of zinc in the form of zinc slabs, zinc oxide, or zinc dust. Zinc recovery involves three general operations; pretreatment, melting, and refining (see Exhibit 9). Secondary recovery begins with the separation of zinc-containing metals from other materials, usually by magnetics, sink-float, or hand sorting. In situations where nonferrous metals have been mixed in shredder scrap, zinc can be separated from higher-melting metals such as copper and aluminum, by selective melting in a sweating furnace. A sweating furnace (rotary, reverberatory, or muffle furnace) slowly heats the scrap containing zinc and other metals to approximately 787 degrees F. This temperature is sufficient to melt zinc but is still below the melting point of the remaining metals.

Exhibit 9 Secondary Zinc Processing



R0076426

Molten zinc collects at the bottom of the sweat furnace and is subsequently recovered. The remaining scrap is cooled and removed to be sold to other secondary processors. In the case of zinc-galvanized steel, the zinc will be recovered largely in furnace dust after the scrap is charged into a steel making furnace and melted. Almost all of the zinc in electric arc furnace (EAF) dust is first recovered in an upgraded, impure zinc oxide product and is then shipped to primary pyrometallurgical zinc smelter for refinement to metal.

Clean new scrap, mainly brass and rolled zinc clippings and reject diecastings, generally require only re-melting before reuse. During melting, the zinc-containing material is heated in kettle, crucible, reverberatory, and electric induction furnaces. Flux is used to trap impurities from the molten zinc. Facilitated by agitation, flux and impurities float to the surface of the melt as dross, and is skimmed from the surface. The remaining molten zinc may be poured into molds or transferred to the refining operation in a molten state. Drosses, fragmentized diecastings, and mixed high-grade scrap are typically re-melted, followed by zinc distillation with recovery as metal, dust, or oxide. Sometimes, high-purity drosses are simply melted and reacted with various fluxes to release the metallic content; often the recovered metal can be used directly as a galvanizing brightener or master alloy. Zinc alloys are produced from pretreated scrap during sweating and melting processes. The alloys may contain small amounts of copper, aluminum, magnesium, iron, lead, cadmium, and tin. Alloys containing 0.65 to 1.25 percent copper are significantly stronger than unalloyed zinc.

Medium and low-grade skims, oxidic dust, ash, and residues generally undergo an intermediate reduction-distillation pyrometallurgical step to upgrade the zinc product before further treatment; or, they are leached with acid, alkaline, or ammoniacal solutions to extract zinc. For leaching, the zinc containing material is crushed and washed with water, separating contaminants from zinc-containing material. The contaminated aqueous stream is treated with sodium carbonate to convert zinc chloride into sodium chloride and insoluble zinc hydroxide. The sodium chloride is separated from the insoluble residues by filtration and settling. The precipitate zinc hydroxide is dried and calcined (dehydrated into a powder at high temperature) to convert it into crude zinc oxide. The zinc oxide product is usually refined to zinc at primary zinc smelters. The washed zinc-containing metal portion becomes the raw material for the melting process.

Distillation retorts and furnaces are used either to reclaim zinc from alloys or to refine crude zinc. Bottle retort furnaces consist of a pear-shaped ceramic retort (a long-necked vessel used for distillation).

Bottle retorts are filled with zinc alloys and heated until most of the zinc is vaporized, sometimes as long as 24 hours. Distillation involves vaporization of zinc at temperatures from 1800 to 2280 degrees F, and condensation as zinc dust or liquid zinc. Zinc dust is produced by vaporization and rapid cooling, and liquid zinc results when the vaporous product is condensed slowly at moderate temperatures.

A muffle furnace is a continuously charged retort furnace which can operate for several days at a time. Molten zinc is charged through a feed well that also acts as an airlock. Muffle furnaces generally have a much greater vaporization capacity than bottle retort furnaces.

Air pollution control can be an area of concern when pyrometallurgical processes are employed in the secondary recovery of zinc. When the recovery process used is simply an iron pot re-melt operation to produce zinc metal, fumes will not normally be generated. If slab zinc is needed and a rotary furnace is used, any air emissions are captured directly from the venting system (a rotating furnace sweats, or melts, the zinc separating it from drosses with different melting points, which allows it to be poured off separately). Air emissions become more of a concern when more complicated processes are used to produce zinc powder. Retort and muffle furnaces used to produce zinc powder heat the zinc and other charges to such a high temperature that the zinc vaporizes and is captured in the pollution control equipment. It is this zinc oxide dust that is the process' marketable product. Hoods are employed around the furnace openings used to add additional charge. The fumes collected from the hoods are not normally of high quality and will be used for products like fertilizer and animal feed.

For the most part, the zinc materials recovered from secondary materials such as slab zinc, alloys, dusts, and compounds are comparable in quality to primary products. Zinc in brass is the principal form of secondary recovery, although secondary slab zinc has risen substantially over the last few years because it has been the principal zinc product of EAF dust recycling. Impure zinc oxide products and zinc-bearing slags are sometimes used as trace element additives in fertilizers and animal feeds. Currently about 10 percent of the domestic requirement for zinc is satisfied by old scrap.

Due to environmental concerns, both domestic and world-wide secondary recovery of zinc (versus disposal) is expected to increase. However, the prospect for gains higher than 35 to 40 percent of zinc consumption is relatively poor because of the dissipative nature of zinc vapor.

VI.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary zinc processing are presented by media in Exhibit 10.

Exhibit 10
Process Materials Inputs/Pollution Outputs - Zinc

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Zinc Calcining	Zinc ore, coke	Sulfur dioxide, particulate matter containing zinc and lead		Acid plant blowdown slurry (K066)
Zinc Leaching	Zinc calcine, sulfuric acid, limestone, spent electrolyte		Wastewaters containing sulfuric acid	
Zinc Purification	Zinc-acid solution, zinc dust		Wastewaters containing sulfuric acid, iron	Copper cake, cadmium
Zinc Electrowinning	Zinc in a sulfuric acid/aqueous solution, lead-silver alloy anodes, aluminum cathodes, barium carbonate, or strontium, colloidal additives		Dilute sulfuric acid	Electrolytic cell slimes/sludges (K066)
Secondary Zinc Smelting	Zinc scrap, electric arc furnace dust, drosses, diecastings, fluxes	Particulates		Slags containing copper, aluminum, iron, lead, and other impurities
Secondary Zinc Reduction Distillation	Medium-grade zinc drosses, oxidic dust, acids, alkalines, or ammoniacal solutions	Zinc oxide fumes		Slags containing copper, aluminum, iron, lead, and other impurities

Primary Zinc Processing

Primary zinc processing activities generate air emissions, process wastes, and other solid-phase wastes. Air emissions are generated during roasting, which is responsible for more than 90 percent of the potential SO_2 emissions. Approximately 93 to 97 percent of the sulfur in the feed is emitted as sulfur oxides. Sulfur dioxide emissions from the roasting process at all four primary zinc processing facilities are recovered at on-site sulfuric acid plants. Much of the particulate matter emitted from primary zinc facilities is also attributable to roasters.

Though the amount and composition of particulate varies with operating parameters, the particulate is likely to contain zinc and lead.

Wastewaters may be generated during the leaching, purification, and electrowinning stages of primary zinc processing when electrolyte and acid solutions become too contaminated to be reused again. This wastewater needs to be treated before discharge.

Solid wastes, some of which are hazardous, are generated at various stages in primary zinc processing. Slurry generated during the operation of sulfuric acid plants is regulated as hazardous waste K066 as is the sludge removed from the bottom of electrolytic cells. The solid copper cake generated during purification is generally sent off-site to recover the copper.

Secondary Zinc Processing

Secondary zinc processing generates air emissions and solid-phase wastes. Air emissions result from sweating and melting and consist of particulate, zinc fumes, other volatile metals, flux fumes, and smoke generated by the incomplete combustion of grease, rubber, and plastics in zinc scrap. Zinc fumes are negligible at low furnace temperatures. Substantial emissions may arise from incomplete combustion of carbonaceous material in the zinc scrap. These contaminants are usually controlled by afterburners, and particulate emissions are most commonly recovered by fabric filters. Emissions from refining operations are mainly metallic fumes. Distillation/oxidations operations emit their entire zinc oxide product in the exhaust dust. Zinc oxide is usually recovered in fabric filters with collection efficiencies of 9 to 99 percent.

The secondary zinc recovery process generates slags that contain metals such as copper, aluminum, iron, and lead. Though slag generated during primary pyrometallurgical processes is exempt from regulation as a hazardous waste under RCRA, slag resulting from secondary processing is not automatically exempt. Therefore if secondary processing slag exhibits a characteristic (e.g., toxicity for lead), it would need to be managed as a hazardous waste.

VII. MANAGEMENT OF CHEMICALS IN WASTESTREAM

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 11 shows that the primary and secondary metals industry managed about 1.9 billion pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 35 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 70 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (12.8 percent), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has increased and the portions treated or managed through energy recovery on-site have remained steady, but are projected to decrease, between 1992 and 1995.

Exhibit 11
Source Reduction and Recycling Activity for SIC 333-334

A	B	C	D	E	F	G	H	I	J
Year	Production Related Waste Volume (10^6lbs.)*	% Reported as Released and Transferred	On-Site			Off-Site			Remaining Releases and Disposal
			% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	
1992	1,875	28%	42.98%	1.05%	23.93%	17.38%	0.15%	0.89%	12.68%
1993	1,991	35%	44.77%	0.99%	23.75%	17.17%	0.16%	0.33%	12.85%
1994	2,014	—	46.79%	0.88%	23.12%	16.60%	0.14%	0.35%	12.11%
1995	2,023	—	48.42%	1.01%	21.16%	16.39%	0.18%	0.39%	12.45%

VIII. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds.

Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

R0076434

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

VIII.A. EPA Toxics Release Inventory for the Nonferrous Metals Industry

TRI release amounts listed below are not associated with non-compliance with environmental laws. These facilities appear based on self-reported data submitted to the Toxics Release Inventory program.

Exhibits 11-16 illustrate TRI releases and transfers for the primary nonferrous metals smelting and refining industry (SIC 333). For SIC 333 as a whole, chlorine comprises the largest number of TRI releases. This is reflected in the fact that chlorine is a by-product of the magnesium industry and the largest reporter for SIC 333 is a magnesium facility. The other top SIC 333 releases are copper compounds, zinc compounds, lead compounds, and sulfuric acid, all of which are by-products of the processes discussed previously.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 12
Top 10 TRI Releasing Primary Metal Industries Facilities (SIC 333)

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
3339	73,300,250	Magnesium Corp. of America, Rowley Plant	Rowley	UT
3339	42,728,498	Asarco, Inc., E. Helena Plant	East Helena	MT
3331	14,773,759	Phelps Dodge Mining Co., Hidalgo Smelter	Playas	NM
3331	11,717,315	Kennecott Utah Copper	Magna	UT
3339	8,194,328	DOE Run Co., Herculaneum Smelter	Herculaneum	MO
3331	8,142,539	Chino Mines Co., Hurley Smelter	Hurley	NM
3339	7,085,302	Asarco, Inc., Glover Plant	Annapolis	MD
1021, 3331, 3351	6,223,505	Cyprus Miami Mining Corp.	Claypool	AZ
3331	5,970,420	Asarco,.Inc., Amarillo Copper Refinery	Amarillo	TX
3321, 3365	4,496,188	GMC Powertrain Group, Saginaw Grey Iron	Saginaw	MI

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 13
Top 10 TRI Releasing Primary Smelting and Refining Facilities

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	73,300,250	Magnesium Corp. of America, Rowley Plant	Rowley	UT
2	42,728,498	Asarco Inc., E. Helena Plant	East Helena	MT
3	14,773,759	Phelps Dodge Mining Co., Hidalgo Smelter	Playas	NM
4	1,1717,315	Kennecott Utah Copper	Magna	UT
5	8,194,328	Doe Run Co., Herculaneum Smelter	Herculaneum	MO
6	8,142,539	Chino Mines Co., Hurley Smelter	Hurley	NM
7	7,085,302	Asarco, Inc., Glover Plant	Annapolis	MD
8	5,970,420	Asarco, Inc., Amarillo Copper Refinery	Amarillo	TX
9	1,123,708	Glenbrook Nickel Co.	Riddle	OR
10	780,927	Alcoa Rockdale Works	Rockdale	TX

Source: U.S. EPA, Toxics Release Inventory Database, 1993..

Note: *Being included on these lists does not mean that the release is associated with non-compliance with environmental laws.*

R0076437

Exhibit 14
TRI Reporting Primary Smelting and Refining Facilities (SIC 333) by State

State	Number of Facilities	State	Number of Facilities
AZ	1	NM	2
CO	1	NY	2
CT	1	OH	3
IN	1	OR	3
KY	1	PA	2
MD	1	SC	1
MO	3	TX	5
MT	3	UT	3
NC	2	VA	1
NE	1	WA	7
NJ	1		

Source: U.S. EPA, Toxics Release Inventory Database, 1993..

Exhibit 15
Releases for Primary Smelting and Refining (SIC 333) in TRI, by Number of Facilities (releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Average Releases per Facility
Copper	20	9412	248340	508	0	500254	758514	37926
Chlorine	19	153751	67037082	2803	0	11	67193647	3536508
Sulfuric Acid	15	24527	1013009	0	5700000	100920	6838456	455897
Hydrogen Fluoride	14	1565588	1520212	5	0	0	3085805	220415
Manganese	11	15	5130	0	0	5	5150	468
Zinc Compounds	10	47545	102940	8505	5	42345637	42504632	4250463
Chromium	8	10	398	5	0	0	413	52
Copper Compounds	8	559987	408015	1502	65000	27574267	28608771	3576096
Hydrochloric Acid	8	3853	6155294	0	5	5	6159157	769895
Lead Compounds	8	68834	274504	7263	730	7713452	8064783	1008098
Arsenic Compounds	7	7147	30181	3005	52000	2190652	2282985	326141
Antimony Compounds	6	6319	4398	3143	2100	661740	677700	112950
Cadmium Compounds	6	1286	18912	311	0	39734	60243	10041
Nickel Compounds	6	1323	8956	225	4200	1149028	1163732	193955
Nitric Acid	6	15	23670	0	5	15	23705	3951
Aluminum (Fume Or Dust)	5	5760	32472	44	0	5	38281	7656
Lead	5	138589	96836	18	0	2352628	2588071	517614
Nickel	5	345	781	4	0	29052	30182	6036
Silver Compounds	5	848	2210	270	100	19633	23061	4612
Barium Compounds	4	5	1850	0	890	456308	459053	114763
Arsenic	3	270	28264	9	0	7114	35657	11886
Cadmium	3	981	6181	11	0	4824	11997	3999
Chromium Compounds	3	250	592	250	0	190005	191097	63699
Manganese Compounds	3	620	823	0	0	2400643	2402086	800695
Selenium Compounds	3	1350	38000	250	2300	120265	162165	54055
Zinç (Fume Or Dust)	3	10190	25682	46	0	4010295	4046213	1348738
1,1,1-Trichloroethane	3	75031	0	0	0	0	75031	25010
Anthracene	2	250	25487	0	0	0	25737	12869
Antimony	2	500	10915	5	0	0	11420	5710
Cobalt	2	250	5	0	0	0	255	128
Cobalt Compounds	2	669	262	255	0	5	1191	596
Cyanide Compounds	2	0	0	500	0	0	500	250
Ethylene Glycol	2	0	0	0	0	0	0	0
Phosphoric Acid	2	0	0	0	0	0	0	0
Thiourea	2	60	0	0	5300	255	5615	2808
Ammonia	1	250	0	0	0	0	250	250
Beryllium Compounds	1	0	0	0	0	0	0	0
Cresol (Mixed Isomers)	1	250	0	250	0	750	1250	1250
Decabromodiphenyl Oxide	1	0	250	0	0	0	250	250
Dichlorodifluoromethane	1	18000	0	0	0	0	18000	18000
M-Xylene	1	14000	0	0	0	0	14000	14000
Naphthalene	1	0	467	0	0	0	467	467
Phenol	1	0	0	1	0	0	1	1
Styrene	1	1900	0	0	0	5	1905	1905
Thallium	1	5	250	0	0	755	1010	1010
Titanium Tetrachloride	1	250	250	0	0	0	500	500
1,2,4-Trimethylbenzene	1	18000	0	0	0	0	18000	18000
Total	---	2,738,235	77,122,618	29,188	5,832,635	91,868,262	177,590,938	---

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0076439

Exhibit 16
Transfers for Primary Smelting and Refining (SIC 333) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharge	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Average Transfers per Facility
Copper	20	5	17596	124723	0	0	142324	7116
Chlorine	19	0		9991	0	0	9991	526
Sulfuric Acid	15	1	600	6454346	0	0	6454947	430330
Hydrogen Fluoride	14	0	0	0	0	0	0	0
Manganese	11	0	14	46752	0	0	46766	4251
Zinc Compounds	10	760	2692570	750680	833231	0	4277241	427724
Chromium	8	0	0	2361	0	0	2361	295
Copper Compounds	8	459	2900850	3882069	93989	0	6877367	859671
Hydrochloric Acid	8	0	0	0	0	0	0	0
Lead Compounds	8	2401	2253086	2289461	11239	0	4556187	569523
Arsenic Compounds	7	386	1649205	174013	634487	0	2458091	351156
Antimony Compounds	6	1749	345100	29836	15262	0	391947	65325
Cadmium Compounds	6	346	26097	420187	62987	0	509617	84936
Nickel Compounds	6	260	5	237910	3931	0	242106	40351
Nitric Acid	6	0	5	0	11000	0	11005	1834
Aluminum (Fume Or Dust)	5	0	317650	3826700	0	0	4144350	828870
Lead	5	5	5	640899	0	0	640909	128182
Nickel	5	5		633	0	0	638	128
Silver Compounds	5	174	5765	8756	255	0	14950	2990
Barium Compounds	4	0	0	0	0	0	0	0
Arsenic	3	5	250	55713	0	0	55968	18656
Cadmium	3	5		212387	0	0	212392	70797
Chromium Compounds	3	0	1200	15000	0	0	16200	5400
Manganese Compounds	3	41	0	5639	0	0	5680	1893
Selenium Compounds	3	0	19005	0	0	0	19005	6335
Zinc (Fume Or Dust)	3	250	0	412568	0	0	412818	137606
1,1,1-Trichloroethane	3	0	0	0	250	0	250	83
Anthracene	2	0	14032	0	0	0	14032	7016
Antimony	2	0	4110	1911550	0	0	1915660	957830
Cobalt	2	0	0	0	0	0	0	0
Cobalt Compounds	2	250	0	77640	0	0	77890	38945
Cyanide Compounds	2	0	53213	0	1813	0	55026	27513
Ethylene Glycol	2	0	0	0	8673	0	8673	4337
Phosphoric Acid	2	0	0	0	160	0	160	80
Thiourea	2	0	0	0	0	0	0	0
Ammonia	1	0	0	0	0	0	0	0
Beryllium Compounds	1	0	0	0	0	0	0	0
Cresol (Mixed Isomers)	1	0	0	0	0	0	0	0
Decabromodiphenyl Oxide	1	0	4374	0	0	0	4374	4374
Dichlorodifluoromethane	1	0	0	0	0	0	0	0
M-Xylene	1	0	0	0	0	0	0	0
Naphthalene	1	0	0	0	0	0	0	0
Phenol	1	0	0	0	0	0	0	0
Styrene	1	0	0	0	0	0	0	0
Thallium	1	5	0	750	0	0	755	755
Titanium Tetrachloride	1	0	0	0	0	0	0	0
4-Trimethylbenzene	1	0	0	0	0	0	0	0
Total	225	7,107	10,304,732	21,590,564	1,677,277	0	33,579,680	108187.82

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0076440

Exhibits 17-20 illustrate the TRI releases and transfers for the secondary nonferrous metals smelting and refining industry (SIC 334). For the industry as a whole, the largest releases were the various metals: aluminum (fume or dust), zinc compounds, lead compounds, copper and zinc (fume or dust).

Exhibit 17
Top 10 TRI Releasing Secondary Smelting and Refining (SIC 334)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	881,970	Gulf Chemical & Metallurgical Corp.	Freeport	TX
2	854,630	Imco Recycling Inc.	Morgantown	KY
3	758,089	Alabama Reclamation Plant	Sheffield	AL
4	329,250	Imco Recycling Inc.	Sapulpa	OK
5	288,070	Alcan Recycling Div.	Berea	KY
6	184,460	Wabash Alloys	Wabash	IN
7	147,455	Chemetco Inc.	Hartford	IL
8	146,852	Schuylkill Metals Corp.	Baton Rouge	LA
9	140,000	Southern Reclamation Co.	Sheffield	AL
10	131,899	North Chicago Refiners & Smelters	North Chicago	IL

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on these lists does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 18
TRI Reporting Secondary Smelting and Refining Facilities (SIC 334) by State

State	Number of Facilities
AL	10
AR	3
AZ	1
CA	12
CT	2
FL	1
GA	2
IL	17
IN	13
KS	2
KY	5
LA	1
MA	5
MD	1
MI	7
MN	4
MO	4

State	Number of Facilities
MS	1
NC	1
NJ	5
NM	1
NY	8
OH	12
OK	3
PA	13
RI	3
SC	2
TN	9
TX	6
UT	1
VA	1
WI	4
WV	3

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 19
Releases for Secondary Smelting and Refining (SIC 334) in TRI, by Number of Facilities (Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Copper	74	17235	56198	2720	0	221287	297440	4019
Nickel	38	5646	5873	262	0	12934	24715	650
Chlorine	32	5103	6304	0	0	0	11407	356
Lead	30	13964	29230	571	0	750	44515	1484
Copper Compounds	29	11921	35205	358	0	1500	48984	1689
Lead Compounds	25	11211	115573	404	0	147930	275118	11005
Manganese	25	7848	3547	10	0	74536	85941	3438
Aluminum (Fume Or Dust)	24	34297	196604	922	11	641760	873594	36400
Zinc Compounds	24	41195	263420	3049	0	0	307664	12819
Sulfuric Acid	21	6917	1730	0	0	0	8647	412
Chromium	19	1465	1937	255	0	2005	5662	298
Zinc (Fume Or Dust)	19	57759	79392	331	0	0	137482	7236
Hydrochloric Acid	14	17116	604670	0	0	0	621786	44413
Nickel Compounds	13	1113	1492	297	0	0	2902	223
Chromium Compounds	10	276	617	0	0	0	893	89
Ammonia	9	1343335	168094	53229	57053	353800	1975511	219501
Antimony	9	364	373	586	0	5	1328	148
Antimony Compounds	9	115	1294	44	0	67760	69213	7690
Silver	9	21	517	251	0	0	789	88
Silver Compounds	9	1033	823	5	0	0	1861	207
Manganese Compounds	8	1074	3426	570	0	0	5070	634
Nitric Acid	8	1008	2628	0	0	0	3636	455
Arsenic	7	310	308	36	0	5	659	94
Arsenic Compounds	7	10	573	16	0	27104	27703	3958
Barium Compounds	6	298	2011	0	0	0	2309	385
Cadmium Compounds	6	545	5409	20	0	0	5974	996
Cobalt	6	905	680	5	0	20	1610	268
Cadmium	3	250	874	281	0	0	1405	468
Hexachloroethane	3	0	11536	0	0	0	11536	3845
Aluminum Oxide (Fibrous Form)	2	0	53	0	0	0	53	27
Barium	2	20	45	0	0	0	65	33
Beryllium	2	0	5	0	0	0	5	3
Methanol	2	1000	0	0	0	0	1000	500
Molybdenum Trioxide	2	500	4205	18750	0	0	23455	11728
Ammonium Sulfate (Solution)	1	250	0	0	0	0	250	250
Cobalt Compounds	1	0	0	0	0	0	0	0
Mercury Compounds	1	250	5	5	0	5	265	265
Phosphoric Acid	1	0	0	0	0	0	0	0
Phosphorus (Yellow Or White)	1	0	0	0	0	0	0	0
Polychlorinated Biphenyls	1	0	0	0	0	0	0	0
Selenium	1	0	1	0	0	0	1	1
Xylene (Mixed Isomers)	1	250	0	0	0	0	250	250
1,1,1-Trichloroethane	1	250	0	0	0	0	250	250
Totals	---	1,584,854	1,604,652	82,977	57,064	1,551,401	4,880,948	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 20
Transfers for Secondary Smelting and Refining (SIC 334) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharge	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Total per Facility
Copper	74	7024	139130	20126255	20233	0	20292642	274225
Nickel	38	282	9366	78143	3984	0	91775	2415
Chlorine	32	2545	0	0	0	0	2545	80
Lead	30	1106	675459	1749221	16055	0	2441841	81395
Copper Compounds	29	82	658756	806437	537038	0	2002313	69045
Lead Compounds	25	810	5543943	11216399	1020276	0	17781428	711257
Manganese	25	501	108806	67048	1236	0	177591	7104
Aluminum (Fume Or Dust)	24	500	966226	15417	0	0	982143	40923
Zinc Compounds	24	1661	129752	5571000	229930	0	5932343	247181
Sulfuric Acid	21	5	0	7332842	0	0	7332847	349183
Chromium	19	51	11812	43378	83	0	55324	2912
Zinc (Fume Or Dust)	19	5	164242	1048567	8180	0	1220994	64263
Hydrochloric Acid	14	0	750	56965	27557	0	85272	6091
Nickel Compounds	13	23	34996	1531600	4777	0	1571396	120877
Chromium Compounds	10	251	165015	214000	4664	0	383930	38393
Ammonia	9	0	621718	0	0	0	621718	69080
Antimony	9	927	127443	8180	880	0	137430	15270
Antimony Compounds	9	614	935418	641800	10710	0	1588542	176505
Silver	9	755	0	8680	0	0	9435	1048
Silver Compounds	9	20	835	485550	186	0	486591	54066
Manganese Compounds	8	75	29005	128500	0	0	157580	19698
Nitric Acid	8	5	1500	11299	750	0	13554	1694
Arsenic	7	67	51353	0	1784	0	53204	7601
Arsenic Compounds	7	110	196876	55734	0	0	252720	36103
Barium Compounds	6	4448	115647	82700	31094	0	233889	38982
Cadmium Compounds	6	257	0	393000	0	0	393257	65543
Cobalt	6	5	905	35045	15	0	35970	5995
Cadmium	3	0	12930	23795	900	0	37625	12542
Hexachloroethane	3	0	0	0	0	0	0	0
Aluminum Oxide (Fibrous Form)	2	0	0	0	0	0	0	0
Barium	2	5	62710	0	250	0	62965	31483
Beryllium	2	0	0	7930		0	7930	3965
Methanol	2	0	0	0	0	0	0	0
Molybdenum Trioxide	2	0		165100	17150	0	182250	91125
Ammonium Sulfate (Solution)	1	0	0	0	0	0	0	0
Cobalt Compounds	1	0	0	0	0	0	0	0
Mercury Compounds	1	0	33200	0	10	0	33210	33210
Phosphoric Acid	1	0	0	0	0	0	0	0
Phosphorus (Yellow Or White)	1	250	0	0	0	0	250	250
Polychlorinated Biphenyls	1	0	255	0	0	0	255	255
Selenium	1	0	2673	0	510	0	3183	3183
Xylene (Mixed Isomers)	1	0	0	0	0	0	0	0
1,1,1-Trichloroethane	1	0	0	0	0	0	0	0
Totals	----	22,384	10,800,721	51,904,585	1,938,252	0	64,665,942	-----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

R0076444

VIII.B. Summary of the Selected Pollutants Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[1]. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

Chlorine

Toxicity. Breathing small amounts of chlorine for short periods of time can affect the respiratory tract in humans, causing symptoms such as coughing and chest pain. It is irritating to the skin, eyes, and respiratory tract. Repeated long-term exposure to chlorine can cause adverse effects on the blood and respiratory systems.

[1] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

Ecologically, chlorine is highly toxic to aquatic organisms at low doses.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Most of the chlorine released to the environment will quickly evaporate.

Physical Properties. Chlorine is a highly reactive gas.

Copper

Toxicity. Metallic copper probably has little or no toxicity, although copper salts are more toxic. Inhalation of copper oxide fumes and dust has been shown to cause metal fume fever: irritation of the upper respiratory tract, nausea, sneezing, coughing, chills, aching muscles, gastric pain, and diarrhea. However, the respiratory symptoms may be due to a non-specific reaction to the inhaled dust as a foreign body in the lung, and the gastrointestinal symptoms may be attributed to the conversion of copper to copper salts in the body.

It is unclear whether long-term copper poisoning exists in humans. Some have related certain central nervous system disorders, such as giddiness, loss of appetite, excessive perspiration, and drowsiness to copper poisoning. Long-term exposure to copper may also cause hair, skin, and teeth discoloration, apparently without other adverse effects.

People at special risk from exposure to copper include those with impaired pulmonary function, especially those with obstructive airway diseases, since the breathing of copper fumes might cause exacerbation of pre-existing symptoms due to its irritant properties.

Ecologically, copper is a trace element essential to many plants and animals. However, high levels of copper in soil can be directly toxic to certain soil microorganisms and can disrupt important microbial processes in soil, such as nitrogen and phosphorus cycling.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Copper is typically found in the environment as a solid metal in soils and soil sediment in surface water. There is no evidence that biotransformation processes have a significant bearing on the fate and transport of copper in water.

Hydrochloric Acid

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Lead

Toxicity. Short-term lead poisoning is relatively infrequent and occurs from ingestion of acid soluble lead compounds or inhalation of lead vapors. Symptoms include nausea, severe abdominal pain, vomiting, diarrhea or constipation, shock, tingling, pain, and muscle weakness, and kidney damage. Death may occur in one to two days. If the patient survives the acute episode, characteristic signs and symptoms of chronic lead poisoning are likely to appear. Chronic lead poisoning affects the gastrointestinal, neuromuscular, blood, kidney, and central nervous systems. Individuals with chronic lead poisoning appear ashen, with an appearance of "premature aging," with stooped posture, poor muscle tone, and emaciation. Neuromuscular syndrome (muscle weakness, easy fatigue, localized paralysis) and central nervous system syndrome (progressive mental deterioration, decreased intelligence, loss of motor skills and speech, hyperkinetic and aggressive behavior disorders, poorly controlled convulsive disorder, severe learning impairment) usually result from intense exposure, while the abdominal syndrome (anorexia, muscle discomfort, malaise, headache, constipation, severe abdominal pain, persistent metallic taste) is a more common manifestation of a very slowly and insidiously developing intoxication.

In the U.S., the central nervous system syndrome is usually more common among children, while the gastrointestinal syndrome is more prevalent in adults. Exposure to lead is also linked to decreased fertility in men. Lead is a probable human carcinogen, based on sufficient animal evidence and inadequate human evidence. Populations at increased risk of toxicity from exposure to lead include developing fetuses and young children, individuals with decreased kidney function, and children with sickle-cell anemia.

Environmental Fate. If released or deposited on soil, lead will be retained in the upper two to five centimeters of soil. Leaching is not important under normal conditions, nor generally is the uptake of lead from soil into plants. Lead enters water from atmospheric fallout, runoff or wastewater; it is effectively removed from the water column to the sediment predominantly by adsorption to organic matter and clay minerals. Some lead reenters the water column through methylation by microorganisms. Volatilization is negligible. Lead does not appear to bioconcentrate significantly in fish but does in some shellfish such as mussels. When released to the atmosphere, lead will generally be in dust or adsorbed to particulate matter and subject to gravitational settling.

Zinc and Zinc Compounds

Toxicity. Zinc is a nutritional trace element; toxicity from ingestion is low. Severe exposure to zinc might give rise to gastritis with vomiting due to swallowing of zinc dusts. Short-term exposure to very high levels of zinc is linked to lethargy, dizziness, nausea, fever, diarrhea, and reversible pancreatic and neurological damage. Long-term zinc poisoning causes irritability, muscular stiffness and pain, loss of appetite, and nausea.

Zinc chloride fumes cause injury to mucous membranes and to the skin. Ingestion of soluble zinc salts may cause nausea, vomiting, and purging.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Significant zinc contamination of soil is only seen in the vicinity of industrial point sources. Zinc is a relatively stable soft metal, though burns in air. Zinc bioconcentrates in aquatic organisms.

VIII.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 21 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 21
Pollutant Releases (Short Tons/Year)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	**448,758**	**55,658**	**20,074**	**22,490**	**373,007**	**27,375**
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

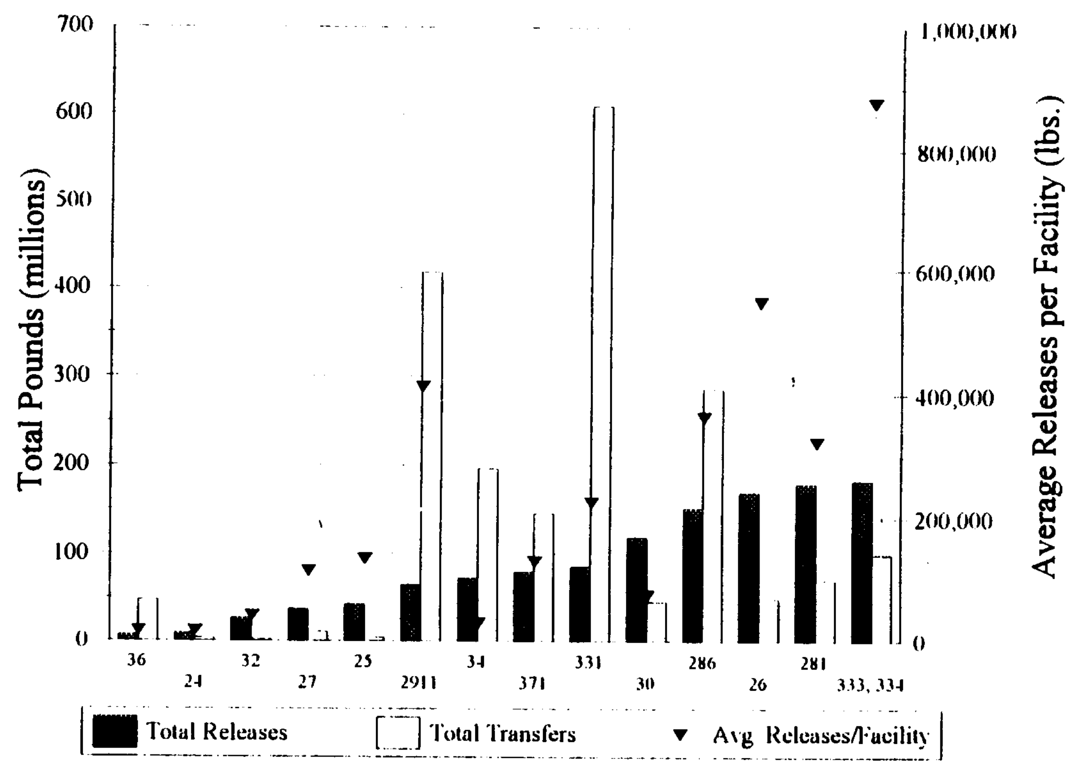
R0076449

VIII.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 22 is a graphical representation of a summary of the 1993 TRI data for the nonferrous metals industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 23 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of nonferrous metals industry, the 1993 TRI data presented here covers 208 facilities. These facilities listed SIC 333-334 nonferrous metals industry as a primary SIC code.

Exhibit 22: Summary of 1993 TRI Data:
Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accecessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0076451

Exhibit 23
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases		Transfers		Total Releases + Transfers (10^6 pounds)	Average Release+ Transfers per Facility (pounds)
			Total Releases (10^6 pounds)	Average Releases per Facility (pounds)	1993 Total (10^6 pounds)	Average Transfers per Facility (pounds)		
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	24	491	8.4	17,036	3.5	7,228	11.9	24,000
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronics/Computers	36	406	6.7	16,520	47.1	115,917	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	371	609	79.3	130,158	145.5	238,938	224.8	369,000
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72.0	30,476	195.7	82,802	267.7	123,000
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	**333, 334**	**208**	**182.5**	**877,269**	**98.2**	**472,335**	**280.7**	**1,349,000**
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IX. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the Nonferrous Metals Industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

IX.A. Identification of Pollution Prevention Activities in Use

Pollution prevention, whether through source material reduction/reuse, or waste recycling, is practiced in various sectors of the nonferrous metals industry. Pollution prevention techniques and processes currently used by the nonferrous metals industry can be grouped into the following general categories:

- Process equipment modification,
- Raw materials substitution or elimination,
- Solvent recycling, and
- Precious metals recovery.

It is interesting to note that while the stated rationale for the use of many of these techniques or processes is applicable environmental regulations, their use is both fairly universal and profitable.

Process equipment modification is used to reduce the amount of waste generated. Many copper, lead, and zinc refiners have modified their production processes by installing sulfur fixation equipment. This equipment not only captures the sulfur before it enters the atmosphere (helping the refining plant meet CAA sulfur standards), but processes it so that a marketable sulfuric acid is produced. Another example is the use of pre-baked anodes in primary aluminum refining. When a pre-baked anode is used, the electrolytic cell, or pot, can be closed, thereby increasing the efficiency of the collection of fluoride emissions. In addition, new carbon liners have been developed which significantly increase the life of the aluminum reduction cell. This has resulted in large reductions in the amount of spent potliner material (hazardous waste K088) generated by the aluminum industry.

Raw material substitution or elimination is the replacement of raw materials with other materials that produce less waste, or a non-toxic waste. Material substitution is inherent in the secondary nonferrous metals industry primarily by substituting scrap metal, slag, and baghouse dust for ore feedstock. All of these materials, whether in the form of aluminum beverage cans, copper scrap, or lead-acid batteries, are commonly added to other feedstock or charges (usually slag containing residual metals) to produce marketable grades of metal. Primary nonferrous metals refining also uses previously refined metals as feedstock, especially zinc-containing electric arc furnace dust (a by-product of the iron and steel industry).

Precious metals recovery is the modification of a refining process to allow the capture of marketable precious metals such as gold and silver. Like sulfur fixation, precious metals recovery is a common waste minimization practice. During primary copper smelting, appreciable amounts of silver and gold present in copper ore will be concentrated into the anode copper and can be recovered as a by-product in the electrorefining process (as the copper anode is electrochemically dissolved and the copper attaches itself to the cathode, silver and gold drop out and are captured in the slime at the bottom of the tank). In the lead refining process the copper often present in lead ore is removed during the initial lead bullion smelting process as a constituent of dross. Silver and gold are removed from the lead bullion later in the process by adding certain fluxes which cause them to form an impure alloy. The alloy is then refined electrolytically and separated into gold and silver. Precious metals recovery also takes place during zinc refining to separate out copper, a frequent impurity in zinc ore. Copper is removed from the zinc ore during the zinc purification process (after zinc undergoes leaching, zinc dust is added which forces many of the deleterious elements to drop out; copper is recovered in a cake form and sent for refining).

IX.B. Important Pollution Prevention Case Studies

Various pollution prevention case histories have been documented for nonferrous metals refining industries. In particular, the actions of the AMPCO Metal Manufacturing Company, Inc. typify industry efforts to simultaneously lessen the impact of the industrial process on the environment, reduce energy consumption, and lower production costs.

AMPCO Metal Manufacturing Company, Inc., in Ohio is participating in the development of pollution prevention technologies. The project, sponsored by the U.S. DOE and EPA, consists of researching and developing the use of electric induction to replace fossil fuel combustion currently used to heat tundishes. Tundishes are used to contain the heated reservoir of molten alloy in the barstock casting process. The fossil fuel combustion process currently used requires huge amounts of energy and produces tremendous amounts of waste gases, including combustion bases and lead and nickel emissions. According to new OSHA regulations, lead emissions from foundries must be reduced by 80 percent by 1998.

Heating the tundish by electric induction instead of fossil fuel combustion will substantially improve the current process, saving energy and reducing pollution. Energy efficiency will jump to an estimated 98 percent, saving 28.9 billion Btu/yr/unit. Industry-wide energy savings in 2010 are estimated to be 206 billion Btu/yr, assuming a 70 percent adoption at U.S. foundries.

In addition to the energy savings, the new process also has substantial environmental benefits. Along with the elimination of lead and nickel gases, carbon dioxide, carbon monoxide, and nitrogen oxide emissions from combustion will decrease. The consumption of refractory (a heat-resisting ceramic material) will decline by 80 percent, resulting in a similar reduction of refractory waste disposal. In all, prevention of various forms of pollution is estimated to be 147 million lb (66.7 million kg)/yr by 2010.

Economically, the elimination of lead and nickel emissions will result in an improved product because exposure of the metal to combustion gases in the current process results in porosity and entrainment of hydrogen gas in the metal. Overall, AMPCO estimates an annual savings in operations and maintenance expenses of $1.2 million with the use of this technology. Assuming the same 70 percent industry adoption, economic savings by 2010 could reach $5.8 million. Without the new electric induction heating process, the capital costs required for compliance could be $3 million.

X. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section X.A contains a general overview of major statutes
- Section X.B contains a list of regulations specific to this industry
- Section X.C contains a list of pending and proposed regulations

The descriptions within Section X are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

X.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities

that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties

that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the

Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)).

These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

X.B. Industry-Specific Requirements

Clean Water Act (CWA)

The Clean Water Act regulates the amount of chemicals/toxins released by industries via direct and indirect wastewater/effluent discharges. Regulations developed to implement this Act establish effluent guidelines and standards for different industries. These standards usually set concentration-based limits on the discharge of a given chemical by any one facility. If a facility is discharging directly into a body of water, it must obtain a National Pollution Discharge Elimination System (NPDES) permit. If a facility is discharging to a publicly owned treatment works (POTW), it must adhere to specified pretreatment standards. The following regulations are applicable to the nonferrous metals industry.

The Metal Molding and Casting Point Source Category (40 CFR Part 464) is applicable to wastewater from these operations:

- Aluminum Casting
- Copper Casting
- Zinc Casting.

The Aluminum Forming Point Source Category (40 CFR Part 467) is applicable to wastewater from these operations:

- Rolling with Neat Oils
- Rolling with Emulsions
- Extrusion
- Forging
- Drawing with Neat Oils
- Drawing with Emulsions.

The Copper Forming Point Source Category (40 CFR Part 468) is applicable to wastewater from these operations:

- Copper Forming
- Beryllium Copper Forming.

The Nonferrous Metals Forming and Metal Powders Point Source Category (40 CFR Part 471) is applicable to wastewater from these operations:

- Lead-Tin-Bismuth Forming
- Magnesium Forming
- Nickel-Cobalt Forming
- Precious Metals Forming
- Refractory Metals Forming
- Titanium Forming
- Uranium Copper Forming
- Zinc Forming
- Zirconium-Hafnium Forming
- Metals Powders.

Clean Air Act (CAA)

The primary regulatory mechanism used to implement source emission requirements under the CAA is State Implementation Plans (SIPs). SIPs provide the States with the authority and discretion to establish a strategy to attain primary NAAQS levels. These requirements can be uniform for all sources or specifically tailored for individual sources. States are not allowed to adopt less stringent standards than NAAQS. Of particular concern to primary and secondary smelters is the fact that SIPs must include steps to reduce SO_2 source emission levels in nonattainment areas. SIPs must demonstrate that nonattainment areas, designated prior to the 1990 CAA Amendments, will achieve compliance with NAAQS as soon as possible and no later than November 1995. For nonattainment areas designated after the 1990 Amendments, compliance is also required five years after the nonattainment designation. Sections 172(c)(5) or 191 and 192 require the imposition of a construction moratorium on new or modified sources of SO_2 in nonattainment areas without a fully approved SIP until the SIP includes appropriate permit requirements.

- NAAQS for sulfur dioxide, nitrogen dioxide, and hydrocarbons that frequently affect the smelting process are found in 40 CFR Part 50.

Also important to primary and secondary smelters is the list of 189 hazardous air pollutants (HAPs) established in the CAA, as amended in 1990. Under the CAA Amendments, Congress required EPA to identify major and area source categories associated with the emission of one or more listed HAPs. To date, EPA has identified 174 categories of sources. Congress also required EPA to promulgate emission standards for listed source categories within 10 years of the enactment of the CAA Amendments (by November 15, 2000). These standards are known as National Emission Standards for Hazardous Air Pollutants (NESHAPs).

In addition to general CAA requirements, specific standards apply to primary and secondary lead smelters, primary copper smelters, primary zinc smelters, and primary aluminum reduction plants.

The Standards of Performance for Secondary Lead Smelters (40 CFR Part 60, Subpart L) are applicable to pot furnaces of more than 250 kg charging capacity, blast furnaces, and reverberatory furnaces that commence construction after June 11, 1973.

These standards require secondary lead smelters to control discharge to the point that:

- Particulate matter emissions do not exceed 50 mg/dscm, and
- Visible emissions do not exhibit 20 percent opacity or greater.

In addition, these standards require that no owner or operator discharge any gases exhibiting 10 percent opacity or greater from any pot furnace on and after the date of performance testing.

The Standards of Performance for Primary Copper Smelters (40 CFR Part 60, Subpart P) are applicable to dryers, roasters, smelting furnaces, and copper converters that commence construction or modification after October 16, 1974.

These standards require that dryers control discharge to the point that particulate matter emissions do not exceed 50 mg/dscm. With respect to roasters, smelting furnaces, and copper converters, no gases containing sulfur dioxide in excess of 0.065 percent by volume are to be emitted. An exception is made in the case of reverberatory smelting furnaces, which are exempt during periods when the total smelter charge at the primary copper smelter contains a high volume of volatile impurities (more than 0.2 weight percent arsenic, 0.1 weight percent antimony, 4.5 weight percent lead, or 5.5 weight percent zinc, on a dry basis).

In addition, these standards require the owner or operator of a dryer of an affected facility using a sulfuric acid plant to control discharges to the point that visible emissions do not exhibit greater than 20 percent opacity on and after the date of performance testing.

The Standards of Performance for Primary Zinc Smelters (40 CFR Part 60, Subpart Q) are applicable to roaster and sintering machine facilities in primary zinc smelters that commence construction or modification after October 16, 1974.

These standards require sintering machines to control discharges to the point that on and after the date of performance testing:

- No gases containing particulate matter in excess of 50 mg/dscm are emitted, and
- Emissions do not exhibit an opacity of greater than 20 percent.

In addition, no roaster may emit gases containing sulfur dioxide in excess of 0.065 percent by volume. The provision also stipulates that any sintering machine that eliminates more than 10 percent of the sulfur initially contained in the zinc sulfide ore concentrates will be considered a roaster. For affected primary zinc smelting facilities that use a sulfuric acid plant, no emissions greater than 20 percent opacity are allowed on and after the date of performance testing. In addition,

- No gases containing more than 50 mg/dscm may be emitted, and
- Visible emissions may not exhibit greater than 20 percent opacity.

In addition, sintering machines, electric smelting furnaces, and converters must control discharges to the point that no gases containing greater than 0.065 percent sulfur dioxide are emitted on and after the date of performance testing.

For affected primary lead smelting facilities that use a sulfuric acid plant, no visible emissions greater than 20 percent opacity are allowed on and after the date of performance testing.

The Standards of Performance for Primary Aluminum Reduction Plants (40 CFR Part 60, Subpart S) are applicable to potroom groups and anode bake plants that commence construction after October 23, 1974.

The standards require that on and after the date of performance testing affected facilities control discharges to the point that no gases containing total fluorides are emitted on and after the date of performance testing in excess of:

- 1.0 kg/Mg of aluminum produced for potroom groups at Soderberg plants
- 0.95 kg/Mg of aluminum produced for potroom groups at prebake plants
- 0.05 kg/Mg of aluminum equivalent for anode bake plants.

Emissions slightly above these levels from Soderberg and prebake plants may be considered to be in compliance if the owner/operator demonstrates that exemplary operation and maintenance procedures are used.

In addition, on and after the date of performance testing, facilities must control discharges to the point that no emissions are discharged exhibiting greater than:

- 10 percent opacity from any potlines
- 20 percent opacity from any anode bake plant.

All of the above standards (Subparts L, P, Q, R, S) require monitoring and testing methods and procedures specific to the affected facilities.

The National Emission Standards for Hazardous Air Pollutants from Secondary Lead Smelting (40 CFR Part 63, Subpart X) are applicable to secondary lead smelters that use blast, reverberatory, rotary, or electric smelting furnaces to recover lead metal from scrap lead, primarily used lead-acid automotive batteries. These standards limit HAP emissions (lead compounds and total hydrocarbons from secondary lead smelting furnaces, refining kettles, agglomerating furnaces, dryers and fugitive dust sources, but do not affect emissions from lead smelters, lead refiners, or lead remelters.

These standards require secondary lead smelters to control:

- Process Emission sources by limiting lead compounds (metal HAP) and total hydrocarbons (organic HAP) to certain levels depending upon furnace type;
- Process Fugitive Emission Sources by requiring the use of enclosure-type hoods or containment buildings which are ventilated to control devices; and
- Fugitive Dust Sources by requiring the development of facility specific standard operating procedures.

In addition to these standards certain compliance testing, monitoring, and recordkeeping requirements also apply to these facilities. New or reconstructed sources (construction commenced after June 9, 1994) must meet these standards by June 23, 1995 or upon start up of operations. Existing secondary lead smelters have until June 23, 1997 to meet them.

Resource Conservation and Recovery Act (RCRA)

RCRA was passed in 1976, as an amendment to the Solid Waste Disposal Act, to ensure that solid wastes are managed in an environmentally sound manner. A material is classified under RCRA as a hazardous waste if the material meets the definition of solid waste (40 CFR 261.2), and that solid waste material exhibits one of the characteristics of a hazardous waste (40 CFR 261.20-24) or is specifically listed as a hazardous waste (40 CFR 261.31-33). A material defined as a hazardous waste may then be subject to Subtitle C generator (40 CFR 262), transporter (40 CFR 263), and treatment, storage, and disposal facility (40 CFR 254 and 265) requirements. The nonferrous metals industry must be concerned with the regulations addressing all these.

The greatest quantities of RCRA listed waste and characteristically hazardous waste that are generated by nonferrous metal industries are identified in Exhibit 24. For more information on identifying RCRA hazardous waste, refer to 40 CFR Part 261.

Exhibit 24
Hazardous Wastes Relevant to the Nonferrous Metal Industry

EPA Hazardous Waste No.	Hazardous Waste
D004 (arsenic) D005 (barium) D006 (cadmium) D007 (chromium) D008 (lead) D009 (mercury) D010 (selenium) D011 (silver) D035 (methyl ethyl ketone) D039 (tetra-chloroethylene) D040 (trichloro-ethylene)	Wastes which are hazardous due to the characteristic of toxicity for each of the constituents.
F001	Halogenated solvents used in degreasing: tetrachloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	Spent halogenated solvents; tetrachloroethylene, methylene chloride, trichlorethylene, 1,1,1-trichloroethane chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, one or more of the above halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	Spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of 10% or more (by volume) of one of those solvents listed in F001, F002, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	Spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005	Spent non-halogenated solvents: toluene, methy ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures.

Exhibit 24
Hazardous Wastes Relevant to the Nonferrous Metal Industry

EPA Hazardous Waste No.	Hazardous Waste
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production.
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production.
K088	Spent potliners from primary aluminum reduction.
K069	Emission control dust/sludge from secondary lead smelting. (Note: this listing is stayed administratively for sludge generated from secondary acid scrubber systems. The stay will remain in effect until further administrative action is taken. If EPA takes further action effecting this stay, EPA will publish a notice of the action in the *Federal Register*.)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting.

One set of RCRA standards that is of particular relevance to nonferrous metals industries that recycle metals and metal-containing materials is 40 CFR Part 266, Subpart H which lays out the requirements for boilers or industrial furnaces that burn hazardous waste for energy recovery or destruction, or processing for materials recovery or as an ingredient in general.

X.C. Pending and Proposed Regulatory Requirements

Clean Air Act (CAA)

In addition to the CAA requirements discussed above, EPA is currently working on several regulations that will directly affect the nonferrous metals industry. Many proposed standards will limit the air emissions from various industries by proposing Maximum Achievable Control Technology (MACT) based performance standards that will set limits on emissions based upon concentrations in the waste stream. Various potential standards are described below.

Primary Lead Smelting

Primary lead smelters are a major source of hazardous air pollutants (HAPs). Potential emissions include compounds of lead and other metallic HAPs as well as organic HAPs.

The proposed regulation will be a MACT-based performance standard that will set limits on certain emissions based upon concentrations in the waste stream . The legal deadline is November 15, 1997.

When promulgated, these standards will regulate an industry comprised of two companies which operate three facilities in two states.

Primary Copper Smelting

Primary copper smelters are known to emit a number of HAPs listed in Section 112 of the Clean Air Act Amendments of 1990 (CAAA). While most smelters have extensive control systems for oxides of sulfur and HAPs, fugitive emissions may cause smelters to exceed major source standards.

EPA is required to promulgate 50 percent of the source categories listed in Section 112(e) CAAA by November 15, 1997. EPA plans to promulgate emissions standards for several HAPs effecting the primary copper industry by August 30, 1995

Primary Aluminum

Primary aluminum processors may be a major source of one or more HAPs. As a consequence, a MACT-based regulatory program is being developed by EPA.

The MACT based performance standards are expected to be proposed in October 1995 and to be promulgated by November 15, 1997.

Secondary Aluminum

EPA has determined that the secondary aluminum industry may reasonably be anticipated to emit several of the 189 HAPs listed in Section 112(b) of the CAA. As a result, the industry is included on the initial list of HAP emitting categories and will be on the list of categories schedule for the development of a regulatory program.

The standards will be MACT-based performance standards and are expected to be proposed in April 1996. The legal deadline for the promulgation of final standards is November 15, 1997.

Resource Conservation and Recovery Act (RCRA)

As part of EPA's groundwater protection strategy, RCRA prohibits the land disposal of most hazardous wastes until they meet a waste-specific treatment standard. While most hazardous wastes have already been assigned treatment standards, EPA must still promulgate two additional rule makings to address newly listed wastes and to make changes to the land disposal restrictions (LDR) program.

When finalized, the Phase III LDR rulemaking will establish treatment standards for some newly listed wastes and will mandate RCRA equivalent treatment be performed upon certain characteristically hazardous wastes that are injected into UIC wells under the Safe Drinking Water Act (SDWA) or managed in Subtitle D surface impoundments prior to discharge pursuant to the Clean Water Act (CWA). By consent decree, EPA must promulgate the final rule for Phase III by January 1996.

Of particular significance to the nonferrous metals industries, Phase III will restrict the land disposal of spent aluminum potliners, K088. Once the prohibition for these wastes becomes effective, the spent potliners would need to meet numeric treatment levels for at least 27 particular hazardous constituents commonly found in K088.

Phase IV will similarly restrict other newly listed or identified wastes from land disposal and create influent treatment standards to mitigate the impact of sludges, leaks, and air emissions from surface impoundments that have managed decharacterized wastes. Among those wastes that will become subject to prohibitions are characteristically hazardous mining wastes that were once excluded from regulation by the Bevill exemptions of §261.4(b)(10). In addition, Phase IV will also change the treatment standards applicable to those wastes that are prohibited from land disposal because they exhibit the characteristic of toxicity for a metal constituent.

XI. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[2] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit,

2 EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IX KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); 10 (AK, ID, OR, WA).

compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or

R0076481

Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

XI.A. Nonferrous Metals Industry Compliance History

Exhibit 25 presents enforcement and compliance information specific to SIC 33, the nonferrous metals industry (information was not available beyond the two-digit SIC level). As indicated in this exhibit, Region 4 conducted the largest number of inspections in this industry, and nearly all of Regions 4's enforcement actions are also state-lead. The numbers in this exhibit do not necessarily represent the geographic location of the industry's primary and secondary processors. This is because the number facilities and inspections represents all SIC 33 facilities and not just SIC 333 and 334 facilities.

R0076482

Exhibit 25
Five Year Enforcement and Compliance Summary for the Nonferrous Metals Industry

A	B	C	D	E	F	G	H	I	J
Nonferrous Metals SIC 33	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	67	35	144	28	13	21	38%	62%	0.15
Region II	71	54	362	12	25	89	83%	17%	0.25
Region III	77	54	447	10	20	69	80%	20%	0.15
Region IV	136	92	870	9	22	65	86%	14%	0.08
Region V	270	126	632	26	24	66	77%	23%	0.10
Region VI	72	40	205	21	13	40	52%	48%	0.20
Region VII	43	23	156	17	8	17	59%	41%	0.11
Region VIII	17	10	56	18	4	15	67%	33%	0.27
Region IX	71	24	69	62	7	16	81%	19%	0.23
Region X	20	16	156	8	9	72	85%	15%	0.46
Total/Average	844	474	3,097	16	145	470	76%	24%	0.15

XI.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 26-29 provide enforcement and compliance information for selected industries. The nonferrous metals industry (all of SIC 33) compromises the 4th largest number of facilities tracked by EPA across the selected industries, and the 5th largest number of facilities inspected. However it has the 3rd largest number of inspections and 2nd largest number of enforcement actions. For this industry, RCRA inspections comprise over 39 percent of all inspections conducted, while CWA inspections account for 23 percent and CAA inspections account for 34 percent. The fairly high CWA inspection rate and low CAA inspection rate seem to be in conflict with the importance of air emissions in the primary and secondary nonferrous metals processing industry; however this may be due to the fact that numbers represent the entire SIC 33 and not the more specific three-digit SIC 333 and 334 level.

Exhibit 26
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	**844**	**474**	**3,097**	**16**	**145**	**470**	**76%**	**24%**	**0.15**
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics/Computers	405	222	777	31	68	212	79%	21%	0.27
Motor Vehicle Assembly	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

R0076485

Exhibit 27
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

R0076486

Exhibit 28
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

R0076487

Exhibit 29
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

XI.C. Review of Major Enforcement Actions

XI.C.1. Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in EPA's *Enforcement Accomplishments Report, FY 1991 - FY 1993* publications, 12 significant enforcement cases were resolved between 1991 and 1993 involving the nonferrous metals industry. Five of the cases were comprised of RCRA violations, five of CERCLA violations, and two involved violations of the Clean Water Act (CWA). One case, U.S. v. ILCO (Interstate Lead Company), et. al., settled in 1992 and 1993, involved violations of all three statutes.

Six of the 12 cases resulted in the assessment of a penalty. Civil penalties ranged from $453,750 to $3.5 million. The average penalty was approximately $1.9 million. In U.S. v. Cerro Copper (1991), a consent decree was entered requiring Cerro to recycle its waste waters in order to meet pre-treatment limits for copper and other nonferrous metals at one of its plants. In addition, the company was required to pay a civil penalty of $1.4 million for its CWA violation.

Some of the settlements required defendants to pay only the past or future cleanup costs of the remedial action. In U.S. et. al. v. Alcan Aluminum Corp. et. al. (1991), the District Court granted the government's motion of summary judgment against Alcan Aluminum, a PRP at the Pollution Abatements Services Superfund site. The penalty was $4 million in past costs from this case and $9.1 million in past costs from an unsettled 1987 case. Violations included illegal dumping of PCBs, and about 4.6 million gallons of waste emulsion contaminated with small quantities of metals including lead, cadmium, and chromium.

In U.S. v. Sanders Lead Co. (1993), a consent decree was entered requiring $2 million in civil penalties and the treatment of waste water as a hazardous waste. This consent decree resolved alleged violations involving illegal disposal of lead-bearing hazardous wastes and violations of land disposal restrictions. This was the first civil case that the U.S. filed to enforce land disposal restrictions, and settles a RCRA enforcement action concerning violations at a Troy, Alabama secondary lead smelter.

In the 1993 RCRA case of U.S. v. ILCO et. al., the Court of Appeals held that lead components from spent automobile batteries were discarded and hence could be regulated as "solid waste" under RCRA. The Appeals Court affirmed the district court's award of $3.5 million in

R0076489

civil penalties and $845,033 in CERCLA response costs for violations of RCRA, the CWA, and corresponding Alabama statutes. The action arose from ILCO's operations at its secondary smelter which reprocessed spent-lead acid batteries.

XI.C.2. Supplemental Environmental Projects

Supplementary Environmental Projects (SEPs) are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. The following chart contains a representative sample of the Regional responses addressing the primary and secondary nonferrous metals industry. The information contained in Exhibit 30 is not comprehensive and provides only a sample of the types of SEPs developed for the primary and secondary nonferrous metals industry.

Exhibit 30
Supplemental Environmental Projects
Nonferrous Metal (SIC 33)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Kaiser Aluminum and Chemical Corporation Tacoma, WA	10	TSCA	Pollution Reduction	$ 12,750	Early disposal of PCB-contaminated electrical equipment.	$ 12,750	$ 6,375
Southern Foundry Supply	4	EPCRA	Pollution Reduction	$ 34,000	Assess the feasibility of a process to recover pure nickel from plant wastestreams. Construct a pilot plant to perform the recovery to reduce the quantity of heavy metals entering environment.	$ 15,840	$ 2,376
Aluminum Company of America (ALCOA) Port Lavaca, TX	6	CERCLA (failure to report release)	Equipmment Donation	$ 10,000	Donate equipment to the Local Emergency Planning Committee (LEPC) to assist local officials in emergency responses to chemical emergencies. Develop and submit article on CERCLA compliance to a national trade journal to assist other facilities in reporting duties.	$ 25,000	$ 3,000
Elken Metals Company Alloy, WV	3		Pollution Reduction	$ 449,000	Remove PCB items including PCB transforers and PCB capapcitors, and retrofilling PCB-contaminated transformers to reduce the amount of PCBs which may be released to the environment.	$ 280,000	$ 17,250

Exhibit 30
Supplemental Environmental Projects
Nonferrous Metal (SIC 33) (contd.)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
J.W. Harris, Inc. Cincinnati, OH	5	EPCRA	Pollution Prevention	$189,350	Correct past EPCRA violations and modify industrial processes. Modification will reduce the releases of silver by 713 lbs/yr; copper by 1592 lbs/yr; antimony by 55 lbs/yr; zinc by 5847 lbs/yr; and nickel by 15 lbs/yr.	$109,500	$10,950

XII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

XII.A. Sector Related Environmental Programs and Activities

Voluntary Aluminum Industrial Partnership

The EPA's Voluntary Aluminum Industrial Partnership (VAIP) is an innovative environmental stewardship and pollution prevention program developed jointly by the EPA and the U.S. primary aluminum industry to promote cost-effective reduction in perflurocarbon. Companies joining the VAIP commit to reductions in perfluorocarbon (PFC) emission released during the production of aluminum and to provide data to EPA that tracks their progress toward reduction targets. In turn, EPA provides VAIP Partners with recognition for their pollution prevention initiative, and for their accomplishments in achieving PFC reductions.

The Partnership has been designed with important and unique characteristics that reflect both the diversity within the primary aluminum industry and the differences between this and other industries. These unique characteristics include: flexibility; a joint commitment to finding answers to critical technical questions; and a clear course for achieving substantial pollution prevention goals by the year 2000. EPA estimates that the VAIP will achieve reductions in PFC emissions of 30-60 percent across the U.S. primary aluminum industry — or 1.8 mmt of carbon equivalent — by the year 2000.

XII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who met their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

Ninety-three companies listed under SIC 333-334 (primary and secondary metals industry) are currently participating in the 33/50 program. They account for 72 percent of the 129 companies under SIC 333-334, which is higher than the average for all industries of 14 percent participation. (Contact: Mike Burns 202-260-6394 or the 33/50 Program 202-260-6907)

Exhibit 31 lists those companies participating in the 33/50 program that reported under SIC code 333-334 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to primary metals production. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 31
Nonferrous Metals Producers Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
3M Minnesota Mining & Mfg Co	St. Paul	MN	3643, 3699, 2851, 3644, 2821, 3357	1	16,481,098	70
Aluminum Company Of America	Pittsburgh	PA	3357	11	2,403,017	51
American Telephone & Telg. Co.	New York	NY	3357, 3661	4	512,618	50
Ampco Metal Mfg., Inc.	Milwaukee	WI	3362, 3351	3	3,395	*
Asarco Incorporated	New York	NY	3331	7	7,582,905	2
Avondale Industries. Inc.	Avondale	LA	3325, 3339, 3341	1	25,279	54
Baker Hughes. Incorporated	Houston	TX	3357	1	193,116	20
Ball Corporation	Muncie	IN	3341, 3356, 3471	1	721,859	86
Bethlehem Steel Corporation	Bethlehem	PA	3312, 3321, 3366	2	792,550	50
Bicc USA Inc.	Chicago	IL	3357	7	152,253	15
Brooklyn Park Oil Co., Inc.	Minneapolis	MN	3364, 3471	1	12,606	13
Cabot Corporation	Boston	MA	3339, 2819	2	2,407,581	50
Chrysler Corporation	Highland Park	MI	3363	1	3,623,717	80
Cooper Industries, Inc.	Houston	TX	3357	1	1,048,465	75
Corning, Inc.	Corning	NY	3357	2	1,521,528	14
Degussa Corporation	Ridgefield Park	NJ	3499, 3369	2	676,418	***
Dexter Corporation	Windsor Locks	CT	3341	1	122,127	51
Doe Run Company	Saint Louis	MO	3339	1	2,270,400	49
Engelhard Corporation	Iselin	NJ	3351, 2819	1	236,302	50
Farley Inc.	Chicago	IL	3366, 3743	1	58,844	2
Federal-Mogul Corporation	Southfield	MI	3365, 3366, 3471	2	255,996	50
Funk Finecast, Inc.	Columbus	OH	3324, 3365, 3366	1	491	*
General Electric Company	Fairfield	CT	2819, 3356, 3499, 3724	2	5,010,856	50
General Motors Corporation	Detroit	MI	3365, 3363	2	16,751,198	*
Halstead Industries, Inc.	Greensboro	NC	3351	1	239,910	50
Handy & Harman	New York	NY	3341	4	477,150	50
Hm Anglo-American, Ltd.	New York	NY	3646, 3363, 3469, 3471	1	1,265,741	2
Honeywell, Inc.	Minneapolis	MN	3822, 3820, 3363, 3900	1	386,054	50
Hydro Aluminum USA Inc.	Rockledge	FL	3354	1	54,700	100
INCO United States Inc.	New York	NY	3356	5	346,594	26
Indal, Ltd.	Weston, Ontario, Can		3354	2	303,909	*
Ingersoll-Rand Company	Woodcliff Lake	NJ	3369, 3471	1	96,553	60

R0076495

Exhibit 31 (cont'd)
Nonferrous Metals Producers Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Jefferson City Mfg. Co., Inc.	Jefferson City	MO	3363, 3451, 3469	1	4,850	**
Kanthal Furnace Prods.	Bethel	CT	3315, 3316, 3357	1	21,581	41
Katy Industries, Inc.	Englewood	CO	3316, 3351, 3353, 3356	1	82,256	52
Keywell Corp.	Baltimore	MD	3341, 5093	1	58,997	*
Linderme Tube Co.	Euclid	OH	3351	1	34,960	***
Litton Industries, Inc.	Beverly Hills	CA	3356	2	332,264	**
Lorin, Ind.	Muskegon	MI	3354, 3471	1	25,500	50
Louisiana-Pacific Corporation	Portland	OR	3354	1	294,823	50
Marmon Group, Inc.	Chicago	IL	3351	7	1,092,218	1
Mascotech	Taylor	MI	3364, 3544, 3471	1	3,163,830	35
Morgan Stanley Leveraged Fund	New York	NY	3357	12	2,166,420	13
National Metals, Inc.	Leeds	AL	3341	1	510	***
National Tube Holding Company	Birmingham	AL	3351	1	78,282	75
Newell Co	Freeport	IL	3341	1	324,283	23
NGK Metals Corp.	Temple	PA	3366	2	56,600	99
Norandal USA	Brentwood	TN	3365, 3714	5	627,740	6
North American Philips Corp.	New York	NY	3357	1	1,281,928	50
Northern Precision Casting Co.	Lake Geneva	WI	3324, 3365, 3366	1	90	99
Olin Corporation	Stamford	CT	3351	5	574,673	70
Pac Foundries	Port Hueneme	CA	3324, 3365	1	4,976	75
Pace Industries, Inc.	New York	NY	3363	3	14,530	**
Parker Hannifin Corporation	Cleveland	OH	3360	1	244,966	50
Pechiney Corporation	Greenwich	CT	3341	6	216,177	***
Peco Manufacturing Co. ,Inc.	Portland	OR	3089, 3363, 3382	1	16,409	100
Peerless Of America, Inc.	Chicago	IL	3354	1	60,463	69
Progress Casting Group, Inc.	Minneapolis	MN	3363	1	15,045	95
Raytheon Company	Lexington	MA	3361	1	706,045	50
Renco Group, Inc.	New York	NY	3339	1	204,629	7
Rexcorp U S, Inc. (Del)	Sandwich	IL	3363, 3364	1	494	***
Reynolds Metals Company	Richmond	VA	3334	9	2,055,294	38
RJR Nabisco Holdings Corp.	New York	NY	2754, 3334	1	1,149,070	12
Rome Group Inc.	Rome	NY	3357	1	8,878	**
RSR Holding Corp.	Dallas	TX	3341	3	2,499,338	***
RTZmerica, Inc.	Garden City	NY	3331	1	3,576,655	32
SEH America, Inc.	Vancouver	WA	3674, 3339	1	53,140	100

R0076496

Exhibit 31 (cont'd)
Nonferrous Metals Producers Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Spectrulite Consortium, Inc.	Madison	IL	3341, 3354, 3355, 3356	1	255	50
Spectrum ,Ltd.	Carrollton	GA	3357	6	355,325	3
T & N Inc.	Ann Arbor	MI	3321, 3365, 3714	1	670,624	**
Tecumseh Products Company	Tecumseh	MI	3361	1	29,510	28
Tenneco Inc.	Houston	TX	3353, 3081	1	1,272,423	8
Texas Instruments Incorporated	Dallas	TX	3822, 2812, 3356, 3471, 3714, 3341	1	344,225	25
U T I Corporation	Collegeville	PA	3569, 3357	1	473,872	50
United Technologies Corp.	Hartford	CT	3354	1	2,393,252	50
USX Corporation	Pittsburgh	PA	3356, 3369	1	1,510,772	25
Vanalco, Inc.	Vancouver	WA	3334	1	12,250	**
Watts Industries, Inc.	North Andover	MA	3366	3	128,842	8
Westinghouse Electric Corp.	Pittsburgh	PA	3356	2	1,137,198	28
Wolverine Tube, Inc.	Decatur	AL	3351, 3499	2	337,685	***

* = not quantifiable against 1988 data.
** = use reduction goal only.
*** = no numerical goal.

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at 202-233-9065 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, 202-260-0700 or the WasteWi$e Hotline at 1-800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, 202-260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, 303-275-4729)

R0076499

XII.C. Trade Association/Industry Sponsored Activity

Various trade associations represent the interests of the nonferrous metals industry. Some of these organizations are discussed in greater detail below.

Aluminum

The Aluminum Association (AA) 900 19th Street, NW Washington, DC 20006 Phone: (202) 862-5100	Members: 86 Staff: 27 Budget: $4,300,000 Contact: David N. Parker

Founded in 1933, AA represents producers of aluminum and manufacturers of semi-fabricated aluminum products. This association represents members' interest in legislative activity and it also conducts seminars and workshops. Its committees cover such topics as legislative/regulatory affairs, environmental affairs, product standards, technical activities and programs, and health and safety. AA maintains a library of 3000 volumes on aluminum technology and the aluminum industry. Its publications include: *Aluminum Association Report* (10 times per year); *Aluminum Standards and Data* (biennially); *Aluminum Statistical Review* (annually); *World Aluminum Abstracts* (monthly), and a free catalog listing all of its publications, reprints, and audiovisual material. AA also maintains the *World Aluminum Abstracts* data base.

Aluminum Recycling Association (ARA) 1000 16th St. NW, Ste. 603 Washington, DC 20036 Phone: (202) 785-0951	Members: 20 Contact: Richard M. Cooperman

Founded in 1929, ARA represents producers of aluminum specification alloys refined from scrap aluminum. ARA has three committees: Environmental Protection, Government Liaison, and Technical. The association was formerly known separately as the Aluminum Research Institute, the Aluminum Smelters Research Institute, and the Aluminum Smelting and Recycling Institute. ARA publishes *Quarterly Reports on Industry Shipments* as well as a brochure.

Copper

International Copper Association (ICA) 260 Madison Ave. New York, NY 10016 Phone: (212) 251-7240 Fax: (202) 251-7245	Members: 42 Staff: 11 Budget: $ 9,000,000 Contact: Dr. William Drescher

Formerly known as the Copper Products Development Association, ICA represents both copper producing and copper fabricating companies. ICA works in concert with commercial, institutional, and university laboratories to conduct research on, and market development of, new and improved uses of copper. The association along with its committees, Chemical and Environmental Advisory; Corrosion Advisory; Electrical Advisory; Metallurgy Advisory; and Program Review conduct seminars and maintain a 300 volume library. ICA publishes an annual report in addition to a monograph series.

Copper and Brass Fabricators Council (CBFC) 1050 17th St. NW, Ste. 440 Washington, DC 20036 Phone: (202) 833-8575 Fax: (202) 331-8267	Contact: Joseph. L. Mayer

CBFC represents copper and brass fabricators in activities involving foreign trade in copper and brass fabricated products, and Federal regulatory matters including legislation, regulations, rules, controls, and other matter affecting brass and copper fabricators. The association has five committees: Critical Materials; Energy Conservation; EPA Advisory; Foreign Trade; and Government Information. CBFC was formerly known as Copper and Brass Fabricators Foreign Trade Association and was founded in 1966.

Copper Development Association (CDA) 2 Greenwich Office Park Box 1840 Greenwich, CT 06836 Phone: (212) 251-7200 or (800) CDA-DATA	Members: 100 Staff: 20 Contact: M. Payne

CDA represents domestic and foreign copper mining, smelting, and refining companies, and domestic fabricating companies. Functioning in committees divided along principal market areas such as transportation and construction and electronics, CDA seeks to expand the applications and markets of copper. CDA provides technical services to users of copper and its alloys, and also researches market statistics for the entire industry. *Copper Update* and *Copper Topics*, both published quarterly, are the primary publications of CDA in addition to handbooks, technical reports, and bulletins. CDA also operates an *Online Copper Data Center* which contains literature from around the world on copper and its alloys.

Lead

Lead Industries Association (LIA) 295 Madison Ave. New York, NY 10017 Phone: (212) 578-4750 Fax: (212) 684-7714	Members: 70 Staff: 4 Contact: Jerome F. Smith

Founded in 1928, LIA represents mining companies, smelters, refiners, and manufacturers of products containing lead. The association researches and gathers statistics and provides technical services and information to lead consumers. Some of the services LIA provides are a 2000-volume library concerning lead, and association committees focusing on: Battery Manufacturers, Environmental Health, Fabricated Products, Oxide and Chemical, and Solder Manufacturers. LIA publishes a semiannual newsletter, *Lead*, with a circulation of 60,000 that contains articles about the application of lead in architecture, chemicals, and other fields.

Association of Battery Recyclers (ABR) Sanders Lead Co. Corp. Sanders Rd. PO Drawer 707 Troy, AL 36081 Phone: (205) 566-1563	Members: 45 Staff: 1 Contact: N. Kenneth Campbell

ABR represents recyclers of lead, oxide manufacturers, industry equipment suppliers, and consulting services. The association's goals are to provide information services relating to worker safety and environmental controls through continuing industry-wide studies. ABR conducts research in: engineering and administrative controls, respiratory protection, and environmental and biological monitoring. ABR was known as the Secondary Lead Smelters Association until 1990.

Zinc

Independent Zinc Alloyers Association (IZAA) 1000 16th St. NW, Ste. 603 Washington, DC 20036 Phone: (202) 785-0558	Members: 15 Contact: Richard M. Cooperman

Founded in 1959, IZAA represents producers of zinc alloys for the die casting industry. The association has one committee which focuses on International Trade.

XIII. RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the nonferrous metals industry, a list of publications is provided below:

General Profile and Pollution Prevention

An Appraisal of Minerals Availability for 34 Commodities, U.S. Department of the Interior, Bureau of Mines, Bulletin 892, 1987.

Aluminum Facts, and other materials provided by the Aluminum Association, Washington, DC, 1995.

Copper Technology Competitiveness, U.S. Congress, Office of Technology Assessment, OTA-E-367, September, 1988.

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc., Detroit, Michigan, 1992.

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Industry & Trade Summary - Aluminum, U.S. International Trade Commission, USITC Publication 2706, April 1994.

Industry & Trade Summary - Copper, U.S. International Trade Commission, USITC Publication 2623 (MM-4), April 1993.

Information provided by the U.S. Department of the Interior, Bureau of Mines, 1995.

McGraw-Hill Encyclopedia of Science & Technology, Vol. 1, 3, 6, and 19, McGraw-Hill Book Company, New York, NY, 1987, 1992.

Report to Congress on Metal Recovery, Environmental Regulation & Hazardous Waste, U.S. Environmental Protection Agency (EPA/530-R-93-018), February 1994.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Industrial Outlook 1994 - Metals, U.S. Department of Commerce.

1987 Census of Manufacturers Industry Series 33C: Smelting and Refining - Nonferrous Metals, U.S. Bureau of the Census, April 1990. (MC87-I-33C)

1987 Census of Manufacturers Industry Series 33D: Metal Mills and Primary Metal, U.S. Bureau of the Census, April 1990. (MC87-I-33D)

1992 Toxic Release Inventory (TRI) Public Data Release, U.S. EPA, Office of Pollution Prevention and Toxics, April 1994. (EPA/745-R94-001)

The Plain English Guide to the Clean Air Act, U.S. EPA Office of Air and Radiation, 400-K-93-001.

Environmental Law Handbook, Government Institutes, Inc., 11th edition, Rockville, MD 1991.

Process Descriptions

Air Pollution Engineering Manual, Anthony J. Buonicore and Wayne T. Davis, ed., Air & Waste Management Association, Van Norstrand Reinhold, New York, NY, 1992.

Background Listing Document for K065, U.S. EPA.

Background Listing Document for K088, U.S. EPA.

Compilation of Air Pollutant Emission Factors (AP 42), U.S. EPA, Office of Air Quality Planning and Standards.

Information provided by the International Copper Association, Ltd.

Recycled Metals in The United States, A Sustainable Resource, U.S. Department of the Interior, Bureau of Mines, Special Publication, October 1992.

Report to Congress on Special Wastes From Mineral Processing: Summary and Findings, Methods and Analyses, Appendices, U.S. EPA, Office of Solid Waste and Emergency Response (530/SW-90-070C), 1990.

APPENDIX A

INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Charge your order. It's easy! VISA MasterCard DISCOVER NOVUS

Order Processing Code:
* 3212

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800

Qty.	Stock Number	**Published in 1995** Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	**Published in 1997** Title	Price Each	Total Price
	055–000–00570–2	Air Transportation Industry, 90 pages	$ 7.50	
	055–000–00571–1	Ground Transportation Industry, 130 pages	10.00	
	055–000–00572–9	Water Transportation Industry, 90 pages	7.50	
	055–000–00573–7	Metal Casting Industry, 150 pages	13.00	
	055–000–00574–5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055–000–00575–3	Plastic Resin & Man–made Fiber Industry, 180 pages	15.00	
	055–000–00576–1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055–000–00577–0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055–000–00578–8	Textile Industry, 130 pages	10.00	
	055–000–00579–6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account ☐☐☐☐☐☐☐–☐

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐ (expiration date) ***Thank you for your order!***

Authorizing signature ˜97

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0076506

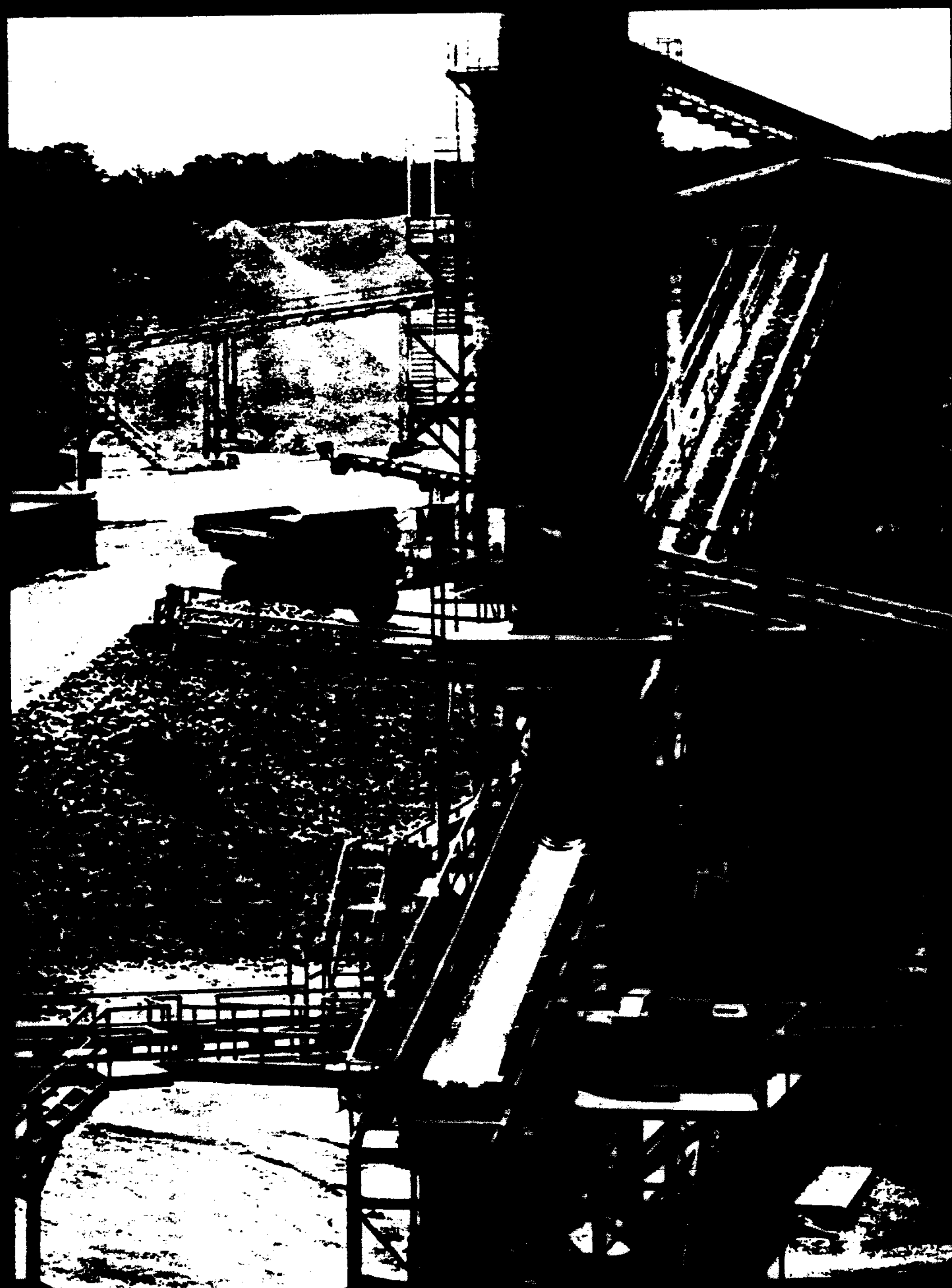
EPA

United States
Environmental Protection Agency
([illegible]21A)
Washington DC 20460

Official Business
Penalty for Private Use
$300

EPA

Profile Of The Non-Fuel, Non-Metal Mining Industry



SECTOR EPA NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

R0076508

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

Recycled/Recyclable • Printed with Vegetable Based Inks on Recycled Paper (20% Postconsumer)

EPA/310-R-95-011

EPA Office of Compliance Sector Notebook Project

Profile of the Non-Fuel, Non-Metal Mining Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048278-X

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be purchased from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
8:00 a.m. to 4:30 p.m., EST, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via Internet on the Enviro$ense World Wide Web. Downloading procedures are described in Appendix A of this document.

All photographs by Steve Delaney, EPA. Photographs courtesy of Luck Stone Corporation, Leesburg, Virginia. Special thanks to John LeGore.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

NON-FUEL, NON-METAL MINING
(SIC 14)
TABLE OF CONTENTS

NON-FUEL, NON-METAL MINING
(SIC 14)
TABLE OF CONTENTS (CONT'D)

NON-METAL, NON-FUEL MINING
(SIC 14)
LIST OF EXHIBITS

NON-FUEL, NON-METAL MINING
(SIC 14)
LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
AMD -	Acid Mine Drainage
ARD -	Acid Rock Drainage
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
f.o.b.-	Free On Board or Freight On Board
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO2 -	Nitrogen Dioxide
NOV -	Notice of Violation

R0076516

NON-FUEL, NON-METAL MINING
(SIC 14)
LIST OF ACRONYMS (CONT'D)

NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)
NPL -	National Priorities List
NRC -	National Response Center
NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SX/EW -	Solvent Extraction/Electrowinning
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

METAL MINING
(SIC 10)
LIST OF ACRONYMS (CONT'D)

NO_x - Nitrogen Oxide
NOV - Notice of Violation
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)
OAR - Office of Air and Radiation
OECA - Office of Enforcement of Compliance Assurance
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
SX/EW - Solvent Extraction/Electrowinning
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

NON-FUEL, NON-METAL MINING
(SIC 14)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

Because this profile was not intended to be a stand-alone document concerning the non-fuel, non-metal mining industry, appended is a full reference of additional EPA documents and reports on this subject, as listed in the March edition of the Federal Register.

II. INTRODUCTION TO THE NON-FUEL, NON-METAL MINING INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the non-fuel, non-metal mining industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of production.

II.A. Introduction, Background and Scope of the Notebook

This profile provides an overview of SIC code 14, which includes mining and quarrying of nonmetallic minerals, except fuels; and establishments engaged primarily in mining or quarrying, developing mines, or exploring for non-fuel, nonmetallic minerals. Also included are certain well and brine operations, and primary preparation plants engaged in crushing, grinding, and washing.

Mining is defined simply as the taking of minerals from the earth. Minerals can be classified as either fuel minerals or non-fuel minerals. Non-fuel minerals can be further divided into metallic and nonmetallic minerals. This industrial profile is concerned only with the mining and quarrying of non-fuel, nonmetallic minerals, although many of the mining activities and processes involved are very similar to those performed in mining metallic minerals. Quarrying is an open-pit mining process designed specifically for the removal of either dimension stone or crushed stone by the cutting and loosening of blocks or blasting.

Establishments engaged primarily in crushing, pulverizing, or otherwise treating non-metal minerals are classified as mining facilities, whether or not they operate in conjunction with mines. However, if the crushing, pulverizing, or other treating activities take place off-site, the establishments are classified under SIC 3295 and are not addressed by this profile.

SIC 14 categorizes the industry according to the types of minerals mined. The following list indicates the three-digit SIC codes used to further distinguish the types of minerals within the industry, and their associated end uses:

SIC 141 - Dimension Stone/End Uses: Construction
SIC 142 - Crushed and Broken Stone, Including Riprap/End Uses: Construction

SIC 144 -	Sand and Gravel/End Uses: Construction, Lime Manufacturing
SIC 145 -	Clay, Ceramic, and Refractory Minerals/End Uses: Bricks, Cement and Paper
SIC 147 -	Chemical and Fertilizer Mineral Mining/End Uses: Glass, Soaps, and Fertilizer
SIC 148 -	Nonmetallic Minerals Services, Except Fuels
SIC 149 -	Miscellaneous Nonmetallic Minerals, Except Fuels/End Uses: Insulation, Textiles, and Abrasives.

Separate profiles have been developed for the metal mining, and stone, clay, glass, and concrete products industries.

II.B. Characterization of the Non-Metal, Non-Fuel Mining Industry

The industry covered in this profile comprises establishments engaged in mining or quarrying, developing mines, or exploring for non-fuel, nonmetallic minerals such as dimension stone; crushed and broken stone; sand and gravel; clay, ceramic, and refractory minerals; chemical and fertilizer minerals, and other miscellaneous non-fuel, nonmetallic minerals. Also included under this SIC code are primary preparation plants, such as those engaged in crushing, grinding, or washing non-fuel, nonmetallic minerals. This section of the profile provides information on industry size and geographic distribution, product characterization, and economic trends. The predominant industries in this SIC code are crushed stone and sand and gravel. This section of the profile concentrates heavily on these two industries.

II.B.1. Industry Size and Geographic Distribution [1]

Crushed Stone Producers

A total freight on board (f.o.b.) of 1.1 billion metric tons of crushed stone, valued at $5.9 billion was reported produced in the United States in 1993 by 1,566 companies with 3,213 operations and 3,915 active quarries through open-pit mining. (See Section III.A. for a discussion of mining processes.) Most of the crushed stone produced in 1993 came from operations with an annual output greater than 300,000 tons; 1,182 operations, representing 37 percent of the total, produced 84 percent of the total tonnage.

In 1993 the ten top producing states, in descending order of tonnage were Texas, Pennsylvania, Florida, Illinois, Missouri, Ohio, Virginia, Georgia, Kentucky, North Carolina, accounting for 51 percent of the total domestic output.

Exhibit 1 lists the ten leading companies that produce crushed stone in the United States. These ten companies, with a total of 507 active operations and 509 quarries, account for 31 percent of the total output of crushed stone in the United States.

Exhibit 1
10 Leading Crushed Stone Producers
(In terms of total output of crushed stone)

Company	Number of Active Operations	States
1. Vulcan Materials Company	158	Alabama, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, Wisconsin
2. Beazer USA, Inc./Hanson PLC	98	Alabama, Arizona, California, Georgia, Indiana, Kentucky, Michigan, New Mexico, New York, North Carolina, Ohio, Oregon, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Washington
3. Martin Marietta Aggregates	130	Georgia, Indiana, Iowa, Kansas, Maryland, Missouri, Nebraska, North Carolina, Ohio, South Carolina, Virginia, Wisconsin
4. CSR America, Inc.	24	Florida, Georgia, Indiana, Ohio, South Carolina

Source: Directory of Principal Crushed Stone Producers in the United States in 1993, U.S. Department of the Interior, Bureau of Mines.

R0076524

Exhibit 1 (cont'd)
Leading Crushed Stone Producers
(In terms of total output of crushed stone)

Company	Number of Active Operations	States
5 Rogers Group Inc.	27	Alabama, Indiana, Kentucky, Ohio, Tennessee, Virginia
6. Lafarge Corporation	20	Illinois, Iowa, Kansas, Kentucky, Michigan, Missouri, New York, Ohio, Pennsylvania, Texas
7. Florida Rock Industries, Inc.	18	Florida, Georgia, Maryland, Virginia
8. Tarmac America, Inc.	11	Florida, South Carolina, Texas, Virginia
9. Dravo Corporation	11	Alabama, Florida, Illinois, Kentucky, Louisiana, Ohio
10. Lone Star Industries, Inc.	12	California, Illinois, Indiana, Missouri, New York, Oklahoma, Oregon, Pennsylvania, Texas

Source: Directory of Principal Crushed Stone Producers in the United States in 1993, U.S. Department of the Interior, Bureau of Mines

A total of 93 underground mines produced 65.2 million metric tons of crushed stone in 1993, as opposed to 1.1 billion metric tons produced from open-pit mining. Underground mines were located in 20 states. The leading states in descending order of tonnage were Kentucky, Iowa, Illinois, Missouri, Indiana, Maryland, and Tennessee. Their production represented 76 percent of the total U.S. crushed stone produced from underground mines.

Sand and Gravel Producers

A total of 919 (834 million short tons) of construction sand and gravel valued at 3.3 billion, f.o.b. plant, was reported produced in 1992 by 4,213 companies with 5,999 operations. Some companies produced both construction and industrial sand and gravel from the same operations. In 1992, most of the sand and gravel came from operations that produced more than 200,000 tons per year; 1,290 operations, representing 22 percent of the total, produced 71 percent of the total tonnage.

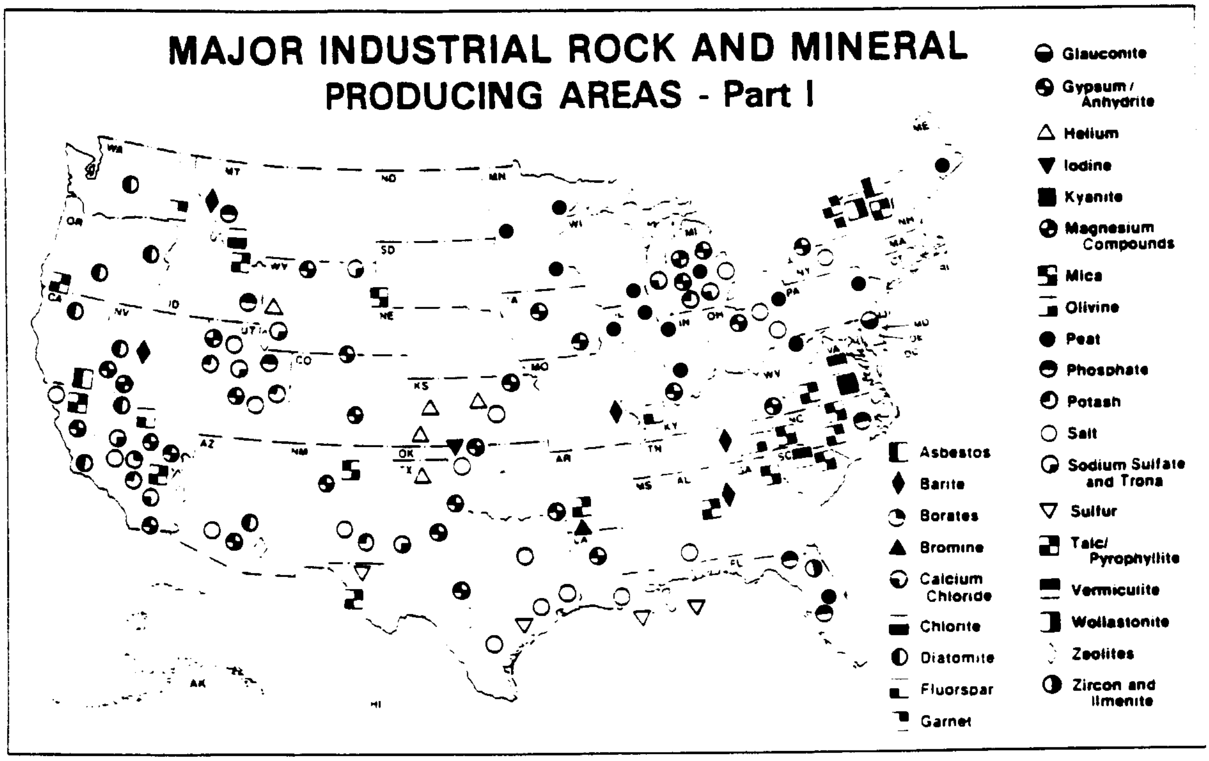
Exhibit 2 lists the ten leading companies that produce sand and gravel in the United States.

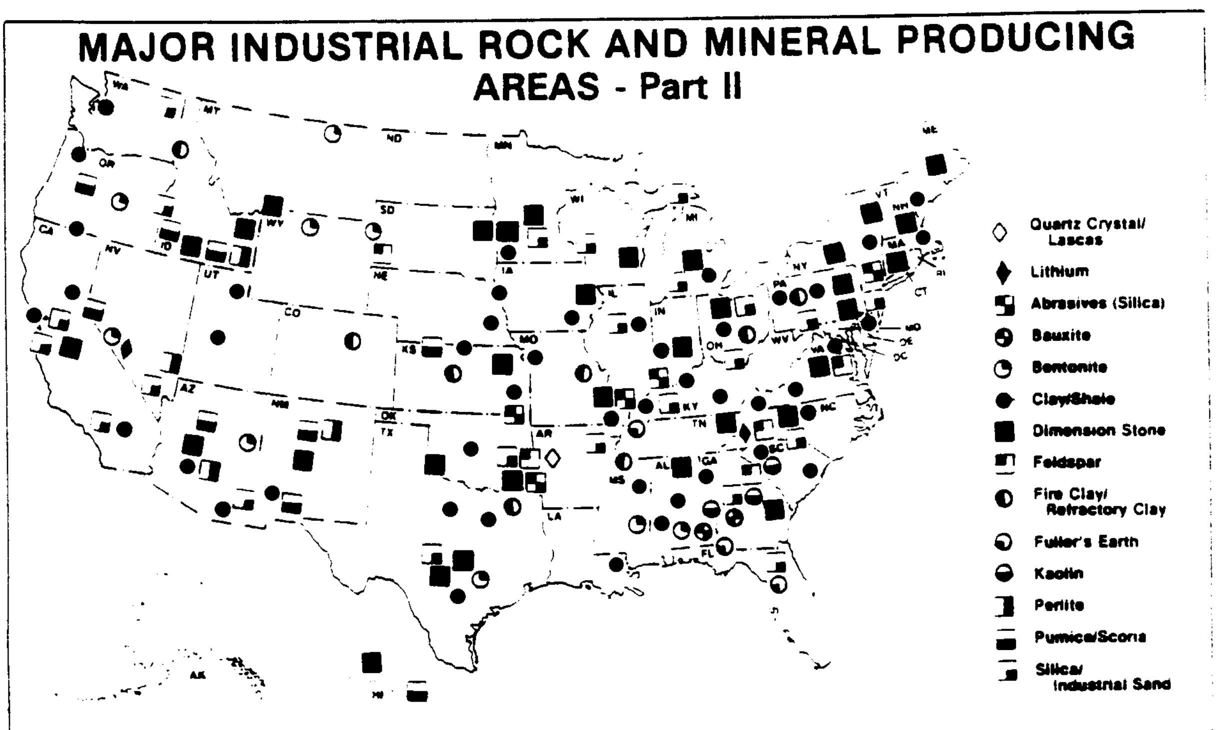
Exhibit 2
10 Leading Companies in Order of Total Output of Sand and Gravel

Company	Number of Active Operations	States
1. Calmat Co.	28	Arizona, California, New Mexico
2. Beazer USA, Inc./Hanson PLC	43	Arkansas, California, Georgia, Indiana, Louisiana, Nevada, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Texas, Washington
3. CSR America Inc.	39n	Arizona, Georgia, Florida, Indiana, Michigan, Nevada, Ohio, South Carolina, Washington
4. Ashland Oil, Inc./APAC, Inc.	41	Alabama, Arizona, Arkansas, Florida, Georgia, Mississippi, Oklahoma, North Carolina, South Carolina
5. Redland PLC	38	Colorado, Kansas, Maryland, New Mexico, Texas
6. Dravo Corporation	17	Alabama, Florida, Ohio, Pennsylvania, West Virginia
7. Vulcan Materials Co.	22	Alabama, Florida, Illinois, Indiana, Iowa, Tennessee, Texas, Wisconsin
8. Lonestar Industries, Inc.	8	California
9. Pioneer Concrete of America	10	Pennsylvania, Texas
10. Lafarge Corp.	19	Louisiana, Missouri, New York, Ohio, Pennsylvania, Texas, Washington, West Virginia

Source: Directory of Principal Sand and Gravel Producers in the United States in 1992, U.S. Department of the Interior, Bureau of Mines.

Exhibit 3
Geographic Distribution of the Industry





Source: *Mineral Commodity Summaries 1994.*

R0076527

II.B.2. Product Characterization

Crushed stone and sand and gravel are the two main sources of natural aggregate. Both are used in almost all residential, commercial, and industrial buildings, and in most public works projects such as roads and highways, bridges, railroads, dams, airports, water and sewer systems, and tunnels. Together, crushed stone and sand and gravel make up approximately half the volume of mined minerals in the United States.

Crushed stone and sand and gravel are widely used commodities that are important elements in many national industries. Sand and gravel (or sand alone) can be used for industrial purposes such as foundry operations, in glass manufacturing, as an abrasive, and in filtration beds of water-treatment facilities. Crushed stone is used as a source of calcium for fertilizers, as a metallurgic fluxstone, and as the major resource in the manufacture of cement and lime. It is also used in water and sewer filtration systems and in the manufacture of glass.

Crushed stone and sand and gravel, however, are most commonly used as aggregate in the construction industry. As an example, an average 1,500-square-foot home requires approximately 114 tons of aggregate. If you add each home's proportional share of new streets, schools, churches, municipal projects, and shopping centers, the total aggregate use per home increases to approximately 328 tons (Shumway and Silva, 1993).

Many types of non-fuel, nonmetallic minerals comprise this industry. The major SIC groups of non-fuel, nonmetallic minerals and some of the minerals within each group include: dimension stone (mica schist, granite, limestone, marble, sandstone, slate), crushed and broken stone (limestone, granite, dolomite, cement rock, sandstone, trap rock), sand and gravel (industrial sand, construction sand, gravel, pebble, silica, abrasive sand), clay, ceramic, and refractory minerals (kaolin, ball clay, fire clay, china clay, paper clay, kyanite), chemical and fertilizer minerals (potassium compounds, boron compounds, sodium compounds, phosphate rock, sulfur), and miscellaneous nonmetallic minerals (asbestos, diatomite, gypsum, asphalt rock, graphite, precious stones). Some of the more commonly mined non-fuel, nonmetallic minerals include crushed and broken stone (limestone), sand and gravel (silica sand), and clay (kaolin clay). Non-fuel, nonmetallic minerals are also referred to as industrial minerals.

II.B.3. Economic Trends

According to a Bureau of Mines Study, the demand for crushed stone in 1994 was expected to be about 1.17 billion metric tons (1.29 billion short tons), a 5 percent increase compared with that of 1993. Gradual increases in demand for construction aggregates have occurred after 1994, based on increased volume of work on the infrastructure that is being financed by the Intermodal Surface Transportation Efficiency Act of 1991 and is the result of the recovery of the U.S. economy. The law authorized $151 billion to be spent in the next 6 years on transportation projects, of which $119.5 billion was allocated for highway work and $32.5 billion for mass transit.

It was estimated that the demand for crushed stone will reach 1.3 billion tons in 1995 although the final numbers for 1995 have not been released. The projected increases will be influenced by construction activity primarily in the public as well as the private sector.

Crushed stone f.o.b. prices are not expected to increase significantly, even if the demand for construction aggregates will rise over the forecasts. However, the delivered prices of crushed stone are expected to increase, especially in and near metropolitan areas, mainly because more aggregates are transported from distant sources.

The demand for construction sand and gravel in 1993 was expected to be about 940 million tons, a 2.5 percent increase compared with that of 1992. Gradual increases in demand for construction aggregates are anticipated after 1993 as well. The factors that stimulate demand in the construction sand and gravel industry are similar to those that affect the crushed stone industry (i.e., the Intermodal Surface Transportation Efficiency Act of 1991 and the recovery of the U.S. economy). Similarly, construction sand and gravel prices are not expected to rise significantly, except for the delivered prices. It is estimated that the demand for construction sand and gravel will reach 975 million tons in 1995. The projected increases will be influenced by construction activity, primarily in the public construction sector.

Dimension stone production for 1993 was estimated at 1.17 million tons, approximately the same as in 1992. The construction industry, a major consumer of stone and stone products, is expected to boost demand for stone and stone products. Increases in new residential construction should also boost demand for stone and stone products.

The domestic construction industry also provided an impetus for mineral demand in 1994. The construction industry is the largest domestic consumer of brick, clay, cement, sand and gravel, and stone.

Expenditures for road construction and maintenance (which consume large quantities of asphalt, cement, crushed stone, and sand and gravel) continued at a high level in 1994 and are expected to remain strong in 1995 due to continued funding for mass transit projects. In addition, apartment building construction (a major end-use sector for brick clay, cement, sand and gravel, steel, and stone) rose sharply in 1994.

III. Industrial Process Description

This section describes the major industrial processes within the non-fuel, non-metal mining industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of waste outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available to supplement this document.

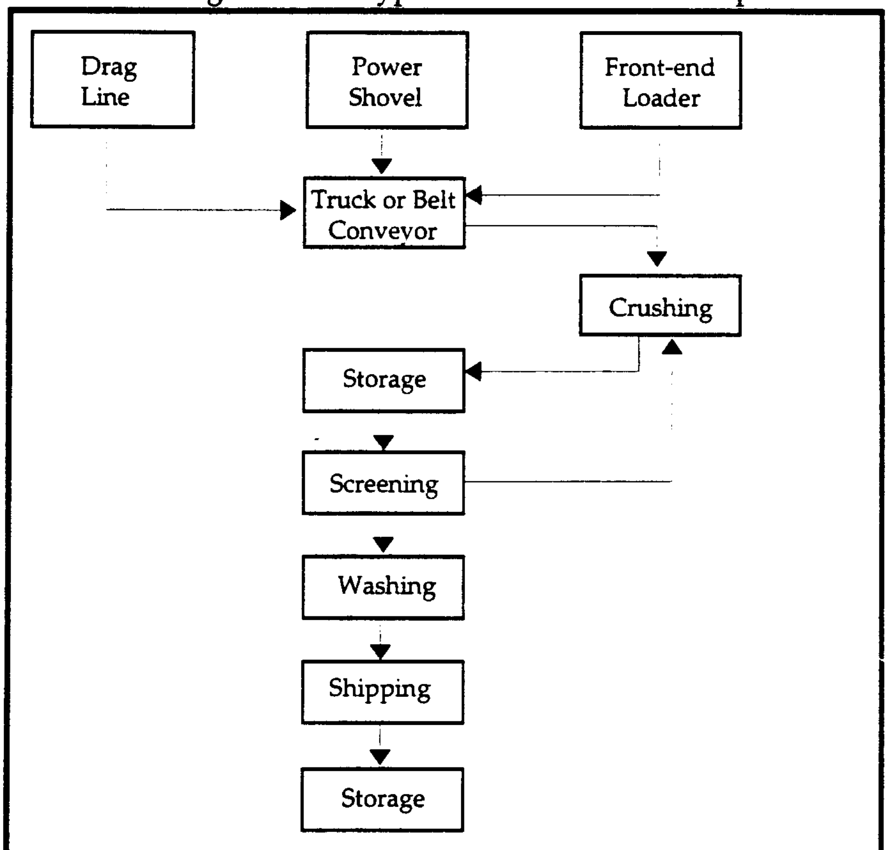
This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

III.A. Industrial Processes in the Non-Fuel, Non-Metal Mining Industry

Minerals extraction is broadly divided into three basic methods: open-pit or surface, underground, and solution mining. The mining method used depends on the particular mineral, the nature of the deposit, and the location of the deposit. Each method is discussed briefly below. For this industry, most mining is open-pit or surface mining.

Surface or open-pit mining requires extensive blasting, as well as rock, soil, and vegetation removal to reach mineral deposits. Waste rock, or overburden, is piled away from the mine. Benches are cut into the walls of the mine to provide access to progressively deeper ore, as upper-level ore is depleted. Ore is removed from the mine and transported to processing plants for concentration.

Exhibit 4
Flow Diagram for a Typical Sand and Gravel Operation



Source : California EPA and the National Stone Association, Aggregate Plants Compliance Assistance Program, September, 1993.

Underground mining involves extraction from beneath the surface at depths as great as 10,000 feet. This requires sinking shafts to reach the main body of deposits. "Drifts," or passages, are then cut from the shaft at various depths to access the ore, which is removed to the surface for processing. Waste rock may be either returned to the mine as fill or put in a disposal area.

Fluid or solution mining entails drilling into intact rock and using chemical solutions to dissolve lode deposits. During solution mining, the leaching solution (usually a dilute acid) penetrates the ore, dissolving soluble minerals. This pregnant leach solution is then retrieved for recovery at a solvent extraction/electrowinning plant.

Historically, the primary mining method has been underground mining. However, with the advent in recent decades of large earth moving equipment, less expensive energy sources, and improved extraction and beneficiation technologies, surface mining now prevails in most industry sectors. It usually costs less to mine a ton of rock from an open-pit mine than from an underground mine. Whether open-pit mining is ultimately less costly than underground mining is closely related to other factors such as stripping ratios, physical properties of the ore body, rates and productivity.

Minerals Extraction

The extraction of minerals from the earth often involves the use of mechanical means such as drilling. Some drill types include rock, diamond, water-jet, and jet flame. Rock and diamond drills involve the rotation of a pipe or rod tipped with a rolling gear-like bit; water-jet drills use a powerful jet of water to blast materials loose; jet flame drills use a high-velocity flame to create holes in hard rock. Other machines unique to mining include mechanical miners and specially adapted materials-handling equipment for use in underground and surface mining. Diesel engines are used for generating small quantities of electric power in remote areas and for transportation units.

Blasting is a method of mineral extraction involving the displacement of solid rock through the use of explosives. Blasting also fragments the deposit into sizes that require a minimum of secondary breakage, and that can be handled by loading and hauling equipment. The explosive charge (usually a mixture of ammonium nitrate and fuel oil) used in blasting must be strategically placed so as to break the solid material efficiently.

Extraction without the use of mechanical methods is also possible if the material surrounding the mine opening is not adequately supported. By removing underlying support, the rock caves into the opening left by the removed supports. If rock needs to be broken down further for transportation, secondary breakage may be required. This involves using drop-ball cranes on the oversized rock to further reduce its size.

Minerals Transportation

The excavation and loading of broken rock is normally performed by mechanical shovels and front-end loaders. The broken rock is either loaded into a haulage vehicle, such as a truck or railroad track-type car for transport to a processing plant, or directly into a primary crusher. At most quarries, large capacity haulage vehicles are used to transport broken rock from the quarry to the primary crusher. Pipelines have also been used successfully to transport many different minerals, such as limestone, phosphates, and sand fills: the dry material is first combined with water to form a slurry and is then pumped to its destination for dewatering. If sufficient dump room or storage capacity exists near the mine, a system of belt conveyors can handle material at high rates and relatively low cost, but only if proper feed control of a sized material allows a continuous, even flow that matches the system design. Other factors that determine the practicality and size of a conveyor system are the rate at which the material must be handled, the material's density and stickiness, the dusting or degradation on transfer, and the need for the system to handle more than one product.

Minerals Processing

Processing minerals after their extraction and transportation to the processing plant involves the use of crushers, grinders, and screens. This equipment is used to separate or scalp larger boulders from the finer rocks that do not need primary crushing, thus minimizing the load to the primary crusher. Following crushing, a variety of mechanical concentration techniques are used to concentrate the desired minerals. Techniques used for non-fuel, nonmetallic minerals include flotation, heavy media separation, and electromagnetic separation.

Flotation is a method of concentrating targeted minerals which uses the physical and chemical properties of the minerals along with process chemicals to separate desired minerals from remaining wastes. Typically, the mineral is entered into an acidic or basic bath of flotation agents. Depending on the type of mineral being concentrated, this bath may consist of such chemicals as sulfuric acid, chromium, phenols, zinc, ammonia, hydrochloric acid, and phosphoric acid. The wastes, including the spent process liquids, are discarded.

Heavy media separation utilizes mainly organic chemicals to separate minerals using the minerals' density differences. Electromagnetic separation uses a magnetic field to remove impurities from the target mineral.

Following are brief descriptions of processes used in mining major non-fuel, nonmetallic minerals.

Dimension Stone

Dimension stone refers to rock that is cut to a certain shape and size. It is commonly used as building material in the construction industry. Common types of dimension stone are limestone, granite, dolomite, sandstone, marble, and slate. Processing the stone begins with sawing the excavated rock into slabs using a rotating diamond or circular saw. Water is used to cool the saws and to remove particles. After the stone has been cut to the desired size, it is finished using natural and synthetic abrasives. Natural abrasives include iron oxide, silica, garnet, and diamond dust. Synthetic abrasives include silicon carbide, boron carbide, and fused alumina.

Crushed and Broken Stone, Including Riprap

Nearly all principal types of stone, including granite, diabase, limestone, sandstone, dolomite, and marble may be used as sources of commercial crushed stone. Stone that breaks in chunky, cubical fragments and is free of surface alteration from weathering is preferred for crushed stone. Such stone should also be free of impurities such as opalescent quartz, which may react with lime in cement and cause disintegration of the concrete in which the stone may be used. Most crushed and broken stone is mined from open quarries; however, in many areas, factors favoring large-scale production by underground mining are becoming more frequent and more prominent.

Surface mining equipment varies with the kind of stone mined, the production capacity needed, the size and shape of the deposit, estimated life of the operation, location of the deposit with respect to urban centers, and other important factors. Ordinarily, drilling is done with tricone rotary drills, long-hole percussion drills, and churn drills. Blasting in smaller operations may still be done with dynamite, but in most medium- to large-size operations, ammonium nitrate fuel oil mixtures (AN-FO), which are much lower in cost, are used.

Other processing activities include conveying, screening, secondary and tertiary crushing, and sizing. Screening is the single most important part of the processing cycle of crushed stone particles. A wide variety of screen types exists, and their selection is a function of the material processed as well as the final product required. Inclined vibratory screens are most commonly used in stationary installations, while horizontal screens are used extensively in portable plants. For screening large sizes of crushed stone, grizzly bars, rod decks, and heavy punched steel or plastic plates are used; for smaller sizes, woven wire, welded wire cloth, rubber, or plastic screens are used. Stone washing is something performed, which consists of processing the crushed stone across sizing screens where it is saturated with water, in order to remove unwanted material.

Underground operations are becoming more common, especially for limestone mining in the central and eastern parts of the United States, as the advantages of such operations are increasingly recognized by the producers. By operating underground, a variety of problems usually connected with surface mining such as environmental impacts and community acceptance are significantly reduced. Underground room-and-pillar mines can be operated on a year-round basis, do not require extensive removal of overburden, and produce a minimum of environmental disturbance.

Of the total crushed stone produced in 1993, about 71 percent was limestone and dolomite; 15 percent granite; and eight percent traprock. The remaining six consisted of sandstone and quartzite, miscellaneous stone, calcareous marl, shell, marble, volcanic cinder and scoria, and slate. Limestone is used in the manufacture of products such as glass, paper, paint, sugar, and cement; of the 1.2 billion tons of crushed stone produced in 1993, approximately 81 percent was used as construction aggregates, mostly for highway and road construction and maintenance; 15 percent for chemical and metallurgical uses including cement and lime manufacture; three percent for agricultural purposes; and one percent for miscellaneous uses and products.

Sand and Gravel

Sand and gravel are the unconsolidated granular materials resulting from the natural disintegration of rock or stone. Sand and gravel deposits are commonly found adjacent to or in river courses or in areas with glaciated or weathered rock. Such deposits often contain the fine alluvial silt that is the primary source of process and fugitive dust from sand and gravel operations.

There are two main types of sand and gravel. Construction sand and gravel are used mainly in concrete, road-base, asphaltic concrete aggregates, and construction fill. Generally, the physical characteristics of construction sand and gravel and their proximity to construction sites is more important than their chemical characteristics. Industrial sand and gravel are used mainly in manufacturing glass, ceramics, and chemicals. The chemical and physical characteristics of industrial sand and gravel are very important to their end uses, and are therefore subject to stricter chemical and physical characterization than construction sand and gravel.

Loose sand and gravel deposits are usually mined without the necessity of drilling and blasting. On rare occasions, blasting with light charges is used to loosen deposits.

Extraction and mining is done by any number of methods, depending on whether the deposit is above or below the water table. Where sand and gravel are above water, extraction is done by power shovels, drag line scrapers, and/or by highly mobile, rubber-tired front-end loaders.

When the sand and gravel deposit is consolidated to the point where digging with a front-end loader or power shovel is too difficult, a bulldozer equipped with a ripper is used to loosen the material. A ripper consists of a large tooth (or series of teeth) which is attached to the rear of the bulldozer and pulled through the material as the bulldozer moves forward. Materials mined below water, in rivers, estuaries, lakes, and oceans must be removed with specialized equipment. This equipment includes dredges, draglines and floating cranes.

Clay, Ceramic, and Refractory Minerals

Common types of clay, ceramic, and refractory minerals include kaolin, ball clay, bentonite, fuller's earth, fire clay, common clay, and shale. Processing of minerals in this category usually entails a combination of crushing, grinding, screening, and shredding to reduce particle size. For kaolin and ball clay, wet and dry processing methods are used. The wet process employs liquid chemical dispersants (phosphates, phosphoric acid, hydroxides) and water to remove impurities. A clay slurry is formed and is made either acidic or basic using sulfuric acid or alum. The slurry is then chemically leached using a reducing agent such as zinc hydrosulfide, ozone, or peroxide to remove unwanted iron and titanium ions. The slurry is dried to remove water and unwanted chemical compounds such as phosphates, phosphoric acids, silicates, iron, and zinc. Clay beads are then formed that are pulverized and calcined (heat treated).

Chemical and Fertilizer Minerals

These minerals include potash and phosphate rock. Potash, a term that describes minerals containing potassium compounds, is used in fertilizers. Processing potash involves mixing crushed potash ore with a brine which is saturated with potassium chloride and sodium chloride. Froth flotation, crystallization, or heavy media separation methods are then used to recover potassium-bearing compounds from the saturated solution.

Processing phosphate rock usually consists of sizing and flotation. Crude ore is pumped and slurried in wells and is transported to a washing plant for sizing. Fine concentrate is sent to flotation, where various flotation methods are used on the concentrate. Typical flotation reagents used include sulfuric acid, which is used in product scrubbing, and soda ash. Additional flotation reagents include fatty acids and amines. Phosphate rock is used mainly in fertilizer manufacturing. Phosphate rock mining involves the movement of huge volumes of soil and other materials in overburden. Phosphate rock preparation involves beneficiation to remove impurities, drying to remove moisture, and grinding to improve reactivity. Usually, direct-fired rotary kilns are used to dry phosphate rock.

Non-fuel, Nonmetallic Minerals Services

This industry code includes facilities which specialize in specific areas of mining operations and which perform services on a contract basis. Specialty areas include exploration and mine development. From a process and chemical use standpoint, activities in this SIC code are similar to other activities conducted in other SIC codes. During the exploration and characterization of a mineral deposit, samples of rock must be collected and analyzed. Drill-based sampling methods are routinely used to characterize a mineral deposit at different depths. These methods include rotary, percussion, auger, and diamond drilling. Diamond drilling will extract a cylindrical core of material, while the former three methods will extract fragmented material. All share the objective of collecting ore material for analysis.

Miscellaneous Non-fuel, Nonmetallic Minerals

Minerals included in this category include lightweight aggregates (pumice, vermiculite), asphaltic minerals (gilsonite, wurtzilite), natural abrasives (millstone, diatomite), gemstones (jade, sapphire), and other minerals, such as asbestos and gypsum. Processing these minerals usually involves crushing, grinding, screening, flotation, heavy media separation, and drying methods similar to those used for other minerals. As in processing other non-fuel, nonmetallic minerals, wet methods are more chemically intensive than dry methods due to the use of various flotation agents to refine the mineral.

III.B. Mining Process Waste Outputs

III.B.1. Process-Specific Wastes

Minerals Extraction

The extraction of minerals requires the removal and disposal of overburden, a layer of soil, vegetation, and rock. Waste rock generated in both surface and underground operations is removed and usually disposed of in impoundment areas or is used to backfill mines. Wastewater is generated from the use of water to suppress dust, wash away waste from the working zone, and cool excavation machinery such as drills. Dusts are generated from the cutting, drilling, sawing, and blasting required to remove the rock. Explosives used in excavation contain mixtures of ammonium nitrate and fuel oil. Hydrocarbons used in machinery as lubricants and fuels can be sources of pollution.

Minerals Processing

Wastes generated from minerals processing include dusts, solid matter, and water effluents. Crushing and screening operations performed to reduce the size of particles are also sources of dust emissions and solid waste. This waste may contain minerals that react with air and water to produce metal ions capable of contaminating water resources such as rivers, streams, and groundwater.

Processes used to remove mineral impurities can be a major source of water contamination. Flotation, a wet method used to refine certain non-fuel, nonmetallic minerals (sand and gravel, kaolin, potash, phosphate rock) is a potential source of water pollution due to the chemicals used to separate impurities from the mineral. Flotation involves placing minerals in an acidic or basic bath of chemicals where pH modifiers such as sulfuric acid, ammonia, and hydrofluoric acid are used to control pH levels in order to separate impurities from the target mineral. Additional materials may be added to the flotation bath to assist in removing impurities, including frothers, conditioning agents, sulfonated oils, and heavy alcohol.

Exhibit 5 summarizes the types of wastes produced at various points in the non-fuel, nonmetal mining industry.

Exhibit 5
Process Waste Materials

Primary	Subprocesses	Air Emissions	Process Waste Water	Other Waste Generated
Minerals Extraction	Drilling, blasting, secondary breakage	Particulates, exhaust from machinery	Surface runoff, groundwater seepage	Overburden (soil, rock)
Minerals Transportation	Loading, conveying, off-road haulage, unloading	Particulates, exhaust from vehicles and machinery	Water for transportation of ore to process plant	
Minerals Processing	Crushing, grinding, screening, washing, drying, calcining, floating	Particulates	Transport water, ore and product wash water, dust suppression water, classification water, heavy media separation water, flotation water, solution water, air emissions control equipment water, equipment, and floor wash down water	Tailings

III.B.2. Mineral-Specific Pollutants

Sand and Gravel

Particulate matter is emitted from sand and gravel operations and is made up principally of inert crustal material (e.g., soil and rock particles). Dust emissions in the form of fugitive dust occur during removal of overburden and sand and gravel from the deposit; from wind-blown dust from storage piles; from traffic on haul roads; from open conveyors exposed to the wind; during material dumping from trucks, front-end loaders, and conveyors; from screening; and from transfer points in conveyor systems. If wet screening is used to produce a washed gravel product, negligible amounts of dust are produced, but effluent water must be clarified by settling before reuse or discharge. The amount of moisture a deposit contains affects the amount of dust emissions that occur. If the deposit is dry and the material and overburden have a high silt content, dust emissions may be significant. If the deposit is wet or is removed by dredging, dust emissions tend to be negligible as long as a high moisture content is maintained in the material.

Methods of controlling dust emissions from sand and gravel operations include using water sprays to keep materials and roads wet, limiting the drop heights of materials, covering trucks and conveyors, using enclosures or hooding material at transfer points and screening operations, and exhausting air from these points to air pollution control systems.

Stone

The source of crushed stone is usually a deposit of relatively solid rock such as limestone, dolomite, trap rock, granite or sandstone. Dust emissions occur from many operations in stone quarrying and processing. Dust is released when rock and crushed stone products are loosened by drilling or blasting them from their deposit beds. Dust is also released when the loosened rock is loaded into trucks by power shovels or front-end loaders. Transporting the quarried material to the processing plant generates dust from the rock inside the truck and from the road. Sources of dust at the processing plant include the dumping of rock into primary crushers; primary, secondary, and tertiary crushing; screening; transferring rock by belt conveyor; loading rock onto storage piles from conveyors; and wind blowing dust from storage piles and open conveyors.

Particulate matter produced during stone quarrying and processing is usually of relatively large particle size. The chemical composition of the dust tends to be homogeneous since its ancestry is the rock formation from which the rock deposit was taken.

Air pollution control techniques for stone quarrying and processing plants include wetting the material and/or surfaces; covering open operations to prevent dust entrainment by the wind; reducing the drop height of dusty material; and using hooding, industrial ventilation systems, and dust collectors (e.g., baghouses) on dusty processes amenable to enclosure. Dust recovered from air pollution control systems is often a valuable product in road building and other construction operations.

Phosphate Rock

Although there are no significant emissions from phosphate rock beneficiation plants, emissions in the form of fine rock dust may be expected from drying and grinding operations. Phosphate rock grinders can be a considerable source of particulates. Because of the extremely fine particle size, baghouse collectors are normally used to reduce emissions. Effluents produced in the mining and beneficiation of phosphate rock are contained in the water suspensions leaving the washer plant. These suspensions are the phosphatic clays and sand tailings. The major effluent is that of the phosphatic clays which contain a suspension of clays and very fine solids. These phosphatic clays are impounded in slime ponds to allow settling and clarification to occur. Clear water is returned from the ponds to the beneficiation plant. When phosphate rock is calcined, fluoride is produced. The fluoride produced is scrubbed with water or dilute hydrofluoric acid.

Because proposed mining activities may also impact aquatic sources, vegetation and wildlife, EPA suggests the following potential mitigation measures for use at mine sites:

Exhibit 6
Ecosystem Mitigation Measures

- Employ sediment retention structures to minimize amount of sediment migrating off-site
- Employ spill prevention and control plans to minimize discharge of toxic/hazardous materials into water bodies
- Site roads, facilities, and structures to minimize extent of physical disturbance
- Avoid construction or new disturbance during critical life stages
- Minimize use of fences or other such obstacles in big game migration corridors; if fences are necessary, use tunnels, gates, or ramps to allow passage of these animals
- Use "raptor proof" designs on power poles to prevent electrocution of raptors
- Use buses to transport employees to and from mine from outer parking areas to minimize animals killed on mine-related roadways
- Limit impacts from habitat fragmentation, minimize number of access roads, and close and restore roads no longer in use
- Prohibit use of firearms on site to minimize poaching.

Source: US EPA, OSW Technical Document/Background for NEPA Reviewers: Non-Coal Mining Operations, 1994.

R0076542

IV. WASTE RELEASE PROFILE

This section provides a general overview of the waste release activities and issues common to the non-fuel, non-metal mining industry. Unlike facilities covered by SIC codes 20 through 39 (manufacturing facilities), non-fuel, non-metal mining facilities are not required by the Emergency Planning and Community Right-to-Know Act to report to the Toxic Release Inventory (TRI). Because TRI reporting is not required for the non-fuel, non-metal mining industry, other sources of waste release data have been identified for this profile. EPA is considering expanding TRI reporting requirements in the future, which may affect such previously exempt industries such as non-fuel, non-metal mining.

IV.A. Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry.

AIRS Data

The Aerometric Information Retrieval System (AIRS) is an air pollution data delivery system managed by the Technical Support Division in EPA's Office of Air Quality Planning and Standards, located in Research Triangle Park, North Carolina. AIRS is a national repository of data related to air pollution monitoring and control. It contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. States are the primary suppliers of data to AIRS. Data are used to support monitoring, planning, tracking, and enforcement related to implementation of the Clean Air Act. AIRS users include State environmental agency staff, EPA staff, the scientific community, other countries, and the general public.

Exhibit 7 summarizes AIRS annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). This information is compared across industry sectors.

Exhibit 7
Pollutant Releases (Short Tons/Year)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	**4,525**	**28,804**	**59,305**	**167,948**	**24,129**	**1,736**
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

Exhibit 8 lists the air emissions of particular chemicals reported for SIC 14 in the Air Facility Subsystem (AFS) of AIRS, presented in a "SIC Code Profile, Non-Metal Mining," prepared by EPA's Office of Pollution Prevention and Toxics in April, 1992. The release data are expressed in pounds released per year, per facility.

Exhibit 8
AIRS Releases

Chemical	Facilities	Med. Releases (lbs/Year/Facility)	Total Releases (lbs/Year/Facility)
Acetaldehyde	19	420	8,200
Acetone	24	80	16,209
Acrolein	19	385	7,789
Acrylic acid	12	54	1,212
Acrylonitrile	16	290	4,599
Aniline	13	95	3,278
Antimony	49	377	37,608
Arsenic	284	2	56,371
Barium	284	3	19,960
Benzene	59	89	70,324
Benzyl chloride	12	50	1,131
Biphenyl	12	2	75
1,3-Butadiene	16	134	45,662
Butyl acrylate	16	215	1,865
sec-Butyl alcohol	15	170	5,753
tert-Butyl alcohol	12	50	1,131
Butyraldehyde	16	220	1,222
Cadmium	286	2	22,557
Carbon disulfide	15	45	1,522
Carbon tetrachloride	16	325	2,706
Chlorine	1,036	1,096	2,177,738
Chlorobenzene	17	142	19,065
Chloroethane	15	145	4,853
Chloroform	16	255	1,506
Chloromethane	4	1	37
Chloroprene	15	170	5,753
Chromium	300	20	85,079
Cobalt	281	24	80,282
Copper	295	16	106,526
Creosote	12	74	8,532
Cresol (mixed isomers)	12	46	1,024
Cumene	13	46	1,024
Cyclohexane	51	62	19,991
1,2-Dibromoethane	12	50	1,131
Dibutyl phthalate	12	6	124
1,2-Dichlorobenzene	16	200	9,112
1,3-Dichlorobenzene	4	1	37
1,4-Dichlorobenzene	15	360	12,202
Dichlorodifluorome-thane CFC-1	15	175	6,008
1,2, Dichoroethane	15	290	9,590

R0076545

Exhibit 8 (cont'd)
AIRS Releases

Chemical	Facilities	Med. Releases (lbs/Year/Facility)	Total Releases (lbs/Year/Facility)
Dichloromethane	11	120	2,016
Dichlorotetrafluoroethane CFC	15	5	239
Dimethyl phthalate	12	10	353
Epichlorohydrin	12	50	1,131
2-Ethoxyethanol	11	58	968
Ethyl acrylate	16	250	3,067
Ethylbenzene	34	194	11,940
Ethylene	36	401	48,592
Ethylene glycol	12	74	8,532
Ethylene oxide	15	190	1,250
Formaldehyde	48	126	48,119
Formic acid	16	210	1,455
Freon	15	200	1,362
Glycol Ethers	16	220	1,339
HCFC-22	15	80	2,725
Isobutyraldehyde	12	50	1,132
Lead	1,039	126	361,044
Maleic anhydride	15	35	1,144
Manganese	1,038	69	135,959
Mercury	41	23	5,542
Methanol	15	700	13,074
2-Methoxyethanol	12	47	1,051
Methyl acrylate	12	46	1,024
Methyl ethyl ketone	16	610	10,214
Methyl isobutyl ketone	16	280	2,876
Methyl methacrylate	16	230	10,150
Methylene bromide	15	15	559
Monochloropenta-fluoroethane	15	10	282
Naphthalene	24	29	4,768
n-Butyl alcohol	15	345	5,429
Nickel	295	7	36,560
Nitrobenzene	12	40	889
Phenol	16	220	13,750
Phosphorus (yellow or white)	284	4	68,277
Phthalic anhydride	15	100	3,443
Propionaldehyde	15	50	1,132
Propylene oxide	16	250	1,405

R0076546

Exhibit 8 (cont'd)
AIRS Releases

Chemical	Facilities	Med. Releases (lbs/Year/Facility)	Total Releases (lbs/Year/Facility)
Propylene (Propene)	38	53	19,610
Selenium	288	8	31,144
Silver	53	13	2,330
Styrene	17	240	44,591
Tetrachloroethylene	11	112	1,882
Toluene	59	125	87,231
1,1,1-Trichloroethane	11	69	1,156
1,1,2-Trichloroethane	11	56	941
Trichloroethylene	11	69	1,156
Trichlorofluoromethane (CFC-11	15	305	5,310
1,2,4-Trimethylbenzene	16	2	120
Vinyl acetate	15	275	9,318
Vinyl chloride	15	210	6,254
m-Xylene	15	68	2,216
o-Xylene	34	89	12,679
p-Xylene	20	200	1,335
Xylene (mixed isomers)	18	112	8,553
Zinc (fume or dust)	1,039	32	191,766
TOTAL	**1,051**	**64**	**4,099,173**

Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and industry-specific descriptions of some pollution prevention advances that have been implemented within the non-fuel, non-metallic industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are, being implemented by this sector. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

The use of pollution prevention technologies and environmental controls can reduce substantially the volume and concentration of the contaminants released/discharged into the surrounding environment. In some cases, these pollution prevention approaches may be economically beneficial to mine operators because they may decrease the process chemicals needed, and therefore the cost of producing a given amount of mineral. The approaches actually used depend on many criteria, including the nature of the mine environment, the funds available for enforcement and inspection, the availability of new technological solutions, and the relationships between government and mine operators.

Waste minimization generally encompasses any source reduction or recycling that results in either the reduction of total volume or the toxicity of hazardous waste. Source reduction is a reduction of waste generation at the source, usually within a process. Source reduction can include process modifications, feedstock (raw material) substitution, housekeeping and management processes, and increases in efficiency of machinery and equipment. Source reduction includes any activity that reduces the amount of waste that exits a process. Recycling refers to the use or reuse of a waste as an effective substitute for a commercial product or as an ingredient or feedstock in an industrial process.

Opportunities for waste minimization may include raw material substitutions, though these opportunities are somewhat limited for mining facilities because of the transportation costs involved in using ores or concentrates produced in other regions or countries. In elemental phosphorous production, raw materials substitution generally takes the form of improving the separation of value from the raw ore during beneficiation, so that the furnace operations would begin with a higher grade of ore concentrate. Processing a feedstock with a higher concentration of phosphorous results in decreased slag generation, although presumably increasing the generation of related beneficiation wastes. Other source reduction opportunities may involve process modifications to increase efficiency during the furnace operation.

Utilization of mineral processing wastes can be a viable alternative to disposal. In 1988, Occidental's Columbia, Tennessee plant reported selling all of its slag while three other facilities sold some portion of their slag for off-site use (specific data are confidential). Phosphorous slag can be used as an aggregate in asphalt manufacturing, and elemental phosphorous slag has been used extensively in highway construction for many years in Idaho, Montana, and Tennessee.

The list below summarizes some of the environmental control technologies and regulatory approaches that may serve as effective pollution prevention techniques for this industry.

Water Pollution Prevention

- Reduce the amount of contaminated water produced by using diversion systems to channel runoff away from exposed mine pits and waste dumps.
- Channel contaminated water into containment ponds for treatment or recycling.
- Reuse contaminated water in the extraction process for dust elimination or drilling.
- Utilize subsurface drainage systems and barriers to collect or deflect groundwater prior to contact with exposed mine pits.

Air Pollution Prevention and Control

- Utilize dust elimination technologies such as wet suppression systems to reduce dust created during excavation and transport.
- Use dust suppressant agents such as magnesium chloride to reduce dust in solid piles and tailings.

Closure and Reclamation Approaches

- Use plant cover and landscape alteration to reduce erosion, dust, and runoff contamination; reintroduce native species to the former mine site; and allow alternative uses of the land.

Sample Planning, Monitoring, Enforcement, and Compliance Approaches

- Use company-managed audits, environmental monitoring, and reporting systems to supplement government-run enforcement efforts.
- Prepare detailed environmental impact statements that estimate potential environmental impacts, outline compliance plans, and detail the management of future environmental problems.
- Discuss alternative mine design and extraction/beneficiation approaches prior to issuing mine permits, and explore options for minimizing environmental impacts.

Additional Pollution Prevention Activities

According to 1992 industry information, pollution prevention activities under evaluation in the non-fuel, nonmetallic mineral mining industry include the physical and chemical stabilization of tailings for backfilling, subaqueous disposal of tailings for chemical stabilization, tailings beneficiation to remove toxic and acid components and recover valuable minerals, and procedures for the reclamation and final closure of mines. Each of these methods is discussed briefly below.

Using mine wastes as backfill can minimize surface subsidence by filling in underground voids. It can also minimize the impacts of surface disposal by reducing the volume of waste on the surface. A potential problem with this is that the material used as backfill could contaminate water resources by generating acid mine waters.

A froth flotation process has been developed by the Bureau of Mines to remove heavy-metal-bearing minerals from tailings. This process recovers the mineral components of the tailings while removing acid-forming minerals, rendering the wastes less susceptible to contaminating ground and surface waters. The Bureau is also investigating a new device called the air-sparged hydrocyclone, which provides a portable, compact unit to treat large volumes of tailings on-site without the usual expensive capital requirements.

Bureau researchers are also developing effective methods for reclamation and closure of mining operations. The focus of this work is on controlling hydrology at sites, decontaminating wastes when necessary, and stabilizing wastes for closure. For example, the current practice for sealing mine shafts and portals is to install a concrete plug. This practice is difficult and expensive because it requires drilling into rock walls to provide support for the plug. Access to remote shafts and portals is also a problem. One possible solution is the use of low-density foaming plastics and/or cements. Studies have shown that injecting foaming materials may cost half that of concrete plugs. In addition, the expansion characteristic of the foaming materials may eliminate the need for drilling into intact rock. Another advantage of using foamed plastic or cement plugs is the provision of a resistant seal to acidic mine waters.

Wastes are also generated from maintenance activities associated with the operation of a mine. Exhibit 9 presents some of these activities, along with the wastes generated by each activity and some waste minimization options.

Exhibit 9
Waste Minimization Options

Activity	Waste Generated	Waste Minimization Options
Metal Parts Cleaning	Miscellaneous chlorinated solvents	Switch to semi-aqueous cleaners or water-based cleaning solutions to reduce or eliminate solvent emission and liquid waste generation.
Flotation	Zinc sulfate, sodium cyanide	Use flotation process control equipment that uses sensors, computing elements, and control units to reduce the amount of flotation reagents needed and to improve separation of waste from product.
Blasting	Ammonium	Maintain storage containers properly.
Changing Lubricating Fluids	Lead, cadmium	Do not mix used oil with solvents or other materials; segregate and recycle used oil; use fluid filtration systems to extend fluid life; segregate and recycle antifreeze; use washable rags instead of disposable rags.

Exhibit 9 (cont'd)
Waste Minimization Options

Activity	Waste Generated	Waste Minimization Options
Mining Vehicle Battery Replacement	Lead, acids	Recycle used batteries. Trade in old batteries when buying new batteries.

Source: Mining and Quarrying of Nonmetallic Minerals, U.S. EPA, Office of Pollution Prevention and Toxics.

V.A. Innovative Waste Management Practices

Pipe Recycling/Reuse

IMC operates phosphate rock mines in West Central Florida and has implemented a waste minimization program involving the reuse and recycling of steel pipe used to transport slurry, water, tailings, and other materials. IMC obtains maximum use from its pipe in several ways:

- Pipe used for matrix and clay transport is periodically rotated to ensure that wear is evenly spaced over the full diameter of the pipe
- To the extent possible, pipe no longer suitable for the most demanding use is used in other, less demanding pipelines
- Pipe no longer suitable for use in pipelines is either used for other purposes (such as culverts) or is sold for off-site reuse or scrap.

IMC has developed a computerized model to predict how long a section of pipe can remain in each position and when it needs to be turned. When pipe can no longer be used for materials transport, any undamaged portions of pipe are removed for onsite reuse as culvert or sold to a local scrap dealer as usable pipe. Damaged pipe is sold to a scrap dealer. By reusing pipe onsite, IMC estimates that it saves approximately $1.5 million each year. In 1991, $316,000 was received for pipe that could be reused offsite, and 4,200 tons of scrap piping was sold for an estimated total of $42,000 - $84,000. IMC's program reduces capital expenditures by reducing the amount of new pipe that must be purchased, as well as saving operating costs by avoiding costly shutdowns when pipes fail.

Mine Tire Recycling

Two Federal regulations will increasingly effect the scrap tire industry markets. First, the Clean Air Act Amendments have redefined tire derived fuel (TDF) as a fuel, no longer considering it a waste fuel.

Increased demand for TDF has already occurred as a result: in 1990 about 10 percent of scrap tires were used as TDF, while in 1992 27 percent, or 65 million scrap tires, were used. Projections for 1994 were that 50 to 55 percent of scrap tires, or 141 million tires, would be needed to meet market demand. Second, the Intermodal Surface Transportation Efficiency Act (ISTEA) requires that five percent of all Federally-funded road projects use rubber from scrap tires in 1994; use of scrap tires must increase five percent annually until 1997, when it tops out at 20 percent. By 1995, 17 million scrap tires will be required in Federal road projects; by 1997 the number will increase to 50 million.

Mine representatives have estimated the price of one large tire to range from $10,000 to $16,000, or over $100,000 to fit one large piece of equipment. Several options exist for recycling or reusing whole large tires. One alternative is retreading the tires for reuse; retreading reduces the demand for new tires and conserves resources (retreading a used tire requires less than 40 percent of the fossil fuel to make a new tire). The purchase price for retreaded tires is less than for new tires, providing an additional savings incentive. In addition to retreading, whole scrap tires are used in civil engineering applications, including construction, erosion control, and agriculture (feeding troughs, for example).

Processing scrap tires involves shearing, cutting and/or shredding tires into smaller pieces. The major markets for processed tires are as TDF and in civil engineering applications. Scrap tires are an excellent fuel source, generating about 80 percent as much energy as crude oil per pound. In recent years, there have been major increases in the use of scrap tires as fuel by a number of industries, including power plants, cement kilns, pulp and paper mills, and tire manufacturing facilities.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section IV.A contains a general overview of major statutes
- Section IV.B contains a list of regulations specific to this industry
- Section IV.C contains a list of pending and proposed regulations

The descriptions within Section IV are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities

R0076554

that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties

that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the

Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year

2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Regulations

The environmental impacts of the non-fuel, nonmetallic mining industry are regulated primarily by two statutes: the Clean Air Act (CAA) and the Clean Water Act (CWA). Other statutes that might be applied to the non-fuel, non-metal mining industry are the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the General Mining Law of 1872, and State statutes.

Clean Air Act (CAA)

Although nonmetallic mining operations are not specifically regulated by the CAA, businesses involved in the processing of the minerals are regulated. 40 CFR Part 60 Subpart OOO, Standards of Performance for Nonmetallic Mineral Processing Plants, and 40 CFR Part 60 Subpart UUU, Standards of Performance for Calciners and Dryers in Mineral Industries, require these industries to control or reduce emissions of particulate matter and impose specific monitoring, recordkeeping, and reporting requirements. Under the Clean Air Act, sources are required to obtain construction and operating permits, not only for particulate emissions but also for NOx, SO2, and CO which are often products of combustion from engines for power and also dryers.

40 CFR Part 60 Subpart OOO applies to facilities that process any of the following 18 minerals: crushed and broken stone, sand and gravel, clay, rock salt, gypsum, sodium compounds, pumice, gilsonite, talc and pyrophyllite, boron, barite, fluorspar, feldspar, diatomite, perlite, vermiculite, mica, and kyanite. The affected facilities are: crushers, grinding mills, screening operations, bucket elevators, belt conveyors,

bagging operations, storage bins, and enclosed trucks or railcar loading stations.

40 CFR Part 60 Subpart UUU applies to calciners and dryers used to process the following minerals: aluminum, ball clay, bentonite, diatomite, feldspar, fire clay, fuller's earth, gypsum, industrial sand, kaolin, lightweight aggregate, magnesium compounds, perlite, roofing granules, talc, titanium dioxide, and vermiculite.

Clean Water Act (CWA)

Discharges from mine sites are addressed under two principal regulatory programs: the NPDES permit program (for process water and storm water point source discharges) and the Non-point source program.

NPDES Point Source Program

A point source is defined in Section 502(14) of the CWA as "any discernible, confined and discrete conveyance, included but not limited to, any pipe, ditch, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft from which pollutants are or may be discharged." The Water Quality Act amendments of 1987 added discharges from "landfill leachate collection systems" to this definition. All point source discharges to waters of the U.S. must be addressed by NPDES permits.

Storm water is defined in 40 CFR 122.26(b)(13) as "storm water runoff, snow melt runoff, and surface runoff and drainage." Storm water associated with industrial activity is defined in 40 CFR Section 122.26(b)(14) as the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw materials storage areas at an industrial plant. Section 402(p) of the CWA generally requires EPA to issue NPDES permits for point source discharges of storm water associated with industrial activity, including active and inactive mines. At mine sites, Section 402(1)(2) specifically limits the permit requirements for storm water that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of the operation.

EPA is currently developing a storm water program for those point source discharges from active and inactive mines not already permitted. Several States are also currently developing general storm water permits for mine sites.

Non-point Source Program

Non-point sources of pollution are addressed under Sections 304(f)(b) and 319 of the CWA of 1972. Non-point source runoff is caused by runoff from diffuse sources, and is generally caused by rainfall or snow melt. Section 304(f)(b) establishes guidelines for identifying and evaluating the nature and source of non-point sources of pollutants, and processes, procedures, and methods to control pollution resulting from mining activities, including runoff and siltation from new, currently operating, and abandoned surface and underground mines. Non-point source discharges may be to streams, lakes, rivers, wetlands, or to groundwater. Specific best management practices (BMPs) requirements for non-point source control at mine sites have not been promulgated at the national level, nor has any national guidance been issued. However, individual States are currently developing programs for storm water management at mine sites. For example, Idaho recently prepared a document that describes practices to minimize non-point source water quality impacts.

Under Section 319 of the Clean Water Act, States developing plans to address problems and solutions to non-point source pollution, are eligible for grants that are administered by the Regions.

In addition to applicable general CWA requirements, active mineral mining and processing operations are subject to the requirements contained in 40 CFR 436, EPA Effluent Guidelines and Standards for Mineral Mining and Processing. The regulation establishes effluent limitation guidelines and pretreatment standards that limit the discharge of pollutants into navigable waters, and requires the application of best practicable control technologies (BPT). For the purposes of these guidelines and standards of performance, the industry is divided into 38 subcategories consisting of specific mineral types or classes of minerals. Effluent limitations are based on factors such as the type of ore, method of transport, type of processing, use of wet air emissions control devices, type of product, and groundwater seepage and runoff into mine and process wastewater impoundments.

Mine dewatering can invoke environmental regulation under CWA. Dewatering is the removal of water that has infiltrated the mining site. Wells, pumps, or ditches and tunnels are typically used to divert the water away from the site. Dewatering can also lead to the unintentional creation of wetlands, requiring a permit under the CWA. EPA's Office of Water, Office of Wastewater Management/Permits Division is currently developing a mining strategy for hard rock mining which will be completed by the fall of 1995.

Exhibit 10
Mine Discharges Subject to Permitting

Runoff/drainage discharges subject to 40 CFR Part 440 effluent limitation guidelines	Subject to storm water permitting (not subject to 40 CFR Part 440)
Land application area Crusher area Spent ore piles, surge piles, ore stockpiles, waste rock/overburden piles Pumped and unpumped drainage and mine water from pits/underground mines Seeps/French drains On-site haul roads, if constructed of waste rock or spent ore or if wastewater subject to mine drainage limits is used for dust control Tailings dams/dikes when constructed of waste rock/tailings Unreclaimed disturbed areas	Topsoil piles Haul roads not on active mining area On-site haul roads not constructed of waste rock or spent ore (unless wastewater subject to mine drainage limits is used for dust control) Tailings dams, dikes when not constructed of waste rock/tailings Concentration/mill building/site (if discharge is storm water only, with no contact with piles) Reclaimed areas released from reclamation bonds prior to 12/17/90 Partially, inadequately reclaimed areas or areas not released from reclamation bond Most ancillary areas (e.g., chemical and explosives storage, power plant, equipment/truck maintenance and wash areas, etc.)

Resource Conservation and Recovery Act (RCRA)

The Bevill Amendment

In 1980, Congress amended RCRA in the Solid Waste Disposal Act Amendments, adopting what has been dubbed the Bevill Amendment, after Representative Tom Bevill of Alabama. The amendment temporarily exempted from Subtitle C regulation solid waste from ore and mineral extraction, beneficiation, and processing. The Amendment directed EPA either to develop Subtitle C regulations for the waste or determine that the exemption should continue, and to present its findings in a report to Congress.

EPA modified its hazardous waste regulations to reflect the Bevill exclusion and issued a preliminary, and quite broad, interpretation of the exclusion's scope. In particular, it interpreted the exclusion as covering "solid waste from the exploration, mining, milling, smelting and refining of ores and minerals."

In 1985 the U.S. District Court for the District of Columbia awarded judgment to the Environmental Defense Fund and two public interest groups that had sued EPA for failing to submit the required report to Congress and make the regulatory determination by the statutory deadline. The court imposed two schedules, one for completing studies of extraction and beneficiation wastes and submitting them in a report to Congress, and the second for proposing reinterpretation of mineral-processing wastes. In so doing, the court effectively split the wastes that might be eligible for exclusion from regulation into two groups: mineral extraction and beneficiation wastes; and mineral processing wastes.

In December 1985 EPA submitted a report to Congress on mining wastes (*1985 Report to Congress: Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale*) in which EPA found that some mining wastes exhibit hazardous characteristics, that waste management practices have caused environmental damage, and that the range of risk from mining waste is broad. In July 1986 EPA published a regulatory determination, upheld in subsequent court challenges, that RCRA Subtitle C regulation of extraction and beneficiation wastes was unwarranted because mining wastes tend to be disposed of in arid climates, facilities and wastes are located in sparsely populated areas where human contact is minimal, and waste volumes are high. It also determined that it should develop a risk-based, State-run mining waste program under RCRA Subtitle D.

In keeping with its court-ordered directive to reinterpret the Mining Waste exclusion for mineral processing wastes, EPA proposed to narrow the scope of the exclusion for mineral-processing wastes to include only a few specific waste streams. Unable to articulate criteria for selecting these wastes, EPA later withdrew this proposal and was subsequently sued by the Environmental Defense Fund. The courts ruled against EPA, holding that the Agency's interpretation of Bevill exclusions was overbroad. The court ordered EPA to restrict the scope of the exclusion as it applied to mineral-processing wastes to include only "large volume, low hazard" wastes.

In a series of rulemaking notices, EPA reinterpreted the exclusion for mineral-processing wastes and defined which mineral-processing wastes met the high-volume, low-hazard criteria. The vast majority of mineral-processing wastes did not meet both criteria. EPA published its final regulatory determination in 1991, in compliance with a court-ordered deadline. The final rule permanently retains the Bevill exemption for 20 mineral-processing wastes. EPA determined that regulation under RCRA Subtitle C was inappropriate for these wastes because of the extremely high cost to industry and the technical infeasibility of managing them under Subtitle C requirements; 18 of the

R0076569

wastes are subject to applicable State requirements, while the remaining two (phosphogypsum and phosphoric acid process waste water) are currently being evaluated by EPA.

Wastes from the extraction and beneficiation of ores and minerals remain exempt from Subtitle C requirements, irrespective of their chemical characteristics; EPA may, in the future, evaluate the appropriateness of regulating these wastes under RCRA Subtitle D as an industrial waste. Wastes from mineral processing, however, are not exempt from Subtitle C unless they are one of the 20 specific wastes identified in EPA's final ruling.

In addition, only wastes that are uniquely associated with the extraction and beneficiation of ores and minerals (or one of the 20 listed mineral processing wastes) are excluded from hazardous waste regulation. Non-uniquely associated wastes are typically generated as a result of maintaining mining machinery or as a result of other facility activities, and continue to be subject to Subtitle C regulation. These non-uniquely associated wastes may include used oil, polychlorinated biphenyls, discarded commercial chemicals, cleaning solvents, filters, empty drums, laboratory wastes, and general refuse.

Determining how and under what circumstances the Bevill Amendment exclusions should be interpreted in regulating mining wastes continues to be a subject of discussion and study, at least in part because many beneficiation terms are used to describe activities common to a wide range of nonexempt industries and to describe mineral-processing operations that occur at the same location as the beneficiation operations. Beneficiation and mineral-processing operations are often closely linked; in order to apply Subtitle C regulations at a mine site, a regulator often must prove that the waste is not a beneficiation waste. Because a variety of regulators, at both Federal and State levels, are independently interpreting the Bevill rules, the potential for inconsistent interpretations is significant. Staff in EPA's OSW have suggested the following guidelines for regulators and the regulated community in distinguishing between exempt and nonexempt wastes at mines and mineral-processing sites:

- Determine whether the material is considered a solid waste under RCRA.
- Determine whether the facility is using a primary ore or mineral to produce a final or intermediate product and also whether 50 percent of the feedstocks are from secondary sources.

- Establish whether the material and the operation that generates it are uniquely associated with mineral production.
- Determine where in the sequence of operations beneficiation ends and mineral processing begins.
- If the material is a mineral-processing waste, determine whether it is one of the 20 special wastes from mineral processing.

This sequence will result in one of three determinations: 1) the material is not a solid waste and therefore not subject to RCRA; 2) the material is a solid waste but is exempt from RCRA Subtitle C because of the Mining Waste Exclusion; or 3) the material is a solid waste that is not exempt from RCRA Subtitle C and is subject to regulation.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Although Bevill wastes are excluded from regulation under RCRA Subtitle C, they can be addressed under CERCLA. Mining companies may be liable under CERCLA for the release or threat of release of hazardous substances, covering releases to air, surface water, groundwater and soils. Many mines, where practices did not incorporate the safeguards now required under the CWA, allowed runoff from mine and tailings sites to flow into nearby streams and lakes. In general, the CERCLA problems associated with mining operations are much more frequent in metal rather than non-metal mining. Even newer mines, which have been subject to CWA regulations, have been targeted for CERCLA enforcement. Mine owners may also be liable for damages to natural resources as a result of mining activity.

National Environmental Policy Act (NEPA)

NEPA requires that all Federal agencies prepare detailed statements assessing the environmental impact of, and alternatives to, major Federal actions that may "significantly affect" the environment. An environmental impact statement (EIS) must provide a fair and full discussion of significant environmental impacts and inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts on the environment; EISs must explore and evaluate all reasonable alternatives, even if they are not within the authority of the lead agency. NEPA authorities are solely procedural; NEPA cannot compel selection of the environmentally preferred alternative.

Federal actions specifically related to mining that may require EISs include Federal land management agency (e.g. BLM and Forest Service) approval of plans of operations for hardrock mining on Federally-managed lands. All effected media (e.g., air, water, soil, geologic, cultural, economic resources, etc.) must be addressed. The EIS provides the basis for the permit decision; for example, an NPDES permit may be issued or denied based on EPA's review of the overall impacts, not just discharge-related impacts, of the proposed project and alternatives. Issues may include the potential for acid rock drainage, aquatic and terrestrial habitat value and losses, sediment production, mitigation, and reclamation.

Endangered Species Act (ESA)

The ESA provides a means to protect threatened or endangered species and the ecosystems that support them. It requires Federal agencies to ensure that activities undertaken on either Federal or non-Federal property do not have adverse impacts on threatened or endangered species or their habitat. In a June 1995 ruling, the U.S. Supreme Court upheld interpretations of the Act that allow agencies to consider impact on habitat as a potential form of prohibited "harm" to endangered species. Agencies undertaking a Federal action (such as a BLM review of proposed mining operations) must consult with the U.S. Fish and Wildlife Service (USFWS); an EIS must be prepared if "any major part of a new source will have significant adverse effect on the habitat" of a Federally or State-listed threatened or endangered species.

State Statutes

In addition to Federal laws, State and common laws also affect waste generation from mining activities. State law generally requires that permits be obtained prior to commencement of mining activities; permits may require design, performance, closure, and reclamation standards, and may impose monitoring requirements. Under common law, a mine owner may be liable for trespassing if wastes migrate into and damage another's property, or if the waste impacts the community as a whole, a miner may be liable for creating a public nuisance. Over the last five years several States have substantially altered their mining regulations to prevent the damage caused by past mining operations. Considerable disagreement remains, however, between mining industry groups and the environmental community regarding the effectiveness of these State regulations in preventing damage to the environment.

Many Western States require mining operations to obtain reclamation bonds and mining permits that are designed to regulate and monitor mining activity. States that require bonding and/or permitting include Alaska, Arizona, California, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, South Dakota, Montana, Wyoming, and Colorado. To regulate mining activity in the State of Colorado, for example, the State requires mining operations to obtain: 1) a performance bond, 2) a reclamation bond, and 3) a permit. The performance bond outlines what the mining operation intends to do on the land, and is simply a promise from the mining operation that it will reclaim the land. This bond gives Colorado the authority to pursue reclamation costs from mining operations that fail to properly reclaim the land. The reclamation bond, also known as a financial warranty, equals the cost the State would incur if it were to hire someone to reclaim the site should the mining operation fail to do so. Although performance bonds are updated periodically, the bonds have not always been adequate to cover closure costs.

VI.C. Pending and Proposed Regulatory Requirements

Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA)

EPCRA Section 313 mandates that owners and operators of facilities that manufacture, process, or otherwise use a listed chemical to report to EPA their annual releases of these chemicals to any environmental medium. EPA makes this information available to the public in the form of the Toxic Release Inventory (TRI). TRI currently requires reporting from facilities in SIC codes 20-39 which meet various threshold requirements.

EPCRA Section 313 gives EPA discretionary authority to modify the coverage of facilities required to report to EPA for inclusion in the TRI. EPA is considering expanding the TRI through the development of reporting requirements for additional facilities. These additional facilities include a list of 25 SIC codes that contribute 99 percent of the non-manufacturing TRI chemical loadings to the environment. SIC 14 is among these 25 SIC codes. EPA anticipates publication of a proposed rule in late 1995 or early 1996 requiring additional facilities to report the use, release, and transfer of TRI chemicals.

Clean Air Act (CAA)

Clean Air Act Amendments (CAAA) of 1990

In 1992, EPA published an initial list of all categories of major and area sources of the hazardous air pollutants (HAPs) listed in Section 112(b) of the CAA. EPA is required to establish dates for the promulgation of emission standards for each of the listed categories of HAP emission sources and develop emission standards for each source of HAPs such that the schedule is met. The standards are to be technology-based and are to require the maximum degree of emission reduction determined to be achievable by the Administrator. Proposed standards for most mineral industries are due by November 1, 1997. The Agency has determined that the phosphoric acid manufacturing industry may be anticipated to emit several of the 189 HAPs listed in Section 112(b) of the CAAA. As a consequence, this source category is included on the initial list of HAP-emitting categories scheduled for standards promulgation.

New Emissions Standards for Hazardous Air Pollutants (NESHAP)

Another proposed rule under the CAA concerns the development of maximum achievable control technology (MACT) or generally achievable control technology (GACT) standards for the asbestos processing source category that is comprised of the milling, manufacturing, and fabrication subcategories of the asbestos NESHAP. Pollutants to be regulated include asbestos and other HAPs emitted in major amounts by these subcategories. Final action on this proposed rule is scheduled for November 1995.

National Ambient Air Quality Standards (NAAQS)

EPA is reviewing and updating the air quality criteria for particulate matter to incorporate new scientific and technical information that has become available since the last review. Based on the revised criteria, EPA will determine whether revisions to the standards are appropriate. This will affect the mining and quarrying of non-fuel, nonmetallic minerals.

Clean Water Act (CWA)

A comprehensive bill was introduced in Congress in 1995 to reauthorize the Clean Water Act. The bill may affect EPA's authority to require changes in production processes, products, or raw materials to control emissions of toxins; may require risk assessments for water quality standards, effluent limitations or other regulatory requirements; and may require social, economic, and environmental benefits to be weighed in establishing regulations. Potentially large sectors of the non-fuel, non-metal mining industry could be affected by this legislation.

Safe Drinking Water Act (SDWA)

Arsenic is one of the non-fuel, nonmetallic minerals covered by SIC 14. A proposed rule will set a maximum contaminant level goal (MCLG) and revised national primary drinking water regulation (NPDWR) for arsenic in drinking water, pursuant to the SDWA amendments of 1986. The SDWA requires EPA to promulgate national primary drinking water regulations for 83 specific contaminants of which arsenic is one.

VII. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors. This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and

EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100% because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Non-Fuel, Non-Metal Mining Industry Compliance History

Exhibit 11 presents enforcement and compliance information specific to the non-fuel, non-metal mining industry. As indicated in the chart, Regions III, IV, V, VIII, and X have been the most active in terms of enforcement actions against this sector.

Exhibit 11
Five Year Enforcement and Compliance Summary for the Non-Fuel, Non-Metal Mining Industry

A	B	C	D	E	F	G	H	I	J
Non-Fuel, Non-Metal Mining SIC 14	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	48	22	80	36	1	1	0%	100%	0.01
Region II	52	39	203	15	8	26	100%	0%	0.13
Region III	62	44	396	9	6	13	85%	15%	0.03
Region IV	428	203	1,310	20	32	59	71%	29%	0.05
Region V	164	100	382	26	6	6	100%	0%	0.02
Region VI	71	36	123	35	8	19	63%	37%	0.15
Region VII	57	19	84	41	5	6	33%	67%	0.07
Region VIII	133	64	347	23	10	31	74%	26%	0.09
Region IX	64	58	297	13	3	10	100%	0%	0.03
Region X	64	46	200	19	5	21	71%	29%	0.11
Total/Average	1,143	631	3,422	20	84	192	76%	24%	0.06

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 12-15 provide enforcement and compliance information for selected industries. The non-fuel, non-metal mineral mining industry has the fourth largest number of facilities tracked by EPA across the selected industries. Of the total number of enforcement actions over five years, 76 percent are State-lead actions and 24 percent are federal-lead actions. For this industry, Clean Air Act inspections comprise 65 percent of all inspections conducted, and Clean Water Act inspections account for 31 percent of all inspections. This inspection pattern seems consistent with the general priority of environmental concerns within this sector. Importantly, the non-fuel, non-metal mining sector exhibits the lowest number of enforcement actions in relations to inspections that any other industry covered under this project over the last five years (see Exhibit 12).

Exhibit 12
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	**1,143**	**631**	**3,422**	**20**	**84**	**192**	**76%**	**24%**	**0.06**
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics/Computers	405	222	777	31	68	212	79%	21%	0.27
Motor Vehicle Assembly	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 13
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 14
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

Exhibit 15
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

**Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substance Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.*

VII.C. Review of Major Legal Actions

VII.C.1. Review of Major Cases

As indicated in EPA's *Enforcement Accomplishments Report, FY 1991* through *FY 1993* publications, two significant enforcement cases were resolved between 1991 and 1993 for the mining and quarrying of non-fuel, nonmetallic minerals. The cases were comprised of CERCLA and the Marine Protection Research and Sanctuaries Act (MAPRSA) violations. Both cases were related to companies in the sand and gravel business.

One of the three cases resulted in the assessment of a penalty. In U.S. v. Petersen Sand & Gravel, Inc. (1993), the defendant failed to furnish accurate and complete information relating to its disposal of hazardous wastes at its site. The defendant mined sand and gravel at the site, during which time several hundred drums of paints, solvents, and other industrial wastes were dumped. The company was required to pay $700,000 and to provide a full response to EPA's original information requests.

In U.S. v. Custom Sand and Gravel (1993), an administrative order was issued under MAPRSA for unauthorized construction of dikes and roadways and for clearing and leveling activities associated with sand and gravel mining operations that impacted wooded swamp. A restoration plan was submitted to restore approximately 65 acres of wetland habitat.

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

EPA's Office of Solid Waste (OSW) conducts research into mining waste issues, including engineering studies conducted on innovative methods of mining to reduce mine waste. OSW prepares reports that evaluate current mining designs and how these designs impact the environment. The reports, which are subject to peer review, cover topics such as the design and operation of waste rock piles, subaqueous disposal of tailings, and cyanide detoxification. OSW also provides outreach and technical support to other program and Regional offices to address mine waste problems located on Indian reservations. OSW is currently involved in providing outreach and technical support to approximately six different sites. (Contact: Steve Hoffman, 703-308-8413)

U.S. Bureau of Mines Environmental Research Program

The U.S. Bureau of Mines environmental research program is developing technology to prevent pollution and to maintain a healthy work environment. In the pollution prevention area, the USBM, in conjunction with the Florida phosphate industry and the Florida Institute of Phosphate Research, is researching the environmental pollution associated with phosphogypsum stacks, and the large process/cooling water ponds associated with them. The Bureau is also evaluating the potential for in-situ mining of western phosphate ores, a technique that would significantly reduce gypsum production in the processing of western phosphate rock. (Contact: Frank Lanzetta, Research Staff, (202) 501-9272)

The focus of the environmental health research is the monitoring and control of small airborne dusts that can be inhaled deep into the lungs and cause respiratory diseases. Emphasis is on the monitoring and control of coal and rock dusts and emissions from diesel engines. A continuous monitor to evaluate dust conditions during the extraction process for mineral ores is being developed to provide a means to alert workers to hazardous dust conditions. Dust control techniques are directed primarily towards reducing concentrations through the application of water sprays, more effective use of ventilation air, and modification of mining operating parameters. (Contact: Dr. J. Harrison, Research Staff (202) 501-9309)

Mine Safety and Health Administration (MSHA) Mines Initiative

Electrical transformers or capacitors containing polychlorinated biphenyls (PCBs) are often used as power sources in underground mines. This equipment is regulated by EPA to ensure against environmental release of PCBs, chemicals classified as probable human carcinogens. Abandoned mines often fill with ground water, which can cause PCB-containing equipment to corrode and leak chemicals into the water.

EPA and MSHA launched a joint effort in early 1993 to identify all underground mines using electrical transformers or capacitors that contain PCBs. During 1993, MSHA inspectors completed PCB checklists that identified mines using PCB- or other liquid-filled equipment underground, and whether there were any violations of EPA regulations governing PCB use, marking, storage, or disposal. In total, 85 underground mines that may use PCB-containing equipment were identified. EPA has used the PCB checklists as part of its enforcement efforts. As a result of these efforts, four mining companies have been cited for mismanaging PCBs and face Federal penalties of up to $317,575. EPA has settled one of these cases and filed three additional complaints.

Miscellaneous Activities

Members of several government agencies have been informally meeting over the past five years to share and communicate ideas on mining waste issues. Known as the Federal Land Management Agencies, this group includes EPA, the National Park Service, the Department of Agriculture, the Department of the Interior, the Bureau of Land Management, and the U.S. Forest Service. According to Steve Hoffman of EPA's Office of Solid Waste, a memo of understanding is currently under development to formalize the group's meetings at the senior level.

EPA has provided a multi-year grant to the Southwest Research and Information Center to conduct research and outreach activities regarding mine waste issues. The Center maintains a clearinghouse of technical studies conducted on mine waste topics. (Contact: Paul Robinson, 505-262-1862)

Over the last few years, EPA has enlisted the advice and assistance of the States in developing a Federally-mandated RCRA mine waste program. In order to facilitate the involvement of the States in this effort, EPA has provided funding to the Western Governors' Association (WGA), an independent non-partisan organization of 21 member governors. In 1988, WGA formed a Mine Waste Task Force to coordinate the views of the member States and to work with EPA, the mining industry, the environmental community, and the public in the development of a workable mine waste management program.

Kansas State University's Hazardous Substance Research Center (HSRC) is an EPA-funded center providing research and technology transfer services for pollution prevention and other waste management techniques. HSRC programs include outreach for industry, assistance to government, videos, radio programs, written materials, data bases, and workshops on pollution prevention and hazardous waste remediation. One pollution prevention focus of HSRC is on soils and mining waste.

Contact: Dr. Larry E. Erickson, Director
Hazardous Substance Research Center (HSRC)
Ward Hall, Room 101
Kansas State University
Manhattan, Kansas 66506-5102
(913) 532-6519

The Arizona Department of Environmental Quality (ADEQ) (602-779-0313) has established a multifaceted pollution prevention program to encourage generators of hazardous waste to prepare a pollution prevention plan. ADEQ encourages companies to prepare pollution prevention plans by reducing environmental permit filing fees 50 percent if companies implement a pollution prevention plan. Some mining companies have participated in this program. In addition, a joint partnership between the State and private industry has been formed, called the Arizona Pollution Prevention Partnership. The Partnership consists of 22 of the State's largest hazardous waste generators. These companies, which include some mining companies, have spelled out specific hazardous waste reduction plans for a two to three year period.

The Mineral Policy Center is a non-profit organization that provides technical, legal, and political strategy assistance to deal with mineral threats to sensitive areas. The main goal of the Center is to promote environmentally responsible mining. The organization educates and assists citizens' groups and agency personnel working with conservation problems related to legislation such as the 1872 Mining

Law and RCRA. The Mineral Policy Center provides educational materials such as fact sheets, information packets, videos, and publications that summarize the results of research conducted on the environmental impacts of mining. Its publications include Burden of Guilt, which provides a current assessment of the abandoned mine problem and a proposal to develop and fund an effective nationwide reclamation program. The Center also conducts roundtable discussions with mining companies to discuss environmental issues facing the mining industry. (Contact: Gary Kravis, 202-887-1872)

In 1990, a funding agreement was entered into between EPA and the Interstate Mining Compact Commission (IMCC) (Contact: Greg Conrad 703-709-8654). IMCC is an association that studies and recommends techniques for the protection and restoration of land, water, and other resources affected by mining. The purpose of the funding agreement between EPA and IMCC is to facilitate State involvement in developing and implementing mine waste regulation. Fifteen member States have participated in this effort thus far.

VIII.B. EPA Voluntary Programs

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project

Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at 202-233-9065 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, 202-260-0700 or the WasteWi$e Hotline at 1-800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, 202-260-4407)

$NICE^3$

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics ($NICE^3$). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, 303-275-4729)

VIII.C. Trade Association/Industry-Sponsored Activity

The Missouri Limestone Producers Association, along with EPA's Region VII developed a voluntary compliance program for Missouri rock crushing companies in violation of the Clean Air Act. Affected rock crusher facilities in Missouri's pilot program must comply with New Source Performance Standards (NSPS) of the Clean Air Act. The EPA regulations, commonly called Subpart OOO, are designed to control air pollution from specific new equipment at nonmetallic mineral processing plants. This includes: rock crushing units, screens, conveyors, and bins. Regulations require owners, who have purchased new equipment since August 31, 1983, to maintain records, conduct performance testing of air emissions, and provide notification to EPA. Many Missouri rock crushers have failed to provide necessary notification and to conduct required performance testing. These failures are violations of Federal regulations and owners are liable for penalties under the Clean Air Act. The maximum penalty can be as much as $25,000 per day, per violation. By participating in the voluntary compliance program, sources are eligible for reduced penalties for notification and testing violations. Forty five companies have taken advantage of this voluntary compliance program and have achieved significant penalty reductions as a result of their participation.

VIII.C.1. Environmental Programs

The National Stone Association produces a Clean Air Management Guide, summarizing provisions of the Clean Air Act, that has been praised by the California Air Resources Board. Additionally, the National Stone Association, along with the Florida Concrete & Products Association and Aggregate Institute produces a course on the Clean Air Act Amendments of 1990 and Title V Operating Permits for the Florida Aggregates Industry. This course has also been taught in other areas of the country i.e. Northern California and Kansas City. The National Stone Association also runs an environmental excellence program for its members with winners receiving Environmental Eagle Awards.

VIII.C.2. Summary of Trade Associations

Trade and professional organizations serving the mining industry in general are divided along mining processes as well as type of mineral mined.

In 1990, a funding agreement was entered into between EPA and the Interstate Mining Compact Commission (IMCC) (Contact: Greg Conrad 703-709-8654). IMCC is an association that studies and recommends techniques for the protection and restoration of land, water, and other resources affected by mining. The purpose of the funding agreement between EPA and IMCC is to facilitate state involvement in developing and implementing mine waste regulation. Fifteen member states have participated in this effort thus far.

National Aggregates Association 900 Spring Street Silver Spring, Maryland 20910 Phone: (301) 587-1400 Fax: (301) 587-9419	Members: 350 Staff: 28 Budget: $1.2 million Contact: Richard A. Morris

The National Aggregates Association (NAA) represents producers of construction aggregates, which include sand, gravel, and crushed and broken stone. For over 75 years, NAA has provided its members with education, training, research, technology, and representation before the Congress and federal regulatory bodies to increase the growth and professionalism of the aggregates industry. NAA is an international trade association with a membership of over 400 companies throughout the United States, Canada, and various foreign countries.

Aggregate Producers Association of Northern California 400 Capitol Mall, Suite 900 Sacramento, CA 95814-4407 Phone: (916) 449-3926 Fax: (916) 443-5369	Members: Staff: 7 Budget: $200,000 Contact: George Cope

The Aggregate Producers Association (APA) is a non-profit trade association comprised of rock, sand and gravel producers, ready-made concrete companies and asphalt companies in Northern California. APA provides its members with a variety of committees that monitor legislation, regulations and other industry issues e.g. environment, safety, product education and promotion, and technical and government affairs. Currently, APA sponsors a Stormwater/NPDES Group Compliance Program for 140 plant locations. APA also meetings regularly with the Mine Safety and Health Administration (MSHA) to address and resolve issues of concern.

The National Stone Association 1415 Elliot Place, NW Washington, DC 20007 Phone: (202) 342-1100 Fax: (202) 342-0702	Members: 579 Staff: 20 Budget: $3.26 million Contact: Bill Ford

The National Stone Association (NSA) is the national trade association representing the many interests and concerns of the crushed stone industry in the United States. NSA, now celebrating its 75th anniversary, is based in Washington, DC. It provides support to member companies, provides technical assistance to universities and schools, and works cooperatively with other national, state and regional groups and associations that help advance the interests of the industry.

National Mining Association 1130 17th Street Washington, DC 20036 Phone: (202) 861-2800 Fax: (202) 861-7535	Contact: Richard L. Lawson

Founded in 1995 as a result of a merger between the American Mining Congress and the National Coal Association, the National Mining Association represents producers of domestic coal, metals, and industrial and agricultural minerals; manufacturers of mining and mineral processing machinery, equipment, and supplies; engineering/consulting firms; and financial institutions that serve the mining industry. It also offers tax, communications, and technical workshops.

Missouri Limestone Producers Association P.O. Box 1725 Jefferson City, Missouri 65102 Phone: (314)-635-0208 Fax: (314)-634-8006	Members: 66 Staff: 2 Budget: $220,000 Contact: Steve Rudloff

The Missouri Limestone Producers Association represents the crushed stone producers for the state of Missouri. This association has taken an active role in voluntary compliance initiatives with EPA's Region VII office.

American Society for Surface Mining and Reclamation (ASSMR) 21 Grandview Dr. Princeton, WV 24740 Phone: (304) 425-8332	Members: 450 Regional Groups: 2 Contact: William T. Plass

Founded in 1973, ASSMR members consist of mining companies and corporations, representatives from Federal agencies and State governments, and individuals from the academic community. It encourages efforts to protect and enhance land disturbed by mining. In addition, ASSMR assists in research and demonstrations and fosters communication among research scientists, regulatory agencies, landowners, and the surface mining industry. Its publications include the Reclamation Newsletter (quarterly).

InterState Mining Compact Commission (IMCC) 459B Carlisle Dr. Herndon, VA 22070 Phone: (703) 709-8654 Fax: (703) 709-8655	Members: 17 Staff: 2 Budget: $150,000 Contact: Gregory E. Conrad

Founded in 1971, IMCC consists of States engaged in surface mining. Its purposes are to study and recommend techniques for the protection and restoration of land, water, and other resources affected by mining; to assist in reducing, eliminating, or counteracting pollution or deterioration of natural resources; to encourage programs of member States that will achieve comparable results in protecting and improving the usefulness of natural resources; and to maintain an efficient and productive mining industry. IMCC also compiles industry statistics, disseminates studies and reports on surface mining and legislative developments, and maintains liaison between State and Federal governments. IMCC publications include The Compact (quarterly).

Society for Mining, Metallurgy, and Exploration, Inc. (SME, Inc.) P.O. Box 625005 Littleton, CO 80162 Phone: (303) 973-9550 Fax: (303) 973-3845	Members: 20,000 Staff: 31 Budget: $3,700,000 Contact: Tom Hendricks

Founded in 1871, SME, Inc. consists of persons engaged in the finding, exploitation, treatment, and marketing of all classes of minerals (metal ores, industrial minerals, and solid fuels) except petroleum. SME, Inc. promotes the arts and sciences connected with the production of useful minerals and metals. Specialized education programs are offered, as well as publications such as Minerals and Metallurgical Processing (quarterly), Mining Engineering (monthly), and handbooks and other materials on mining.

Coalition for Responsible Mining Law (CRML) c/o Coeur D'Alene Mines Corp. P.O. Box 1 Coeur D'Alene, ID 83816-0316 Phone: (208) 667-3511 Fax: (208) 667-2213	Members: 300 Contact: Justin Rice

Founded in 1979, CRML consists of mining company executives, exploration geologists, small miners, and others interested in mining laws. CRML is organized as a means of focusing Western mining interests behind a proposal to preserve the basic provisions of the National Mining Law of 1872. It seeks to raise the level of awareness about the law within the mineral industry, Congress, and the general public through specialized education. Publications include a periodic newsletter.

Clay Minerals Society (CMS) P.O. Box 12210 Boulder, CO 80303 Phone: (303) 444-6405	Members: 950 Contact: Jo Eberl

Founded in 1963, CMS consists of professionals concerned with clay mineralogy and technology in industry, university research, and government. It includes students of mineralogy and other scientific disciplines as well as representatives of clay mining companies. CMS seeks to stimulate research and disseminate information relating to all aspects of clay science and technology. It maintains a store of clay minerals at the Geology Department of the University of Missouri. CMS publications include Clays and Clay Minerals (bimonthly), and Quantitative Mineral Analysis.

Asbestos Information Association/North America (AIA/NA) 1745 Jefferson Davis Hwy., Ste. 509 Arlington, VA 22202 Phone: (703) 979-1150 Fax: (703) 979-1152	Members: 45 Staff: 30 Budget: $300,000 Contact: B.J. Pigg

Founded in 1970, AIA/NA represents manufacturers, processors, and miners/millers of asbestos or products containing asbestos. Its main purposes are: to provide industry-wide information on asbestos and health and on industry efforts to eliminate existing hazards; to cooperate with government agencies in developing and implementing industry-wide standards for exposure to asbestos dust and for the control of asbestos dust emissions into air and water; to exchange information on methods and techniques of asbestos dust control; to assist in solving problems arising from the health effects of asbestos; and to increase public knowledge of the unique benefits and importance of asbestos products. AIA/NA acts as a central information center for collecting and disseminating medical and technical information on asbestos-related disease, asbestos dust control, and other asbestos-related ecological considerations. Publications include News and Notes (monthly) and other technical materials.

Gypsum Association (GA) 810 1st St., N.E., No. 510 Washington, D.C. 20002 Phone: (202) 289-5440	Members: 17 Staff: 30 Budget: $1,000,000 Contact: Jerry A. Walker

Founded in 1930, GA represents miners and manufacturers of gypsum and gypsum products. It sponsors basic and applied research programs at educational institutions and commercial testing laboratories on fire resistant assemblies, structural assemblies, wallboard application techniques, and new uses for gypsum products. GA also compiles market statistics and publishes technical bulletins and data on gypsum products.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

General Profile

Annual Report 1992 - Industrial Sand and Gravel, Wallace P. Bolen, Bureau of Mines, September 1993.

Annual Report 1992 - Clays, Robert L. Virta, Bureau of Mines, September 1993.

Annual Report 1992 - Gypsum, Lawrence L. Davis, Bureau of Mines, September 1993.

Annual Report 1992 - Phosphate Rock, David E. Morse, Bureau of Mines, September 1993.

Burden of Guilt, Mineral Policy Center, Washington, D.C., June 1993.

Bureau of Mines Research 92 - A Summary of Significant Results and Economics in Mineral Technology, Bureau of Mines, 1992. (GPO no. I 28.115:992)

California Environmental Protection Agency and the National Stone Association, Aggregate Plants Compliance Assistance Program, September 1993.

CRS Issue Brief, The 1872 Mining Law: Time to Reform?, Marc Humphries, Environment and Natural Resources Policy Division, Congressional Research Service, Library of Congress, July 7, 1994. (Order Code IB89130)

Directory of Principal Crushed Stone Producers in the United States in 1993, U.S. Department of the Interior, Bureau of Mines, Mineral Industry Surveys, January 1995.

Directory of Principal Sand and Gravel Producers in the United States in 1992, U.S. Department of the Interior, Bureau of Mines, Mineral Industry Surveys, November 1993.

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc, Detroit, Michigan, 1992.

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Internal Document: TRI Industry Expansion, Description of Industry Sector Activities, U.S. EPA, Office of Pollution Prevention and Toxics.

Internal EPA Letter: Mine Safety and Health Administration Mines Initiative, Connie Musgrove, Office of Compliance Monitoring, U.S. EPA, June 7, 1994.

Memo: Lead Inspection Inquiry Regarding Region VIII Mining Initiative, Beth Greenwald, U.S. EPA Region VIII, September 21, 1994.

Mineral Commodity Summaries 1994, Bureau of Mines.

Minerals Yearbook, Metals and Minerals, vol. I, Bureau of Mines, 1992.

1987 Census of Mineral Industries: Clay, Ceramic, and Refractory Minerals, Bureau of the Census, April 1989. (MIC87-I-14C(P))

1987 Census of Mineral Industries: Miscellaneous Nonmetallic Minerals (Except Fuels) and Services, Bureau of the Census, August 1989. (MIC87-I-14E(P))

1987 Census of Mineral Industries: Sand and Gravel, Bureau of the Census, August 1989. (MIC87-I-14B(P))

1987 Census of Mineral Industries: Stone, Bureau of the Census, August 1989. (MIC87-I-14A(P))

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

Sustainable Environmental Law, Ch. 16, Campbell-Mohn, Environmental Law Institute, 1993.

Technical Support Document, International Training Workshop, Principles of Environmental Enforcement, Office of Enforcement and Compliance Assurance, U.S. EPA, April, 1994.

1992 Toxic Release Inventory (TRI) Public Data Release, U.S. EPA, Office of Pollution Prevention and Toxics, April 1994. (EPA/745-R94-001)

U.S. Industrial Outlook 1994 - Metals and Industrial Minerals Mining, U.S. Department of Commerce.

U.S. Industrial Outlook 1994 - Construction Materials, U.S. Department of Commerce.

Process Description

Air Pollution Engineering Manual, 3rd ed., Air & Waste Management Association, International Thomson Publishing, New York, New York, 1992.

Draft SIC Code Profile 14, Mining and Quarrying of Nonmetallic Minerals, Office of Pollution Prevention and Toxics, U.S. EPA, December 9, 1993.

McGraw-Hill Encyclopedia of Science & Technology, 7th ed., vol. 11, McGraw-Hill Book Company, New York, New York, 1992.

Nonmetallic Mineral Processing Plants - Background Information for Proposed Standards, Office of Air Quality Planning and Standards, U.S. EPA, April 1983. (EPA-450/3-83-001a)

Regulatory Profile

Mineral Mining and Processing Point Source Category Rules and Regulations, Federal Register vol. 40, no. 201, October 16, 1975.

Standards of Performance for Nonmetallic Mineral Processing Plants Rules and Regulations, Federal Register vol. 50, no. 148, August 1, 1985.

Pollution Prevention

Environmental Fact Sheet, Recycling Municipal Solid Waste: Facts and Figures, Office of Solid Waste and Emergency Response, U.S. EPA, July 1992. (EPA/530-SW-91-024)

Contacts*

Name	Organization	Telephone
Steve Fruh	EPA Office of Air Quality Planning & Standards	919-541-2837
Linda Carrico	Bureau of Mines	202-501-9651
Paul Novak	EPA Region V (inspector)	216-522-7260
Brian Symmes	EPA Office of Pollution Prevention and Toxics	202-260-9121
Greg Conrad	InterState Mining Commission	703-709-8654

Name	Organization	Telephone
Bruce Humphries	Colorado Dept. of Natural Resources	303-866-3567
Steve Hoffman	U.S. EPA Office of Solid Waste	703-308-8413
David Morse	Bureau of Mines	202-501-9402
Edwin G. Buckner	U.S. EPA Region VII Air Branch	913-551-7621
Roger Wilmoth	U.S. EPA Region V	513-564-7509

[1]Please Note: Bureau of Mines data for the crushed stone and sand and gravel industries is reported in alternate years. This profile presents crushed stone industry data for 1993, and sand and gravel industry data for 1992.

* Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Order Processing Code:

* 3212

Charge your order. It's easy!

Fax your orders (202) 512–2250
Phone your orders (202) 512–1800

Qty.	Stock Number	**Published in 1995** Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	**Published in 1997** Title	Price Each	Total Price
	055-000-00570-2	Air Transportation Industry, 90 pages	$ 7.50	
	055-000-00571-1	Ground Transportation Industry, 130 pages	10.00	
	055-000-00572-9	Water Transportation Industry, 90 pages	7.50	
	055-000-00573-7	Metal Casting Industry, 150 pages	13.00	
	055-000-00574-5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055-000-00575-3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055-000-00576-1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055-000-00577-0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055-000-00578-8	Textile Industry, 130 pages	10.00	
	055-000-00579-6	Sector Notebook Data Refresh –1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0076606

EPA

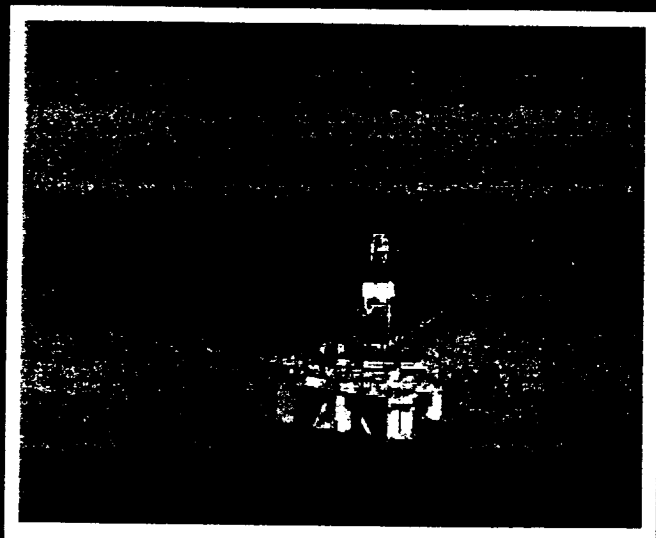
EPA

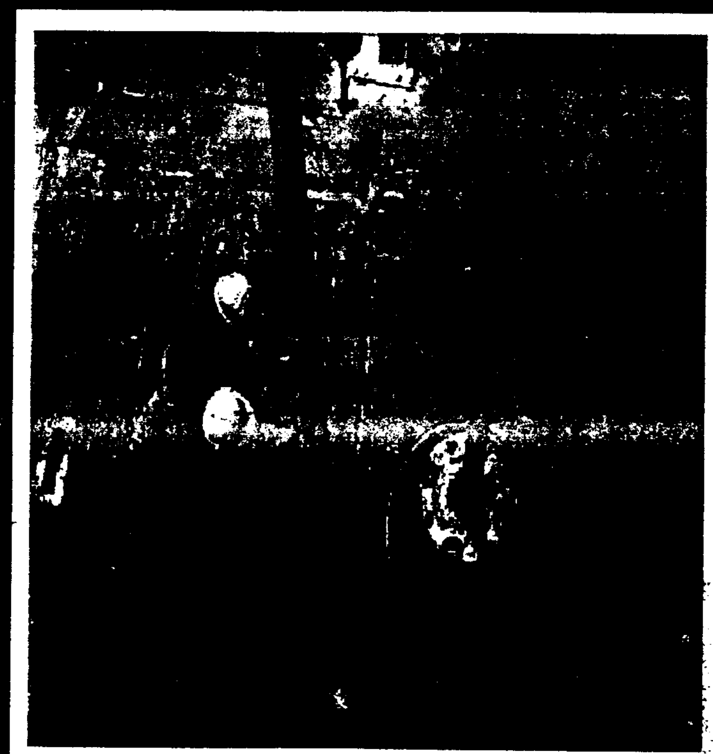
United States
Environmental Protection
Agency

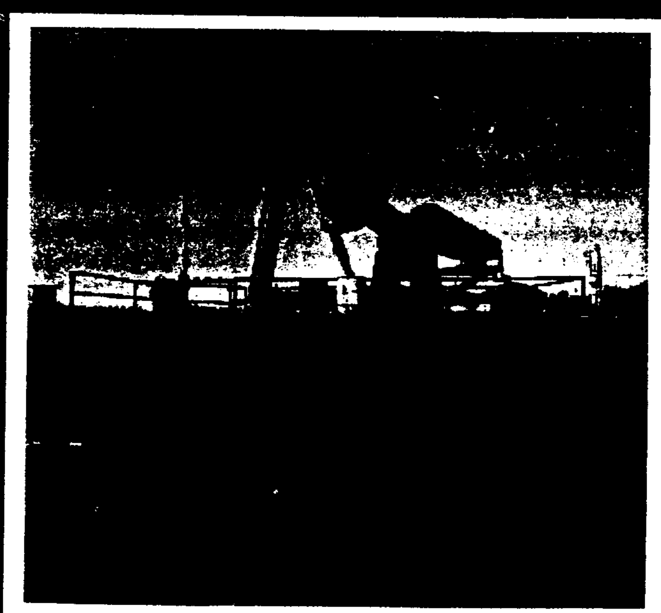
Enforcement and
Compliance Assurance
(2223A)

EPA-310-R-00-004
October 2000

Profile Of The Oil And Gas Extraction Industry







SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 18 1997

THE ADMINISTRATOR

Message from the Administrator

Since EPA's founding over 25 years ago, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and those as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper and smarter. As a result, we no longer have rivers catching fire. Our skies are clearer. American environmental technology and expertise are in demand around the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

The Environmental Protection Agency has undertaken its Sector Notebook Project to compile, for major industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with an extensive series covering other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to understand better their regulatory requirements, and learn more about how others in their industry have achieved regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that we together achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

EPA/310-R-99-006

EPA Office of Compliance Sector Notebook Project

Profile of the Oil and Gas Extraction Industry

October 2000

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW
Washington, DC 20460

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

Obtaining copies:

Electronic versions of all sector notebooks are available via Internet on the Enviroene World Wide Web at www.epa.gov/oeca/sector. Enviroene is a free, public, environmental exchange system operated by EPA's Office of Enforcement and Compliance Assurance and Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization. Direct technical questions to the "Feedback" button on the bottom of the web page.

Purchase printed bound copies from the **Government Printing Office (GPO)** by consulting the order form at the back of this document or order via the Internet by visiting the on-line GPO Sales Product Catalog at https://orders.access.gpo.gov/su_docs/sale/prf/prf.html. Search using the exact title of the document "Profile of the XXXX Industry" or simply "Sector Notebook." When ordering, use the GPO document number found on the order form at the back of this document.

Complimentary volumes are available to certain groups or subscribers, including public and academic libraries; federal, state, tribal, and local governments; and the media from EPA's National Service Center for Environmental Publications at **(800) 490-9198.** When ordering, use the EPA publication number found on the following page.

The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Seth Heminway, Coordinator, Sector Notebook Project
US EPA Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017

For further information, and for answers to questions pertaining to these documents, please refer to the contact names listed on the following page.

SECTOR NOTEBOOK CONTACTS

Questions and comments regarding the individual documents should be directed to the specialists listed below. **See the Notebook web page at: *www.epa.gov/oeca/sector* for the most recent titles and staff contacts.**

EPA Publication Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*	Steve Hoover	564-7007
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-005.	Profile of the Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*	Scott Throwe	564-7013
EPA/310-R-95-008.	Profile of the Metal Mining Industry	Maria Malave	564-5027
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry	Debbie Thomas	564-5041
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	564-2628
EPA/310-R-95-012.	Profile of the Organic Chemical Industry *	Walter DeRieux	564-7067
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Profile of the Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Profile of the Pulp and Paper Industry	Seth Heminway	564-7017
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry		564-2310
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.	Scott Throwe	564-7013
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Profile of the Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Profile of the Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Profile of the Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Profile of the Metal Casting Industry	Steve Hoover	564-7007
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Profile of the Textile Industry		564-2310
EPA/310-R-98-001.	Profile of the Aerospace Industry	Anthony Raia	564-6045
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **	Seth Heminway	564-7017
EPA/310-R-99-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry	Michelle Yaras	564-4153
EPA/310-R-99-004.	Profile of the Agricultural Crop Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-99-005.	Profile of the Agricultural Livestock Production Industry	Ginah Mortensen	913-551-5211
EPA/310-R-00-004.	Profile of the Oil and Gas Extraction Industry	Dan Chadwick	564-7054
	Government Series		
EPA/310-R-99-001.	Profile of Local Government Operations		564-2310

* Spanish translations available.

** This document revises compliance, enforcement, and toxic release inventory data for all profiles published in 1995.

Oil and Gas Extraction Industry
(SIC 13)
TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACS - Automatic Casing Swab
AFS - AIRS Facility Subsystem (CAA database)
AIRS - Aerometric Information Retrieval System (CAA database)
AOR - Area of Review (SDWA)
AOSC - Association of Oilwell Servicing Contractors
API - American Petroleum Institute
API ES - American Petroleum Institute Environmental Statement
BAT - Best Available Technology Economically Achievable
bbl - Barrel (42 US gallons)
Bcf - Billion Cubic Feet
BCT - Best Conventional Pollutant Control Technology
bpd - Barrels per Day
BIA - Bureau of Indian Affairs (Department of the Interior)
BIFs - Boilers and Industrial Furnaces (RCRA)
BLM - Bureau of Land Management (Department of the Interior)
BMP - Best Management Practice
BOD - Biochemical Oxygen Demand
BOP - Blowout Preventer
BPT - Best Practicable Technology Currently Available
BS&W - Basic Sediment and Water
BTEX - Benzene, Toluene, Ethylbenzene and Xylene
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CFR - Code of Federal Regulations
CGP - Construction General Permit (CWA)
CO - Carbon Monoxide
CO_2 - Carbon Dioxide
COE - Army Corps of Engineers (Department of Defense)
CZMA - Coastal Zone Management Act
CWA - Clean Water Act
DOC - United States Department of Commerce
DOE - United States Department of Energy
DOI - United States Department of the Interior
E&P - Exploration and Production
EIA - Energy Information Administration (Department of Energy)
EIS - Environmental Impact Statement
EOR - Enhanced Oil Recovery
EPA - United States Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
ESA - Endangered Species Act

EST - Eastern Standard Time
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
FLPMA- Federal Land Policy and Management Act
FPSO- Floating Production, Storage, and Offloading system
FR - Federal Register
FRP - Facility Response Plan
H_2S - Hydrogen Sulfide
HAPs - Hazardous Air Pollutants (CAA)
HSWA - Hazardous and Solid Waste Amendments
IDEA - Integrated Data for Enforcement Analysis
IOGCC - Interstate Oil and Gas Compact Commission
IPAA - Independent Petroleum Association of America
LDR - Land Disposal Restrictions (RCRA)
LEPCs - Local Emergency Planning Committees
MACT - Maximum Achievable Control Technology (CAA)
Mcf - Thousand Cubic Feet
MCLs - Maximum Contaminant Levels
MCLGs - Maximum Contaminant Level Goals
MFC - Magnetic Fluid Conditioner
MIT - Mechanical Integrity Test
MMPA - Marine Mammal Protection Act
MMS - Minerals Management Service (Department of the Interior)
MMTCE - Million Metric Tons of Carbon Equivalent
MPRSA- Marine Protection, Research, and Sanctuaries Act
MSDSs - Material Safety Data Sheets
MSGP - Multi-Sector General Permit (CWA)
NAAQS - National Ambient Air Quality Standards (CAA)
NAICS - North American Industrial Classification System
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NEC - Not Elsewhere Classified
NEPA - National Environmental Policy Act
NESHAP - National Emission Standards for Hazardous Air Pollutants
$NICE^3$ - National Industrial Competitiveness Through Energy, Environment and Economics
NO_2 - Nitrogen Dioxide
NOI - Notice of Intent
NORM - Naturally Occurring Radioactive Material
NOT - Notice of Termination
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)
OAQPS - Office of Air Quality Planning and Standards
OCS - Outer Continental Shelf
OCSLA - Outer Continental Shelf Lands Act

OECA - Office of Enforcement and Compliance Assurance
OMB - Office of Management and Budget
OOC - Offshore Operators Committee
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
PAH - Polyaromatic Hydrocarbon
PCB - Polychlorinated Byphenyls
PCS - Permit Compliance System (CWA Database)
PDC - Polycrystalline Diamond Compact Drill Bit
PM10 - Particulate Matter of 10 microns or less
PMN - Premanufacture Notice
POP - Problem Oil Pit
POTW - Publicly Owned Treatments Works
PSD - Prevention of Significant Deterioration (CAA)
PT - Total Particulates
PTTC - Petroleum Technology Transfer Council
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
RQ - Reportable Quantity (CERCLA)
SARA - Superfund Amendments and Reauthorization Act
SBF - Synthetic-Based Drilling Fluid
SDWA - Safe Drinking Water Act
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SIP - State Implementation Plan
SO_2 - Sulfur Dioxide
SPCC - Spill Prevention Control and Countermeasure
STEP - Strategies for Today's Environmental Partnership
SWPPP - Storm Water Pollution Prevention Plan (CWA)
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TSCA - Toxic Substances Control Act
TSD - Treatment Storage and Disposal
TSP - Total Suspended Particulates
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
USDW - Underground Sources of Drinking Water (SDWA)
USFS - United States Forest Service (Department of Agriculture)
USFWS - United States Fish and Wildlife Service (Department of the Interior)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds
WSPA - Western States Petroleum Association

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are becoming an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2223-A), 401 M St., SW, Washington, DC 20460. Comments can also be sent via the web page.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks, please contact the Office of Compliance at (202) 564-2310.

II. INTRODUCTION TO THE OIL AND GAS EXTRACTION INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the oil and gas extraction industry. Facilities described within the document are described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

This industry sector profile provides an overview of the oil and gas industry as listed under SIC code 13. The SIC code 13 encompasses the oil and gas extraction process from the exploration for petroleum deposits up until the transportation of the product from the production site. There are five major groups within SIC code 13:

SIC 1311. Crude petroleum and natural gas. Establishments in this industry are primarily involved in the operation of oil and gas field properties. Establishments under this category might also perform exploration for crude oil and natural gas, drill and complete wells, and separate the crude oil and natural gas components from the natural gas liquids and produced fluids.

SIC 1321. Natural gas liquids. This industry is comprised of establishments that separate natural gas liquids from crude oil and natural gas at the site of production. Examples of these gases are propane and butane. Natural gas liquids producers that remove additional material at petroleum refineries are classified under SIC code 29, and establishments that recover other salable contaminants such as helium are classified under SIC code 28.

SIC 1381. Drilling oil and gas wells. This industry is made up of establishments that drill wells on a contract or fee basis.

SIC 1382. Oil and gas field exploration services. Establishments in this industry perform geological, geophysical and other exploration services for oil and gas on a contract or fee basis.

SIC 1389. Oil and gas field services, not elsewhere classified (NEC). Establishments in this industry perform services on a contract or fee basis that are not elsewhere classified. These include the preparation of drilling sites by building foundations and excavating pits, the completion of wells and preparation for production, and the performing of maintenance.

While this notebook covers all of the SIC codes listed above, the diverse nature of the industries will not allow a detailed description of each. Since the service industries (SIC codes 1381, 1382, and 1389) and natural gas liquids industry (SIC code 1321) are tied to the economic, geographic, and production trends of SIC code 1311, most attention is focused on the crude petroleum and natural gas industry. Although certain products under these SIC codes may not be specifically mentioned, the sector-wide economic, pollutant output, and enforcement and compliance data in this notebook covers all establishments involved with oil and gas extraction.

SIC codes were established by the Office of Management and Budget (OMB) to track the flow of goods and services within the economy. OMB is in the process of changing the SIC code system to a system based on similar production processes called the North American Industrial Classification System (NAICS). In the NAICS, the SIC codes for the oil and gas extraction industry correspond to the following NAICS codes:

1987 SIC	U.S. SIC Description	1997 NAICS	NAICS Description
1311	Crude Petroleum and Natural Gas	211111	Crude Petroleum and Natural Gas Extraction
1321	Natural Gas Liquids	211112	Natural Gas Liquid Extraction
1381	Drilling Oil and Gas Wells	213111	Drilling Oil and Gas Wells
1382	Oil and Gas Field Exploration Services	54136	Geophysical Surveying and Mapping Services
		213112	Support Activities for Oil and Gas Operations
1389	Oil and Gas Field Services, NEC	213112	Support Activities for Oil and Gas Operations

II.B. Characterization of the Oil and Gas Extraction Industry

II.B.1. Product Characterization

The primary products of the industry are crude oil, natural gas liquids, and natural gas. Crude oil is a mixture of many different hydrocarbon compounds that must be processed to produce a wide range of products. U.S. refinery processing of crude oil yields, on average, motor gasoline (approximately 40 percent), diesel fuel and home heating oil (20 percent), jet fuels (10 percent), waxes, asphalts and other nonfuel products (5 percent), feedstocks for the petrochemical industry (3 percent), and other lesser components [U.S.

Department of Energy, Energy Information Administration (EIA), 1999]. Volumes of oil and refined products typically are reported in barrels (bbl), which are equal to 42 gallons.

When crude oil is first brought to the surface, it may contain a mixture of natural gas and produced fluids such as salt water and both dissolved and suspended solids. On land (and at many offshore operations) Natural gas is separated at the well site and is processed for sale if natural gas pipelines (or other transportation vehicles) are nearby, or is flared as a waste (at onshore operations only). Water (which can be more than 90 percent of the fluid extracted in older wells) is separated out, as are solids. Only about one-third of the production platforms offshore in the Gulf of Mexico separate water. The other offshore Gulf platforms transport full well stream, sometimes great distances, to central processing facilities. The crude oil is at least 98 percent free of solids after it passes through this onsite treatment and is prepared for shipment to storage facilities and ultimately refineries (Sittig, 1978).

Natural gas can be produced from oil wells (called *associated gas*), or wells can be drilled with natural gas as the primary objective (called *non-associated gas*). Methane is the predominant component of natural gas (approximately 85 percent), but ethane (10 percent), propane, and butane are also significant components. The heavier components, including propane and butane, exist as liquids when cooled and compressed; these are often separated and processed as natural gas liquids.

Less frequently, oil and gas can be produced by other methods. Oil can be found in tar sands, which are porous rock (sandstone) structures on the surface to 100 meters deep. The material is fairly viscous and also is fairly high in sulfur and metals. Although the Athabasca region in Canada is the primary area of significant tar sand mining, there are some deposits in the western United States.

Oil may also be extracted from oil shale. These deposits may be 10 to 800 feet below the surface and can be removed by surface mining or subsurface excavation. The oil, in a highly viscous form called *kerogen*, is usually heated to allow it to flow. Because only approximately 30 gallons (less than a barrel) are produced per ton of shale, the process is costly, and the oil shale mining industry is currently only a minor contribution to the domestic oil supply.

A small but increasingly significant source of natural gas is coalbed methane. In all coal deposits, methane is found as a byproduct of the coalification process and is loosely bound to coal surface areas. This methane historically was considered a safety hazard in the coal mining process and was vented, but recently it has been recovered in conjunction with mining or produced independently via wells in deposits that are too deep for mining. Generally, coalbed methane is collected by drilling a well similar to those used for conventional oil and gas deposits, but with some adaptations to accommodate mining operations and different rock characteristics (EPA, 1992). In 1997, coalbed methane production accounted for six percent of the total U.S. natural gas production (EIA, 1998).

Methane hydrates are another form of natural gas, for which economically viable recovery methods are still in development. Methane hydrates are structures in which methane molecules are trapped within a lattice of ice. They are found principally in cold and/or pressurized conditions: on land in permafrost regions, or beneath the ocean at depths greater than 1,500 feet below the water surface. These eventually could be an immense resource; estimated amounts of methane in these structures in the United States is 200,000 trillion cubic feet, compared to an estimated 1,400 trillion cubic feet in conventional natural gas deposits. A goal of the U.S. Department of Energy methane hydrates research program is to develop a commercial production system by the year 2015 (U.S. DOE, 1998).

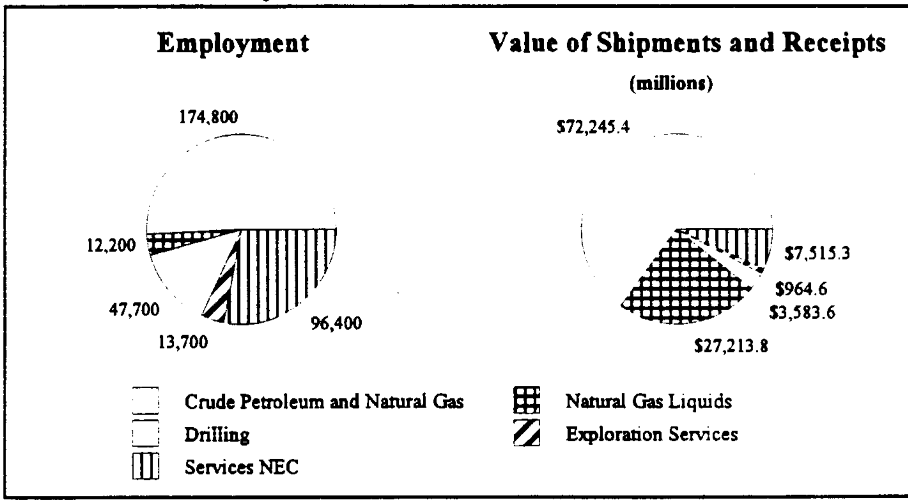
II.B.2. Industry Size and Distribution

The oil and gas extraction industry is an important link in the energy supply of the United States. Petroleum and natural gas supply 65 percent of the energy consumed in the United States, and domestic producers supply approximately 40 percent of the petroleum and 90 percent of the natural gas [EIA and Independent Petroleum Association of America (IPAA), 1999]. According to the 1992 Census of Mining Industries, the industry employed 345,000 people and had yearly revenues of $112 billion.

Several factors influence the size of the industry, including technology development and crude oil prices (which are set in world markets) (EIA, 1999). Employment in the industry is also affected by the recent trend in mergers and consolidation among companies in the industry.

Within the overall oil and gas extraction industry group (SIC code 13), SIC 1311 (crude petroleum and natural gas) is the largest. As shown in Figure 1, this industry employs half of the total workers in this SIC group, and accounts for about 60 percent of the sales. SIC code 1389 (services not elsewhere classified) is the next largest employer, but SIC code 1321 (natural gas liquids) is more significant with respect to sales.

Figure 1: Employment and Value of Shipments and Receipts in the Oil and Gas Industry



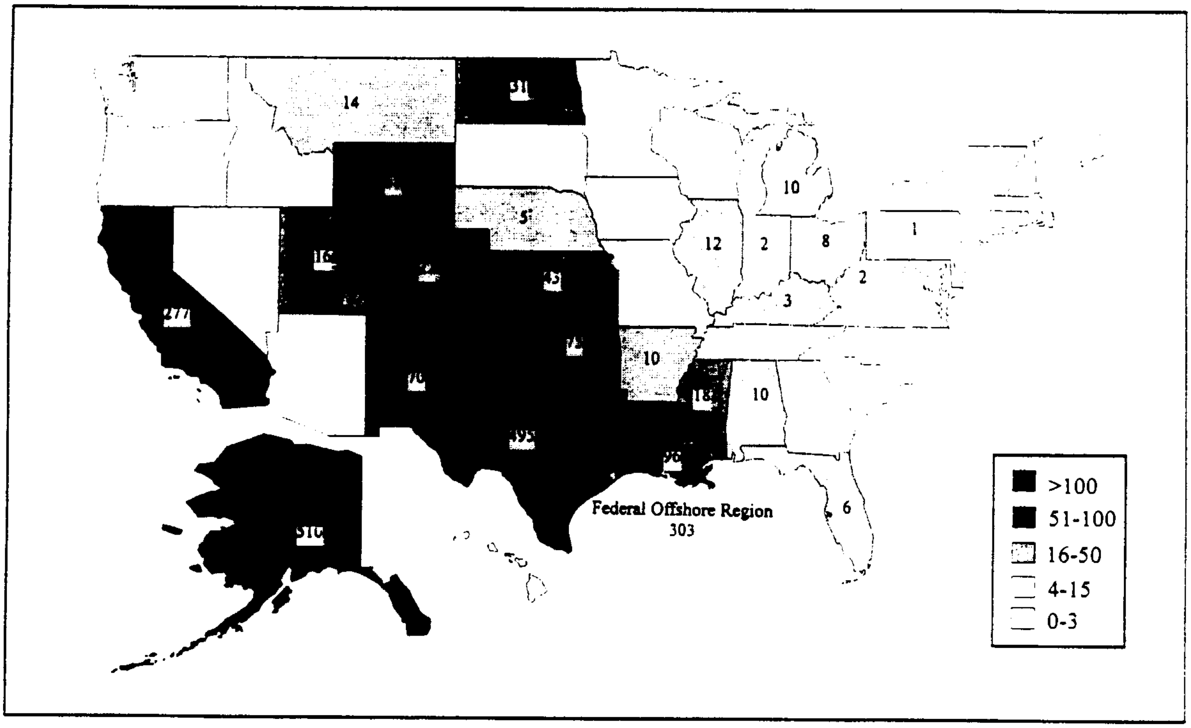
Source: *1992 Census of Mineral Industries,* U.S. Department of Commerce, 1995.

The major oil and gas producing areas in the United States are in the Gulf of Mexico region (onshore and offshore), California, and Alaska (see Figure 2). The Gulf of Mexico and surrounding land in particular is the most concentrated area of production; in 1998, Texas (onshore and offshore) produced 23 percent of the nation's crude oil, Louisiana produced 5 percent, and the Federal offshore region produced 14 percent.[1]

The geographic distribution is similar for natural gas; Texas, Louisiana, and the Gulf of Mexico are the major producing locations (Figure 3). New Mexico, Oklahoma, Wyoming, and Kansas are also important gas-producing states, while California and Alaska are less important with respect to natural gas production than they are for crude oil.

[1] The Federal Offshore Region, or Outer Continental Shelf (OCS), is seaward of State jurisdiction (3 nautical miles, or approximately 3.3 statute miles, from an established baseline except for Texas and the Gulf coast of Florida, for which the boundary is 3 marine leagues, or approximately 10 statute miles), and landward of a line defined by international law at a minimum of 200 nautical miles (MMS, 1997) (See p101 for more details).

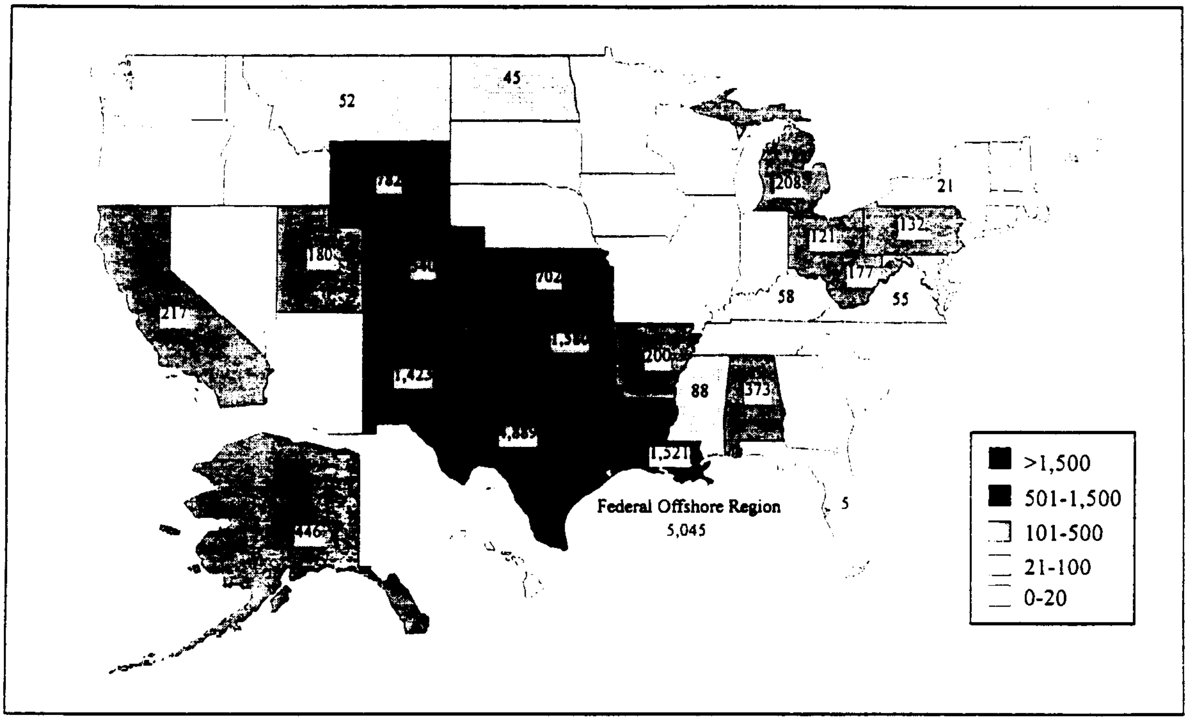
Figure 2: 1996 U.S. Crude Oil Production (Million Barrels per Year)



Note: Small quantities are also produced in Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.
Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1996 Annual Report*, EIA, 1997.

R0076626

Figure 3: 1996 U.S. Natural Gas Production (Billion Cubic Feet per Year)



Note: Small quantities are also produced in Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.
Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1996 Annual Report*, EIA, 1997.

The oil and gas industry has a unique standing for census purposes because of the sheer number of wells in the country. For the purposes of simplifying reporting procedures under SIC code 1311, the census defines an establishment as all activities of an operating company in an entire state. Therefore, these data give no information on the number of individual wells. Data collected by the Independent Petroleum Association of America, however, indicated that in 1997 there were 573,504 active wells extracting primarily crude oil, and 303,724 wells producing primarily natural gas in the United States (IPAA, 1999).

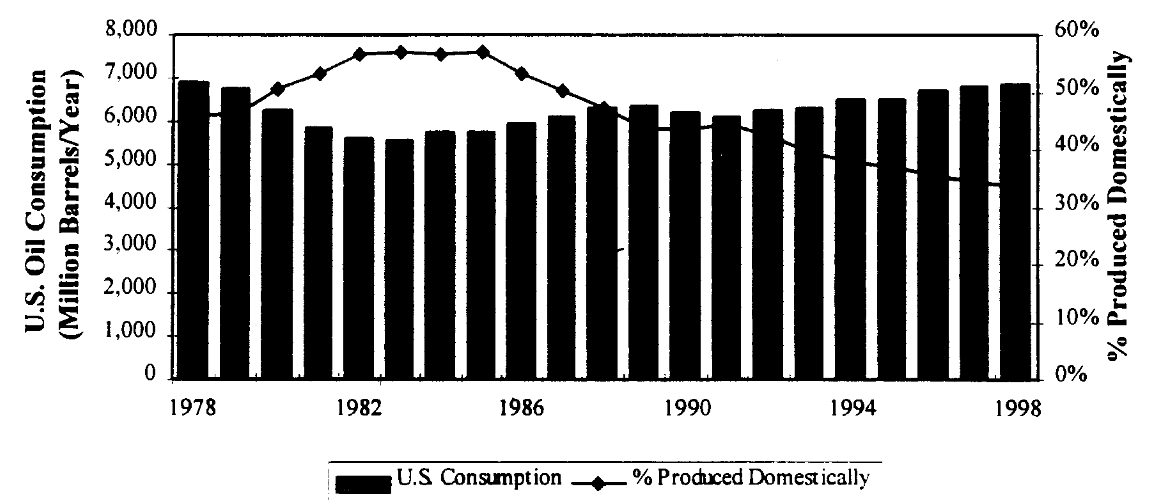
Another unique aspect of the industry is the marginal nature of many operations. Oil and gas wells can have very long lives (20 years or more); some wells drilled in the early years of this century are still producing, but only in small volumes. Wells typically have higher production in the early years, then decline and can level off at a low level of production that can be sustained for a long period (API, 1999). Wells that produce less than 10 barrels of oil per day are called "stripper wells." As of 1997, there were 436,000 active stripper wells (76 percent of all active domestic wells) producing an average of 2.2 barrels each daily. Together stripper wells account for about 15 percent of domestic production (IPAA, 1999).

II.B.3. Economic Trends

Domestic Consumption

The consumption of oil and gas in the United States is closely linked to the overall economy of the country. Between 1990 and 1998, crude oil consumption increased approximately 1.4 percent each year, and natural gas consumption increased at a rate of 2.0 percent per year. The rate of natural gas consumption is expected to continue growing, mostly at the expense of coal. Natural gas is expected to become an important source of energy in the future and will be accelerated by government policies and the development of the natural gas transportation infrastructure. In the past several years, however, the percent of the domestic consumption of both oil and gas met by domestic producers generally has decreased (Figures 4 and 5).

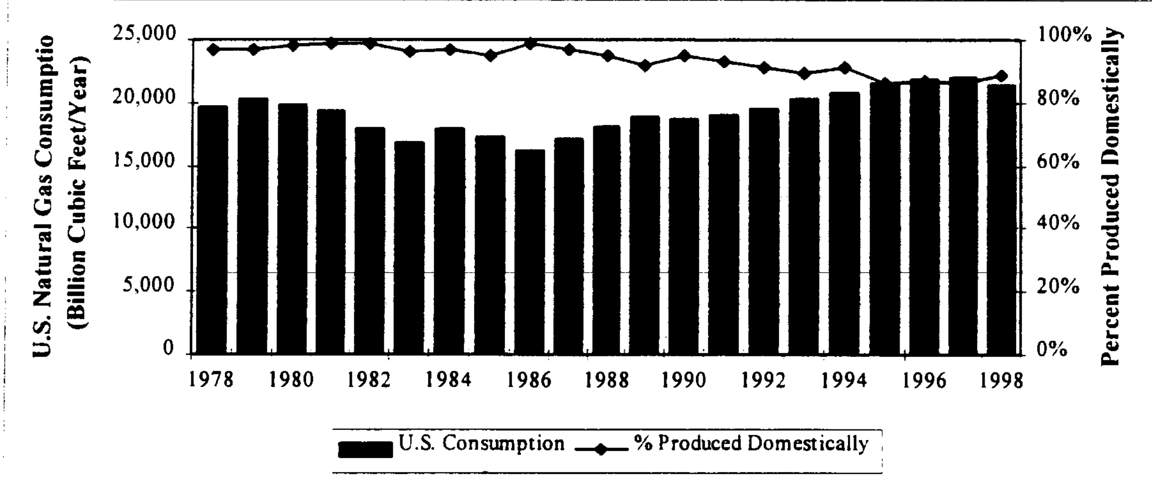
Figure 4: U.S. Oil Consumption and Percent Produced Domestically



Source: EIA and IPAA, 1999.

R0076628

Figure 5: U.S. Natural Gas Consumption and Percent Produced Domestically



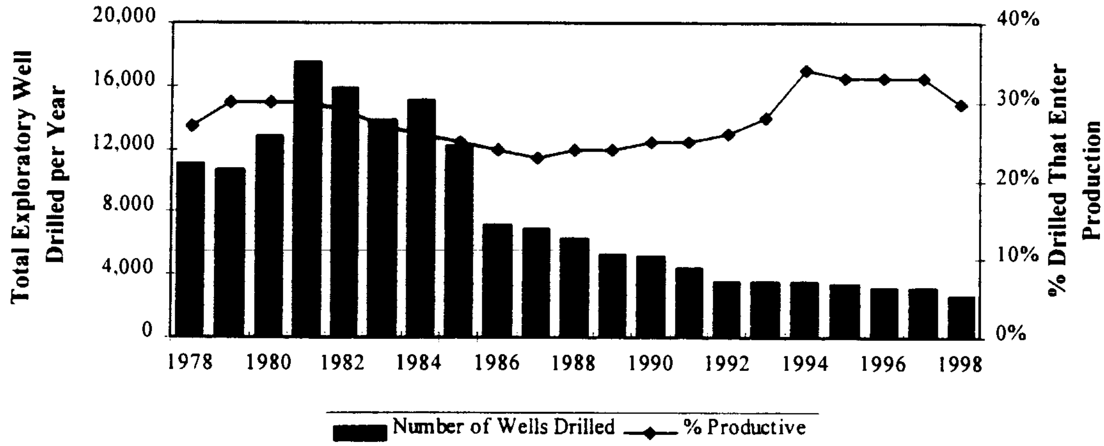
Source: EIA and IPAA, 1999.

Exploration and Reserves

The industry is exhibiting a general trend in exploration from domestic to foreign locations. In 1986, U.S. petroleum companies spent $17 billion on exploration and development within the United States and $7.5 billion abroad. In 1995, these firms spent $12.4 billion in the United States and $13.2 billion abroad (U.S. Department of Commerce (U.S. DOC), 1998). This shift in funds has placed an emphasis on drilling exploratory wells only at the most promising sites in the U.S. The results can be seen in Figure 6; many fewer exploratory wells are being drilled, but the success rate is higher.

R0076629

Figure 6: Number of Exploratory Wells Drilled and Percent That Enter Production



Note: Includes both oil and natural gas wells.
Source: American Petroleum Institute, 1999.

The most active areas of exploration are the Gulf of Mexico and Alaska. In the Gulf of Mexico, the development of technology that facilitates drilling in deeper water (including floating structures, drillships and subsea completions) has made it more feasible to explore deep water sites. Another new source for potential reserves[2] is in Alaska, where roughly 87 percent of the Northeast National Petroleum Reserve was opened in 1998 for exploration and leasing (DOI, 1998). Developments such as these temporarily have boosted hydrocarbon reserves above production levels. In 1997, for the first time in a decade, crude oil reserves were added at a level greater than the amount depleted through production. However, it is expected that in the future reserves will again decline relative to production (EIA, 1998).

Natural gas exploration efforts in the United States have been more successful than crude oil exploration at keeping pace with production. Between 1994 and 1997, the industry added more reserves than it extracted in production. In 1997, about 64 percent of the new reserves of natural gas were found in the Gulf of Mexico Federal Offshore region and Texas (EIA, 1998).

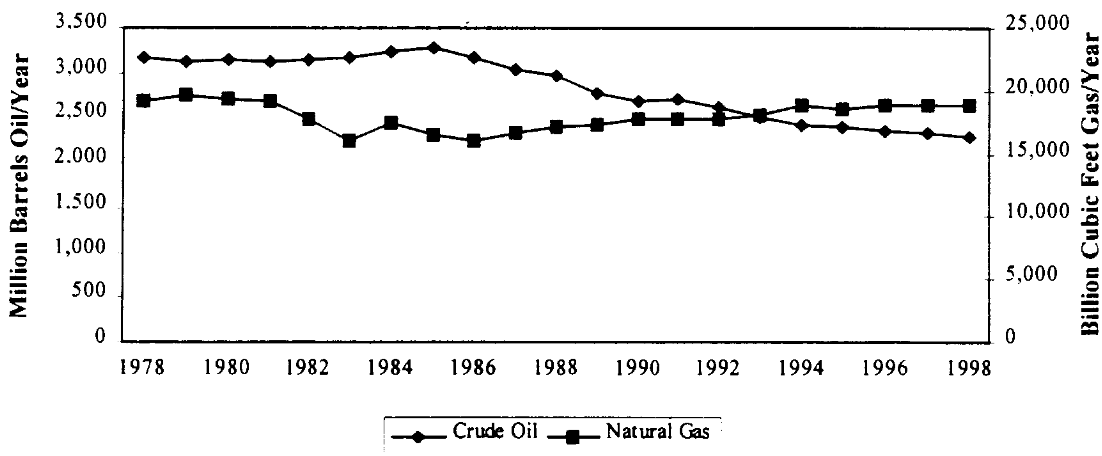
[2] The Energy Information Administration of the U.S. Department of Energy defines proved reserves as those volumes of oil and gas that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions (EIA, 1998).

Domestic Production and Prices

Production of crude oil is showing a decreasing trend, and natural gas production is showing an increasing trend. As shown in Figure 7, crude oil production is decreasing at an approximate rate of 1.5 percent per year. Leading the decline is Alaska, where production has declined approximately three percent per year in the past decade and six percent in 1997.

The production of natural gas, however, has been increasing steadily. Historically, growth has been about 1 percent per year, and is expected to grow at a rate of 1.6 percent per year through 2002 (U.S. DOC, 1998).

Figure 7: Domestic Crude Oil and Natural Gas Production



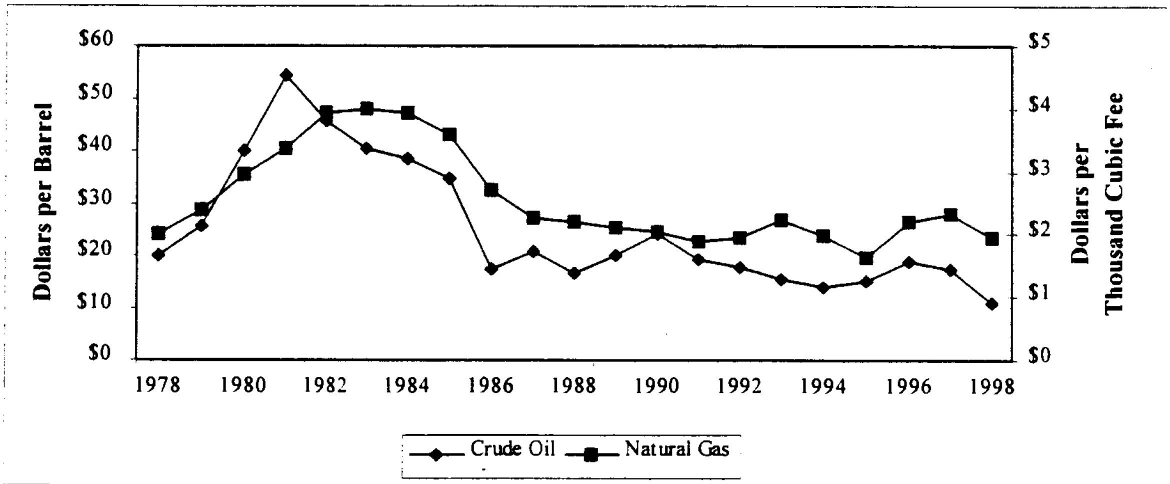
Source: EIA and IPAA, 1999.

As shown in Figure 8, the prices of both oil and gas have been quite volatile during the period between 1978 and 1997. In constant 1998 dollars, the wellhead price of crude oil has ranged between $10 and $54 per barrel. In 1998 and early 1999, prices were near $10 per barrel, but by August 1999 the price rebounded to over $20 per barrel (EIA, 1999).

Natural gas prices also have fluctuated. Wellhead prices reached a low point of $1.62 per thousand cubic feet in 1995, but increased in the subsequent two years. Prices of natural gas are expected to increase faster than those of oil through 2002, but still less than the rate of inflation (U.S. DOC, 1998).

R0076631

Figure 8: Wellhead Crude Oil and Natural Gas Prices, Fixed 1998 Dollars



Source: EIA and IPAA, 1999.

R0076632

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the oil and gas extraction industry, including the materials and equipment used and the processes employed. Specifically, this section contains a description of commonly used drilling and production processes, associated raw materials, the byproducts produced or discharges released, and the materials either recycled or transferred off-site. This discussion also provides a concise description of both the production and the potential fate of wastes produced in each process.

The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections concerning waste outputs, pollution prevention opportunities, and federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available to supplement this document.

III.A. Industrial Processes in the Oil and Gas Extraction Industry

The oil and gas extraction industry can be classified into four major processes: (1) exploration, (2) well development, (3) production, and (4) site abandonment. Exploration involves the search for rock formations associated with oil or natural gas deposits, and involves geophysical prospecting and/or exploratory drilling. Well development occurs after exploration has located an economically recoverable field, and involves the construction of one or more wells from the beginning (called *spudding*) to either abandonment if no hydrocarbons are found, or to well completion if hydrocarbons are found in sufficient quantities.

Production is the process of extracting the hydrocarbons and separating the mixture of liquid hydrocarbons, gas, water, and solids, removing the constituents that are non-saleable, and selling the liquid hydrocarbons and gas. Production sites often handle crude oil from more than one well. Oil is nearly always processed at a refinery; natural gas may be processed to remove impurities either in the field or at a natural gas processing plant.

Finally, site abandonment involves plugging the well(s) and restoring the site when a recently-drilled well lacks the potential to produce economic quantities of oil or gas, or when a production well is no longer economically viable.

R0076633

Two ancillary processes are also discussed in this section because they have significant economic and environmental implications. Maintenance of the well and reservoir is important in sustaining the safety and productivity of the operation and in ensuring protection of the environment. Spill mitigation is important in the oil and gas production industry because spills and other types of accidents can have serious implications for worker safety and the environment.

III.A.1. Exploration

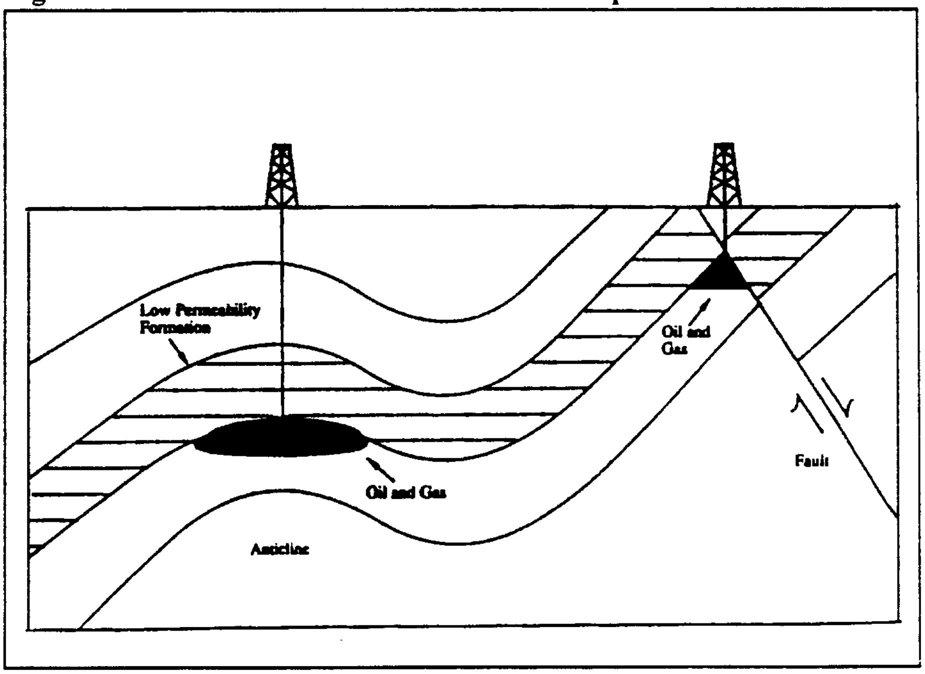
Oil and natural gas deposits are located almost exclusively in sedimentary rock and are often associated with certain geological structures. Geophysical exploration is the process of locating these structures in the subsurface via methods that fall under the category of remote sensing. In particular, common hydrocarbon-containing structures are those where a relatively porous rock has an overlying low-permeability rock that would trap the hydrocarbons (Berger and Anderson, 1992). Two common structural traps are found in Figure 9: anticlines are upward folds in the rock layers, while faults are fractures in the Earth's surface where layers are shifted.

Geophysicists search for these structures by taking advantage of the fact that seismic waves will travel through, bend, absorb, and reflect differently off of various layers of rock (Berger and Anderson, 1992). Geophysicists generate these seismic waves at the earth's surface, and measure the reflected seismic waves with a series of sensors known as geophones. Seismic waves can be generated by a variety of sources ranging from explosives that are detonated in holes drilled below the surface, to land vibroseis and marine airguns. Land vibroseis is typically used near populated areas and near sensitive environmental areas where detonations are not desirable. In the vibroseis process, trucks are used to drop a heavy weight on hard surfaces such as paved roads in order to create seismic waves.

In marine locations, explosives are less effective and have deleterious environmental impacts. In addition, vibroseis is impractical in water that is hundreds of feet deep. Seismic energy is therefore created by an airgun, a large device that can be emptied of air and water to create a vacuum. Seismic waves are created when water is allowed into the device at a very fast rate. It should be stressed that geophysical remote sensing cannot identify oil or gas accumulations directly; it can only indicate the potential for reserves via the presence or absence of certain rock characteristics that may be worthy of exploration.

After a site has been judged to have a reasonable chance of discovering a sufficient amount of hydrocarbons an exploratory well is drilled. It should be noted that although seismic exploration technology is constantly improving, it is not perfect. The only true way to discover the presence and quantity of petroleum is by drilling a well into the formation or structure suspected of containing hydrocarbons.

Figure 9: Common Oil and Gas Structural Traps



Source: EPA, 1992.

III.A.2. Well Development

Drilling

During the drilling process, wellsite geologists will augment the remote geophysical data with wireline logs, which are taken by means of devices lowered into the wellbore with wires. Wireline logs include several types of measurements that help to characterize the depths and thickness of subsurface formations and the type of fluids that they may contain. As an example, one type of log analyzes the resistance of the formation to electrical current, which helps to indicate the type of fluid and the porosity of the formation. For exploratory wells, mud logs may also be developed, which document the drill rate, types of rocks encountered, and any hydrocarbons encountered. The range of depths of well holes, or *wellbores,* is anywhere between 1,000 and 30,000 feet, with an average depth of all U.S. wells drilled in 1997 of 5,601 feet (API, 1998a).

For both onshore and offshore sites, the subterranean aspects of the drilling procedure are very similar. The drill bit is the component in direct contact with the rock at the bottom of the hole, and increases the depth of the hole by

R0076635

chipping off pieces of rock. The bit may be anywhere from three and three-fourths inches to two feet in diameter, and is usually studded with hardened steel or diamond. The selection of the drill bit can vary, depending on the type of rock and desired drilling speed. For example, a large-toothed steel bit may be used if the formation is soft and speed is important, while a diamond-studded bit may be used for hard formations or when a long drill life is desired (Kennedy, 1983). The drill bit is connected to the surface by several segments of hollow pipe, which together are called the *drill string*. The drill string is usually about 4 inches in diameter; drilling fluid is pumped down through its center and returns to the surface through the space, called the *annulus*, between the drill string and the rock formations or casing.

Drilling Fluids

Drilling fluid is an important component in the drilling process. A fluid is required in the wellbore to: (1) to cool and lubricate the drill bit; (2) remove the rock fragments, or *drill cuttings*, from the drilling area and transport them to the surface; (3) counterbalance formation pressure to prevent formation fluids (i.e. oil, gas, and water) from entering the well prematurely, and (4) prevent the open (uncased) wellbore from caving in (Berger and Anderson, 1992; Souders, 1998). Different properties may be required of the drilling fluid, depending upon the drilling conditions. For example, a higher-density fluid may be needed in high-pressure zones, and a more temperature-resistant fluid may be desired in high-temperature conditions. While drilling fluid may be a gas or foam, liquid-based fluids (called *drilling muds*) are used for approximately 93 percent of wells (API, 1997). In addition to liquid, drilling muds usually contain bentonite clay that increases the viscosity and alters the density of the fluid. Drilling mud may also contain additional additives that alter the properties of the fluid. The most significant additives are described later in this section. The American Petroleum Institute (API) environmental guidance document "Waste Management in Exploration and Production Operations," (API E5) considers the three general categories of drilling fluid (muds) to be water-based, oil-based, and synthetic-based. Synthetic-based muds are used as substitutes for oil-based muds, but also may be an advantageous replacement for water-based muds in some situations.

Water-based muds are used most frequently. The base may be either fresh or salt water, for onshore and offshore wells, respectively. The primary benefit of water-based muds is cost; they are the least expensive of the major types of drilling fluids, and in general they are less expensive to use since the resultant drilling waste can be discharged onsite provided these wastes pass regulatory requirements (EPA, 1999). The significant drawback with water-based muds is their limited lubricity and reactivity with some shales. In deep holes or high-angle directional drilling, water-based muds are not able to supply sufficient lubricity to avoid sticking of the drill pipe. Reactivity with clay shale can cause the destabilization of the wellbore. In these cases, oil-based and synthetic muds are needed.

In 1993 EPA estimated that about 15 percent of wells drilled deeper than 10,000 feet used some oil-based muds (USEPA, 1993b). Oil-based muds are composed primarily of diesel oil or mineral oil and are therefore more expensive than water-based muds. This higher cost, which includes the added burden of removing the oil from drill cuttings, and the required disposal options make oil-based muds a less frequently used option. Oil-based muds are well suited for the high temperature conditions found in deep wells because oil components have a higher boiling point than water, and oil-based muds can avoid the pore-clogging that may occur with water-based muds. Also oil-based muds are used when drilling through reactive (or high pressure) shales, high-angle directional drilling, and drilling in deep water. These situations encountered while drilling can slow down the drilling rate, increase drilling costs or even be impossible if water-based muds are used. In cases when oil-based muds are necessary, the upper section of a well generally is drilled with water-based muds and the conversion is made to oil-based mud when the situation requires it. It is predicted that since the industry trend is toward deeper wells, oil-based muds may become more prominent. However, because oil-based muds and their cuttings can not be discharged this may not be the case.

Since about 1990, the oil and gas extraction industry has developed many new oleaginous (oil-like) base materials from which to formulate high performance drilling fluids. A general class of these fluids are called synthetic materials, such as the vegetable esters, poly alpha olefins, internal olefins, linear alpha olefins, synthetic paraffins, ethers, linear alkylbenzenes, and others. Other oleaginous materials have also been developed for this purpose, such as enhanced mineral oils and non-synthetic paraffins. Industry developed synthetic-based fluids with these synthetic and non-synthetic oleaginous materials as the base fluid to provide the drilling performance characteristics of traditional oil-based fluids based on diesel and mineral oil, but with the potential for lower environmental impact and greater worker safety through lower toxicity, elimination of Polyaromatic hydrocarbons (PAH), faster biodegradability, lower bioaccumulation potential and in some drilling situations decreased drilling waste volume (FR 66086, December 16, 1996).

On land, air and foam fluids may be used in drilling wells. These fluids are less viscous than drilling muds and can enter smaller pores more easily. They are used when a higher rate of penetration into the formation is desired. Because air is less dense than a liquid, however, these fluids cannot exert the same pressure in the hole as liquid, and their viscosity can be altered if drilling encounters liquid in the formation. For this reason, air and foam fluids are used only in relatively low-pressure and water-free drilling locations, but are preferred in these situations because these fluids are much less expensive than other fluids (Kennedy, 1983; Souders, 1998). Air and foam fluids currently are used in the drilling of about seven percent of the wells in the United States (API, 1997).

Drilling muds typically have several additives. (Air and foam fluids typically do not contain many additives because the additives are either liquid or solid, and will not mix with air and foam drilling fluids.) The following is a list of the more significant additives:

- Weighting materials, primarily barite (barium sulfate), may be used to increase the density of the mud in order to equilibrate the pressure between the wellbore and formation when drilling through particularly pressurized zones. Hematite (Fe_2O_3) sometimes is used as a weighting agent in oil-based muds (Souders, 1998).

- Corrosion inhibitors such as iron oxide, aluminum bisulfate, zinc carbonate, and zinc chromate protect pipes and other metallic components from acidic compounds encountered in the formation.

- Dispersants, including iron lignosulfonates, break up solid clusters into small particles so they can be carried by the fluid.

- Flocculants, primarily acrylic polymers, cause suspended particles to group together so they can be removed from the fluid at the surface.

- Surfactants, like fatty acids and soaps, defoam and emulsify the mud.

- Biocides, typically organic amines, chlorophenols, or formaldehydes, kill bacteria that may produce toxic hydrogen sulfide gas.

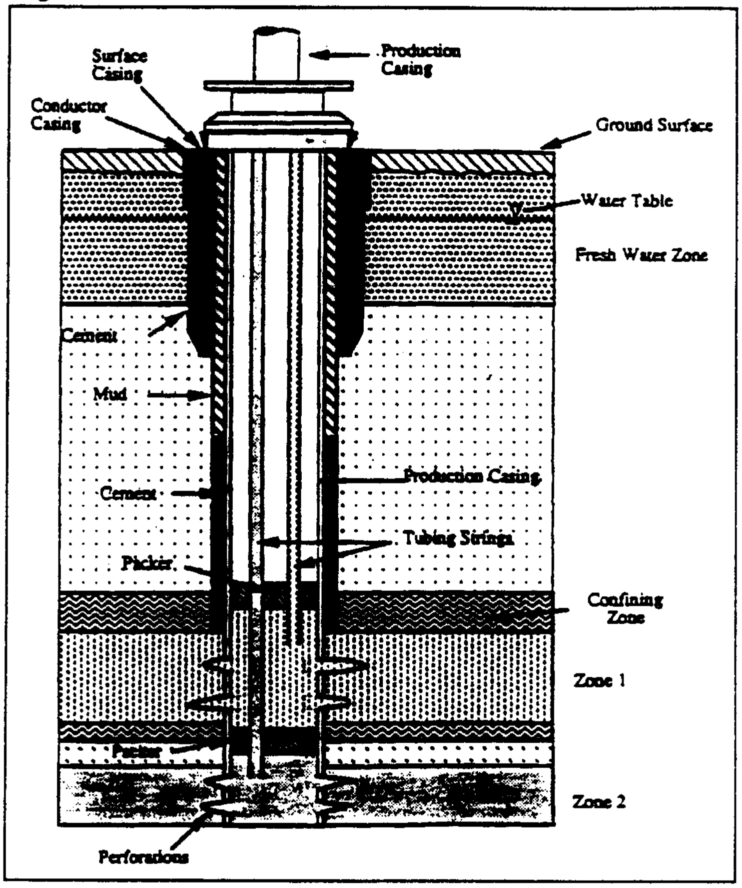
- Fluid loss reducers include starch and organic polymers and limit the loss of drilling mud to under-pressurized or high-permeability formations (EPA, Office of Solid Waste, 1987).

Casing

As the hole is drilled, casing is placed in the well to stabilize the hole and prevent caving. The casing also isolates water bearing and hydrocarbon bearing zones. As shown in Figure 10, three or four separate casing "strings" (lengths of tubing of a given diameter) may be used in intermediate-depth wells. In locations where surface soils may cave in during drilling, a "conductor" casing may be placed at the surface, extending only twenty to one hundred feet from the surface. This string is often placed prior to the commencement of drilling with a pile driver (Berger and Anderson, 1992). The next string, or "surface" casing, begins at the surface and may penetrate two thousand to three thousand feet. Its primary purpose is to protect the surrounding fresh-water aquifer(s) from the incursion of oil or brine from greater depths. The "intermediate" string begins at the surface and ends within a couple thousand feet of the bottom of the wellbore. This section prevents the hole from caving in and facilitates the movement of equipment used in the hole, e.g., drill strings and logging tools. The final "production" string extends the full length of the wellbore and encases the downhole production equipment. Shallow wells may have only two casing strings, and deeper wells may have multiple intermediate casings. After each casing string has been installed, cement is forced out through the bottom of the casing up the annulus to hold it in place and surface casing is cemented to the surface. Casing is cemented to prevent migration of fluids behind the casing and to prevent communication of higher pressure productive formations with lower pressure non-productive formations. Additional features and equipment shown in Figure 10 will be installed during the completion process for production: perforations will allow reservoir fluid to enter the wellbore; tubing strings will carry the fluid to the surface; and packers (removable plugs) may be installed to isolate producing zones.

Casing is important for both the drilling and production phases of operation, and must therefore be designed properly. It prevents natural gas, oil, and associated brine from leaking out into the surrounding fresh-water aquifer(s), limits sediment from entering the wellbore, and facilitates the movement of equipment up and down the hole. Several considerations are involved in planning the casing. First, the bottom of the wellbore must be large enough to accommodate any pumping equipment that will be needed either upon commencement of pumping, or in the later years of production. Also, unusually pressurized zones will require thicker casing in that immediate area. Any casing strings that must fit within this string must then be smaller, but must still accommodate the downhole equipment. Finally, the driller is encouraged to keep the hole size to a minimum; as size increases, so does cost and waste.

Figure 10: Cross Section of a Cased Well



Source: EPA, 1992.

Drilling Infrastructure

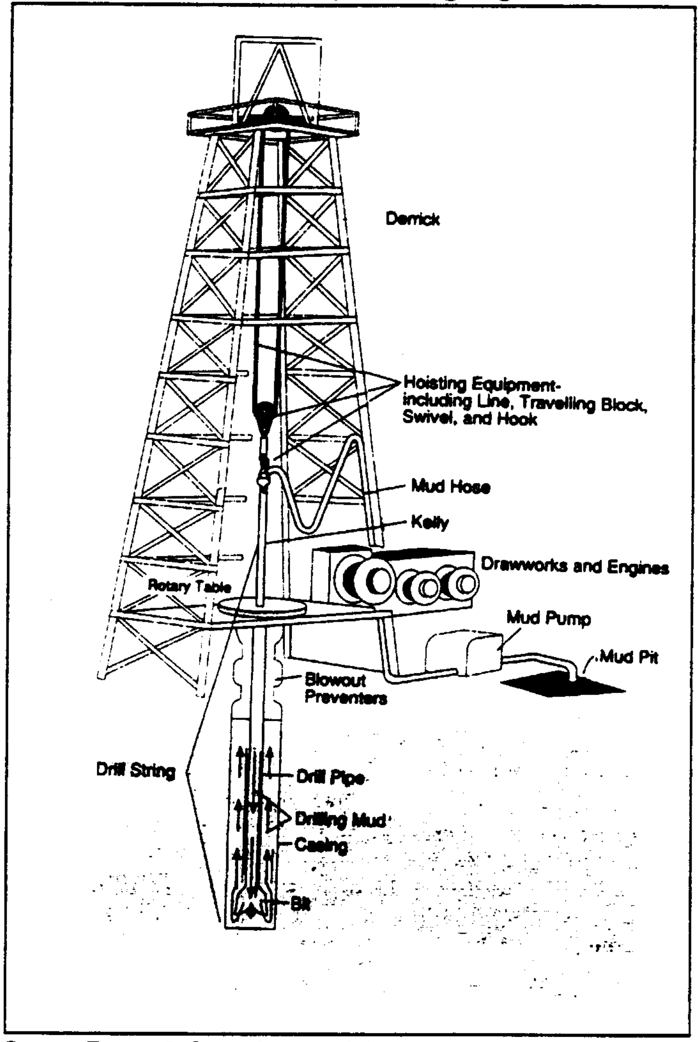
In addition to the well and its accouterments, infrastructure including construction and equipment is necessary at the surface. Roads and a pad are built at onshore sites; a ship, floating structure, or a fixed platform is needed for offshore operations. In addition, devices are needed to lift and lower the drilling equipment, filter rock cuttings from the drilling fluid, and store excess fluid and waste. The following sections describe the equipment required for onshore and offshore sites, respectively.

<u>Onshore Drilling</u>
Because the majority of onshore drilling sites are accessed by road, the equipment is geared toward mobility. First, an access road is built. In many locations the building of an access road is not difficult, but some areas present complications. On the North Slope of Alaska, for example, building a road that does not melt the permafrost can be both challenging and expensive. Board roads are used in some locations where soil conditions are not stable. Next, a footing for the equipment, usually gravel, is created in

areas where the ground may be either unstable or subject to freeze/thaw cycles. Finally, the drilling rig is brought in. For shallow wells, the drill rig may be self-contained on a single truck; for deeper wells, the rig may be brought to the site in several pieces and assembled at the site.

A basic arrangement of the actual drilling equipment, or *rig*, is shown in Figure 11. The derrick (sometimes referred to as the mast) is the centerpiece of the operation, and is the frame from which the drill string is lifted, lowered, and turned. The hoisting equipment, kelly, and drill pipe connect the bit to the derrick. The drawworks and engines next to the derrick lift and drive the drill string, by turning the rotary table. The drilling mud is circulated through the wellbore via the mud hose (also called a gooseneck), down through the rotary hose (not shown), kelly, and drillpipe, out nozzles in the drill bit, and back up to the surface between the drill string and the wellbore. The mud is pumped by the mud pump, and is stored in the mud (or reserve) pit or in mud tanks. Finally, blowout preventers, which are described later in this section, are installed as a safety measure to prevent the drill pipe and subsurface fluids from being blown out of the hole if a high-pressure formation is encountered during drilling. Rigs will often have much more equipment, including a shale shaker which separates rock cuttings, a desander and desilter, which remove smaller particles, and a vacuum degasser, which removes entrained gas (Berger and Anderson, 1992).

Figure 11: Typical Rotary Drilling Rig



Source: Energy Information Administration, Department of Energy, 1991.

Offshore Drilling

For offshore sites, selecting the type of drilling rig needed is very important. Two primary considerations in rig selection are: (1) the size of the rig needed for the depth drilled, and (2) the depth of the water. Exploratory wells (called wildcat wells) may be located far from established oil and natural gas fields, and the rig must be transported over a significant distance. Mobility is therefore a primary concern in these situations. The depth of water at the drilling site is also important. If the water is fairly shallow, a ground-supported rig may be used. If the water is deep (typically over 400 feet), a floating rig may be necessary. The following is a description of the significant offshore rig types:

R0076642

Drillships are a popular choice for drilling in deep water, because they are the most mobile of the rig types and have a large capacity for drill strings, casing, and similar supplies. A drillship has a standard ship hull, with the derrick extending from its center. The ship is kept in place by anchors or by dynamic positioning, a system in which propellers on each side of the ship are coordinated to keep the ship in the same location despite wind, currents, and the torsion caused by drill activities.

Semi-submersible drilling rigs are another option at deep water sites. The rig is usually a rectangular structure that holds the drilling equipment, with ballast containers underneath. These containers can be filled with air to float the rig when moving it. The rig is held in place by anchors or dynamic positioning. The semi-submersible rig is more stable than a drillship, but it is also more cumbersome to move from site to site.

Jack-up rigs float and are very mobile, but rest on the sea floor when drilling. For this reason, they are used in relatively shallow water (i.e., under 400 feet). The rig is towed into place floating, and legs, previously raised for transportation, are lowered to the ocean bottom so that the rig is raised above the water and supported on the ocean floor. The legs may be raised and lowered independently to compensate for an uneven sea floor. In an alternative footing method, mat support, the legs are attached to a mat on the sea floor; this mat distributes the weight over a larger area and minimizes the risk of the rig sinking into the soft ocean floor.

Fixed structures are commonly used after exploratory or developmental drilling prove a site has economically recoverable hydrocarbons. In these cases, offshore drilling rigs are mounted onto the production platform, which are securely pinned to the sea floor by concrete, steel, or tension legs. Tension legs are hollow steel tendons that allow no vertical movement, but some horizontal movement. They are the largest and most complex offshore structures and can be used in water in depths of over 500 feet (usually less than 1,000 feet). Platforms are very stable and can withstand waves greater than 60 feet high, and winds in excess of 90 knots. Assembling a fixed platform is a sizeable investment; some platforms have been reported to cost over $1 billion (Berger and Anderson, 1992). For this reason, multiple wells are usually drilled at outward angles from a single platform. The centralizing of pumps and separation equipment also make this a convenient arrangement for production (Kennedy, 1983).

<u>Lake and Wetland Drilling</u>

Inland regions of water often require additional engineering techniques and special adaptations other than the onshore and offshore practices mentioned above. In places of deeper and more open water, barge rigs may be used for drilling. In shallow areas or wetlands, stationary rigs can be constructed or the area can be backfilled and drilled with a land-based rig. Canals may also be dredged to bring in floating or submergible drilling rigs. It is common while drilling in wetlands to use the directional drilling technique in order to disrupt as little of the wetland as possible while developing a field. Often supplies and equipment must be transported by helicopter, or dredging is required for access by barge rigs. Regardless of the approach used, these areas often pose challenges for erecting the rig and transporting materials and personnel to and from the site, and involves compliance with Clean Water Act wetlands regulations (See Section VI.B for additional information) (Kennedy, 1983, and EPA, 1995).

Well Completion

When drilling has been completed, several steps may be needed before production begins. First, testing is performed to verify whether the hydrocarbon-bearing formations are capable of producing enough hydrocarbons to warrant well completion and production. As many as three types of tests may be performed before the final (production) string of casing is installed. These tests are coring, wireline logging, and drill stem testing.

Coring is typically performed only in exploratory wells. and not in fields where several wells have already been drilled. A special drill removes an intact sample, or *core*, of rock at the depth where oil or gas is most likely to be. The core can be as short as 15 feet or as long as 90 feet. Special side-wall coring techniques may be employed in some wells. Unlike the more indirect testing methods described below, a core allows a geologist to observe the rock type directly, and measure its *porosity*, or the volume of fluid-occupying space relative to the volume of rock. and *permeability*, the ease with which fluids can flow through a porous rock.

Wireline logging refers to the recording of acoustical, electrical resistivity, and other geophysical measurements within a wellbore. These measurements provide detailed information on the geologic formations encountered by the well, and augment the seismic data recorded prior to the well drilling and the mud log for that well. These data often help to determine more precisely the depth at which oil and gas could be produced. A logging of electrical resistivity takes advantage of the fact that some compounds are better insulators of electrical charge than others. For example, oil, gas, and consolidated rock resist electrical current better than water and unconsolidated rock. Additional tests may be used; radioactivity logs can differentiate between types of rock, and neutron logs can measure the amount of liquid in the formation (but not differentiate between oil and water). Logging is performed on nearly all wells, and multiple forms of logging may be used in conjunction with each other to attain a more complete analysis. For example, a neutron log will indicate the amount of liquid in a formation.

and a resistivity log may help to determine what percentage of that liquid is oil. Certain types of logs may be conducted during drilling with a special tool located on the drillstring above the bit.

Drill stem testing may be the most important and definitive test. Equipment attached to the bottom of a drill string traps a sample of formation fluid. Measuring the pressure at which the fluid enters the chamber and the pressure required to expel that fluid back into the formation yields an estimate of the flow rate of formation fluid to be expected during production. If the flow rate is expected to be too low, procedures such as stimulation (see below) may be required to increase the flow before production equipment is installed.

Perforation

When the production casing is cemented in the wellbore, the casing is sealed between the casing and the walls of the well. For formation fluid (oil, gas, and water) to enter the well, the casing must be perforated. The depth of the producing zone is determined by analyzing the logging data; small, directed explosive charges are detonated at this depth, thereby perforating the casing, cement, and formation. The result is that formation fluid enters the well, yet the rest of the well's casing remains intact.

Stimulation

Some formations may have a large amount of oil as indicated by coring and logging, but may have a poor flow rate. This may be because the production zone is not have sufficient permeability, or because the formation was damaged or clogged during drilling operations. In these cases, pores are opened in the formation to allow fluid to flow more easily into the well. The hydraulic fracturing method involves introducing liquid at high pressure into the formation, thereby causing the formation to crack. Sand or a similar porous substance is then emplaced into the cracks to prop the fractures open. Another method, acidizing, involves pumping acid, most frequently hydrochloric acid, to the formation, which dissolves soluble material so that pores open and fluid flows more quickly into the well. Both fracturing and acidizing may be performed simultaneously if desired, in an acid fracture treatment. Stimulation may be performed during well completion, or later during maintenance, or *workover*, operations, if the oil-carrying channels become clogged with time (EPA, 1992).

Production equipment installation

When drilling, casing, and testing operations are completed, the drilling rig is removed and the production rig is installed. In most cases, tubing is installed in the well which carries the liquids and gas to the surface. At the surface, a series of valves, collectively called the Christmas tree because of its appearance, is installed to control the flow of fluid from the well. Pumps are added if the formation pressure is not sufficient to force the formation fluid to the surface. Different types of pumps are available; the most common is the rod pump. The rod pump is suspended on a string of rods from a pumping unit, and the prime mover for pumping units can be an electric motor, or a gas engine. Equipment is usually installed onsite to separate natural gas and liquid phases of the production and remove impurities. Finally, a pipeline connection or storage container (tank) is connected to the well to facilitate transport or store the product. In the case of natural gas, which cannot be stored easily, a pipeline connection is necessary before the well can be placed on production.

Although the practice is becoming less common, one or more pits may be constructed for onshore facilities. These may include a skimming pit, which reclaims residual oil removed with water that has been removed from the product stream; a sediment pit, which stores solids that have settled out in storage tanks; or an evaporation or percolation pit, which disposes of produced water (EPA, 1992).

III.A.3. Petroleum Production

The major activities of petroleum production are bringing the fluid to the surface, separating the liquid and gas components, and removing impurities. Frequently, oil and natural gas are produced from the same reservoir. As wells deplete the reservoirs into which they are drilled, the gas to oil ratio increases (as well as the ratio of water to hydrocarbons). This increase of gas over oil occurs because natural gas usually is in the top of the oil formation, while the well usually is drilled into the bottom portion to recover most of the liquid. Although the following discussion is geared toward wells producing both oil and gas, the majority of the discussion also applies to wells producing exclusively one or the other.

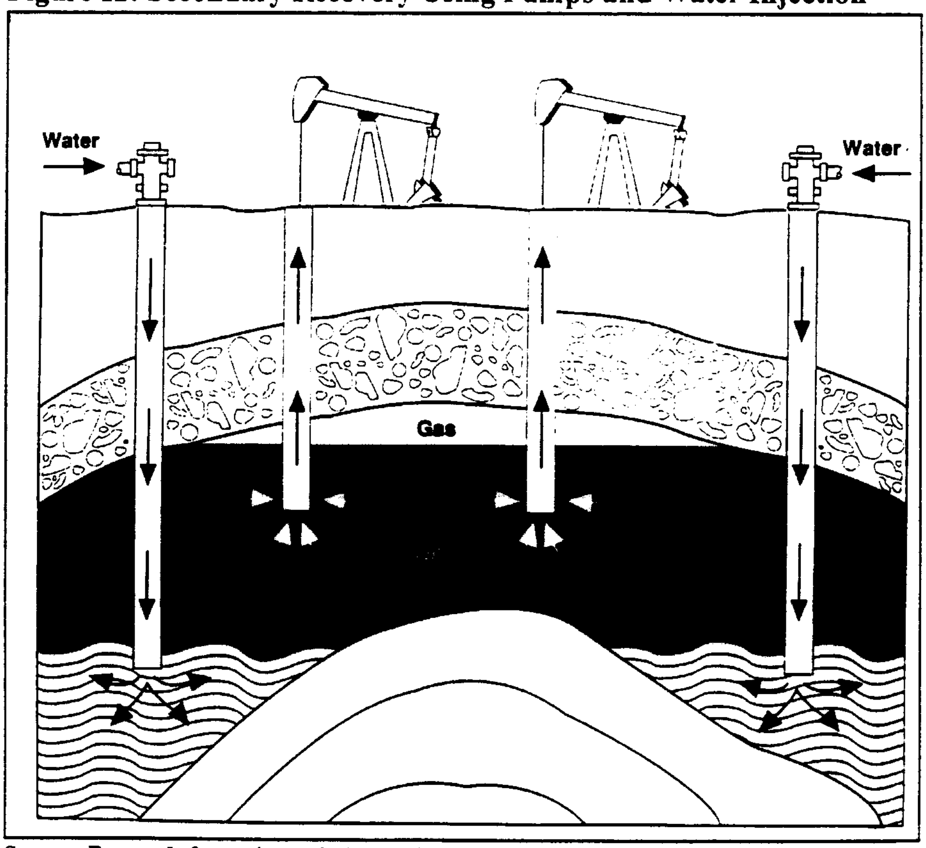
Primary Production

Primary recovery is the first stage of hydrocarbon production, and natural reservoir pressure is often used to recover oil. When natural pressure is not sufficiently capable of forcing oil to the surface, artificial lift equipment is then employed. This includes various types of pumps, gas lift valves, and may occasionally include oil stimulation. When pumping is employed, motors may be used at the surface or inside the wellbore to assist in lifting the fluid to the surface. Primary production accounts for less than 25 percent of the original oil in place.

Secondary Recovery

Secondary recovery enhances the recovery of liquid hydrocarbons by repressurizing the reservoir and reestablishing or supporting the natural water drive. Usually water which is produced with the oil is reinjected, but other sources of water may also be used. This type of secondary recovery is generally called a "waterflood" (See Figure 12). Produced water injection for enhanced recovery of crude oil and natural gas is recognized as a form of recycling of this waste. Furthermore, produced water is more commonly injected for the purpose of secondary recovery than in an injection well that is only used for disposal (in Texas, approximately 61 percent of injected produced water is for enhanced recovery) (Texas Railroad Commission, 1999). This procedure is described further in Section III.C., Management of Wastestreams. Gas is injected to enhance gas cap drive in some reservoirs.

Figure 12: Secondary Recovery Using Pumps and Water Injection



Source: Energy Information Administration, Department of Energy, 1991.

R0076647

Tertiary Recovery

A final method for removing the last extractable oil and gas is tertiary recovery. In contrast to primary and secondary recovery techniques, tertiary recovery involves the addition of materials not normally found in the reservoir (Lake, 1989). These methods are often expensive and energy-intensive (Sittig, 1978). In most cases, a substance is injected into the reservoir, mobilizes the oil or gas, and is removed with the product. Examples include:

- Thermal recovery, in which the reservoir fluid is heated either with the injection of steam or by controlled burning in the reservoir, which makes the fluid less viscous and more conducive to flow;
- Miscible injection, in which an oil-miscible fluid, such as carbon dioxide or an alcohol, is injected to reduce the oil density and cause it to rise to the surface more easily;
- Surfactants, which essentially wash the oil from the reservoir; and
- Microbial enhanced recovery, in which special organic-digesting microbes are injected along with oxygen into the formation to digest heavy oil and asphalt, thereby allowing lighter oil to flow (Lake, 1989; EPA, 1992)

Crude Oil Separation

When the formation fluid is brought to the surface, it may contain a spectrum of substances including natural gas, water, sand, silt, and any additives used to enhance extraction. The general order of separation with respect to oil is the following: the separation of gaseous components, the removal of solids and water, and the breaking up of oil-water emulsions. (The conditioning of the natural gas that is removed in the first step will be discussed in the next subsection.)

The removal of gaseous components primarily is intended to remove natural gas from the liquid; however, gaseous contaminants such as hydrogen sulfide (H_2S) also may be produced in some fields during this process. The gases are removed by passing the pressurized fluid through one or two decreasing pressure chambers; less and less gas will remain dissolved in the solution as the pressure is lowered.

The liquids and solids that remain are usually a complex mix of water, oil, and sand. Water and oil are generally immiscible; however, the extraction process is usually very turbulent and may cause the water and oil to form an emulsion, in which the oil forms tiny droplets in the water (or vice versa). Fluid separation often produces a layer of sand, a layer of relatively oil-free water, a layer of emulsion, and a (small) layer of relatively pure oil. The free water and sand, or basic sediment and water (BS&W) are generally removed by a process called free water knockout, in which the BS&W are removed primarily by gravity. Finally, emulsions are broken by heating the fluid in a heater-treater to a temperature of 100-160 degrees fahrenheit, or by treating it with emulsion-breaking chemicals (Arnold and Stewart, 1998). Following the emulsion breaking, the oil is about 98 percent pure, which is sufficient for storage or transportation to the refinery (Sittig, 1978).

Natural Gas Conditioning

Natural gas conditioning is the process of removing impurities from the gas stream so that it is of high enough quality to pass through transportation systems. It should be noted that conditioning is not always required; natural gas from some formations emerges from the well sufficiently pure that it can pass directly to the pipeline. As the natural gas is separated from the liquid components, it may contain impurities that pose potential hazards or problems. The most significant is hydrogen sulfide (H_2S), which may or may not be contained in natural gas. Hydrogen sulfide is toxic (and potentially fatal at certain concentrations) to humans and corrosive for pipes; it is therefore desirable to remove it as soon as possible in the conditioning process. Another concern is that posed by water vapor. At high pressures, water can react with components in the gas to form gas hydrates, which are solids that can clog pipes, valves, and gauges (Manning and Thompson, 1991). Nitrogen and other gases may also be mixed with the natural gas (methane) in the subsurface. These other gases must be separated from the methane prior to sale. At cold temperatures the water can freeze, also clogging pipes, valves, and gauges. High vapor pressure hydrocarbons that are found to be liquids at surface temperature and pressure (benzene, toluene, ethylbenzene, and xylene, or BTEX) are removed and processed separately. Two significant natural gas conditioning processes are dehydration and sweetening.

Dehydration is performed to remove water from the gas stream. Three main approaches toward dehydration are the use of a liquid or solid desiccant, and refrigeration. When using a liquid desiccant, the gas is exposed to a glycol that absorbs the water. The water can be evaporated from the glycol by a process called heat regeneration, and the glycol can then be reused. Solid desiccants, often materials called molecular sieves, are crystals with high surface areas that attract the water molecules. The solids can be regenerated simply by heating them above the boiling point of water. Finally, particularly for gas extracted from deep, hot wells, simply cooling the gas to a temperature below the condensation point of water can remove enough water to transport the gas. Of the three approaches mentioned above, glycol dehydration is the most common when processing occurs in the field (at or near the well). At natural gas plants, solid desiccants are most commonly used (Smith, 1999).

Sweetening is the procedure in which H_2S and sometimes CO_2 are removed from the gas stream. The most common method is amine treatment. In this process, the gas stream is exposed to an amine solution, which will react with the H_2S and separate them from the natural gas. The contaminant gas solution is then heated, thereby separating the gases and regenerating the amine. The sulfur gas may be disposed of by flaring, incinerating, or when a market exists, sending it to a sulfur-recovery facility to generate elemental sulfur as a salable product. Another method of sweetening involves the use of iron sponge, which reacts with H_2S to form iron sulfide and later is oxidized, then buried or incinerated (EPA, 1992).

III.A.4. Maintenance

Production wells periodically require significant maintenance sessions, called *workovers*. During a workover, several tasks may be undertaken: repairing leaks in the casing or tubing, replacing motors or other downhole equipment, stimulating the well, perforating a different section of casing to produce from a different formation in the well, and painting and cleaning the equipment. The procedure often requires bringing in a rig for the downhole work. This rig can be smaller than those used for initially drilling a well.

Two procedures performed to improve the flow of fluid during workovers are removing accumulated salts (called *scale*) and paraffin, and treating production tubing, gathering lines, and valves for corrosion with corrosion-prevention compounds. As fluids are withdrawn from the formation, the salts that are dissolved in the produced water precipitate out of solution as the solution approaches the surface and cools. The resulting scale buildup can significantly reduce the flow of fluid through the tubing, gathering lines, and valves. Examples of scale removal chemicals are hydrochloric and hydrofluoric acids, organic acids, and phosphates (EPA, 1994). These solvents are added to the bottom of the wellbore and pumped through the tubing through which extracted fluid passes. In a similar fashion, corrosion inhibitors may be passed through the system to mitigate and prevent the effects of acidic components of the formation fluid, such as H_2S and CO_2. These corrosion inhibitors, such as ammonium bisulfite or several forms of zinc, may serve to neutralize acid or form a corrosion-resistant coating along the production tubing and gathering lines. Corrosion control activities can be continuous, not just at workover.

III.A.5. Well Shut-in/Well Abandonment

Production may be stopped for several reasons. If it is a temporary stoppage, the well is shut-in. If the closure is to be permanent, the well is either converted to a UIC Class II injection well, or it is plugged and abandoned.

A temporary shut-in is an option when the conditions causing the interruption in production are anticipated to be short-term. Examples include situations when the well may be awaiting a workover crew or a connection to a pipeline, or there may be a (temporary) lack of a market (Williams and Meyers, 1997). A well is shut in by closing the valves on the Christmas tree. Depending on the duration, the stoppage may be called a temporary abandonment, and regulatory approval and testing, including a mechanical integrity test (MIT), may be required in order to be idle (IOGCC, 1996). It is much more desirable to shut-in a well rather than plug it if production is still viable, because once the well is permanently plugged and abandoned, it is highly impractical to re-access the remaining oil in the reservoir.

If the well is part of a production field with many nearby wells still in production, the well may be converted to a UIC Class II injection well, which is regulated under the Safe Drinking Water Act (see Section VI.B, Sector-Specific Requirements for more information). Such a well can be used either for disposal of the produced water from these other wells, or may be part of a coordinated Enhanced Oil Recovery (EOR) effort in the field.

The final option is to plug and abandon the well. The goal of this procedure is to prevent fluid migration within the wellbore, which could contaminate aquifers or surface water. Oil and gas producing states all have specific regulations governing the plugging and abandonment of wells (see Section VI.B.4., State Regulations). When a well is plugged, the downhole equipment is removed and the perforated parts of the wellbore are cleaned of fill, scale and other debris. A minimum of three cement plugs are then placed, each of which are 100 to 200 feet long. The first is pumped into the perforated (production) zone of the well, in order to prevent the inflow of fluid. A second is placed in the middle of the wellbore. A third plug is placed within a couple hundred feet of the surface. Additional plugs may be placed anywhere within the wellbore when necessary. Fluid with an appropriate density is placed between the cement plugs in order to maintain adequate pressure. During this process, the plugs are tested to verify plug placement and integrity (Fields and Martin, 1998). Finally, the casing is cut off below the surface, capped with a steel plate welded to the casing, and at onshore sites, surface reclamation is undertaken to restore natural soil consistency and plant cover (EPA, 1992).

Problems are sometimes encountered with wells that have stopped production, yet neither have government approval nor have been plugged. These are generally called idle wells, or when the owners are not known or are insolvent, are called orphan wells. Please see Section III.B for the possible environmental impacts of such wells.

Offshore Platform Decommissioning
For offshore, the structure itself must be decommissioned in addition to plugging the well. Several options exist:

- Complete removal of the structure and disposing of the structure onshore
- Removing the structure and placing it in an approved location in the ocean
- Reuse of the structure elsewhere (National Research Council, 1996).

The method used will vary with the type of structure and water depth, but the most common approach is the complete removal of the structure, with removal at a minimum of 15 feet below the mudline (seafloor). Other approaches are less expensive and less intrusive to the existing environment, but can be more dangerous for commercial ships, military submarines, fishing trawlers, and recreational boaters. In Texas and Louisiana, however, it may be possible to participate in the states' "rigs-to-reefs" programs, which under the National Fishing Enhancement Act of 1984 seek to convert offshore structures to permanent artificial reefs (MMS, 1999).

When removing the structure, the most common approach is to sever the leg piles with explosives. Explosives must be placed at least five feet below the mud line (sea floor). Explosives are less expensive and are less risky to divers than alternatives such as manual or mechanical cutting, but concern has been raised about the use of explosives and their effect on marine life (National Research Council, 1996).

III.A.6. Spill and Blowout Mitigation

Accidental releases at oil and gas production facilities may come in two forms: spills or blowouts. Oil spills (usually consisting of crude oil or condensate) may come from several sources at production sites (and in some cases at drilling sites): leaking tanks, during transfers, or from leaking flowlines, valves, joints, or gauges. Other spills of oil have occurred such as diesel from drilling operations, oily drilling muds while being offloaded, and production chemicals (MMS, 1998). Spills are the most common type of accident and are often small in quantity.

Well blowouts are rare, but can be quite serious. They are most likely to occur during drilling and workovers, but can occur during any phase of well development including production operations. When the drill encounters an unusually pressurized zone or when equipment is being removed from the hole, the pressure exerted by the formation may become considerably higher than that exerted by the drilling or workover fluid. When this happens, the formation fluid and drilling or workover fluid may rise uncontrollably through the well to the surface. Downhole equipment may also be thrust to the surface. Especially if there is a significant quantity of associated natural gas, the fluid may ignite from an engine spark or other source of flame. Blowouts have been known to completely destroy rigs and kill nearby workers. Some blowouts can be controlled in a matter of days, but some -- particularly offshore -- may take months to cap and control (Kennedy, 1983).

Drilled wells and many workover wells are equipped with a blowout preventer. These blowout preventers (BOPs) are hydraulically operated, and serve to close off the drill pipe. BOPs can be operated manually, or can be automatically triggered. Most rigs have regular blowout drills and training sessions so that workers can operate the BOPs and escape as safely as possible.

Should a spill occur despite precautions, established responses should be undertaken. If the facility is subject to Spill Prevention Control and Countermeasure (SPCC) regulation (see Section VI.B for additional information), the facility will be equipped with secondary containment and diversionary structures to prevent the spill from reaching drains, ditches, rivers, and navigable waters. These structures may be berms, retention ponds, absorbent material, weirs, booms, or other barriers or equivalent preventive systems. Should these secondary containment devices not be adequate, the response will be different for onshore and offshore spills (EPA, 1999). In both cases, the goals are to stop the flow of oil, recover as much as possible of the material as a salable product, then minimize the impact on navigable waterways or groundwater.

<u>Onshore Spills</u>

For onshore spills, concern is for both surface runoff to streams, and for seepage into groundwater. The first considerations are to stop the source of the leakage and to contain the spill. Containment may either be achieved with pre-existing structures, or by using bulldozers at the time of response (Blaikley, 1979). Pooled oil would then be collected, pumped out, and whenever possible, processed for sale. When treating the contaminated soil, the remediation approach taken may vary considerably depending on the porosity of the soil and composition of the spilled fluid. If the spill has permeated less than about 6-10 inches of soil, bioremediation may be the most appropriate approach. With bioremediation, hydrocarbon-digesting microbes found naturally in soil are enhanced with fertilizers and moisture to degrade the material. The site would be tilled periodically and watered to maintain proper amounts of air and moisture. Should the temperature at the site be too cold or should the spill be too deep for bioremediation to be fully effective, approaches such as composting, or soil excavation with landspreading or landfilling, may be used either exclusively or in combination (Deuel and Holliday, 1997). Another option in remote locations or in situations when other options have not been successful is in-situ burning. In these situations, primarily when there is little surrounding vegetation, calm winds, and difficulty in transporting the equipment required for other methods, the oil is concentrated as much as possible and ignited by any of a variety of methods (Zengel, et al., 1998; Fingas, 1998). Application of in situ burning is still being refined.

Offshore Spills

The conditions for an offshore spill cleanup can vary substantially; from deep-water to coastal, from calm water to very choppy seas. As with onshore spills, initial priorities are to contain spilled oil and prevent further leakage. The oil is usually contained by booms, or floating devices that block the movement of surface oil. The booms may then be moved to concentrate the oil, at which point skimmers collect the oil. Booms may also be placed along a shoreline to minimize the amount of oil that reaches shore. For the oil that cannot be collected in this fashion, other approaches are used to minimize environmental impact, including sorbents, dispersants, or oil-digesting bacteria (EPA, 1993). In-situ burning also may be an option for offshore spills. This option may be best suited to arctic conditions, where cold temperatures keep the oil relatively concentrated and where ice may hinder the use of other methods. Depending on the thickness of the oil, the calmness of the seas, and other factors, the destruction rate can be over 90 percent (Fingas, 1998; Buist, 1998). This technique has not been widely used and is still considered experimental.

III.B. Raw Material Inputs and Pollution Outputs

This section describes the impacts that individual steps in the extraction process may have on adding contaminants to the environment. Relevant inputs and significant output wastes are presented, with outputs summarized in Table 2. The management techniques used to handle the wastes are discussed in Section III.C, and more information on the magnitude and qualities of the releases are found in Section IV.

Oil and gas extraction generates a substantial volume of byproducts and wastes that must be managed. Relatively small volumes of chemicals may be used as additives to facilitate drilling and alter the characteristics of the hydrocarbon flow. For example, acids may be used to increase rock permeability, or biocides may be added to wells to prevent the growth of harmful bacteria. The industry also contends with many naturally occurring chemical substances. Byproducts and wastes result from the separation of impurities found in the extracted hydrocarbons or from accidents when oil is spilled. In addition, most processes involving machinery will produce relatively small quantities of waste lubricating oils and emissions from fossil fuel combustion, and inhabited facilities will produce sanitary wastes. Finally, formation oil contamination may be present in the spent drilling fluids and cuttings.

Drilling

There are a number of possible environmental impacts from the wastes generated during the well drilling and completion/stimulation processes. In the drilling process, rock fragments (cuttings) are brought to the surface in the drilling fluid. These cuttings pose a problem both in the large volume produced and the muds that coat the cuttings as they are extracted. Oil-based fluids have the added stigma of having oil frequently coating the cuttings. The volume of rock cuttings produced from drilling is primarily a function of the depth of the well and the diameter of the wellbore. It has been estimated that between 0.2 barrels and 2.0 barrels (8.4 and 84.0 gallons) of total drilling waste are produced for each vertical foot drilled (EPA, 1987).

Drilling mud disposal generally becomes an issue at the end of the drilling process. However, sometimes drilling mud is disposed of during the drilling process when the mud viscosity or density needs to be changed to meet the demands of formation pressures. This can create special concerns for offshore operations where the disposal of a large volume of mud over a short period can create a mud blanket on the seafloor that can have an impact on benthic organisms. Industry is limited to using barite stock for the making of drilling mud, which passes 40 CFR 435 requirements (less than or equal to 1 ug/kg dry weight maximum mercury and 3 mg/kg dry weight maximum cadmium). The muds are combined, however, with dissolved and suspended contaminants including mercury, cadmium, arsenic and hydrocarbons (typically found in trace amounts). The additives listed in Section III.A may be found in waste mud, and components from the formation, such as hydrogen sulfide and natural gas, may also be dissolved in the mud. Rock cuttings from the formations overlying the target formation may contribute contaminants to the drilling mud such as arsenic or metals. Also rock cuttings create a large volume of waste and for water-based fluids the rock cuttings may be discharged to surface waters offshore. Oil-based mud will also contain diesel oil that must be disposed of properly, or more typically, conditioned for reuse. Oil-based muds and cuttings cannot be discharged to surface waters. Both oil-based and synthetic-based fluid are conditioned and reused, which reduces waste volume from drilling operations.

Drilling operations also produce air emissions, such as exhaust from diesel engines and turbines that power the drilling equipment. The air pollutants from these devices will be those traditionally associated with combustion sources, including nitrogen oxides, particulates, ozone, and carbon monoxide. Additionally, hydrogen sulfide may be released during the drilling process (EPA, 1992).

Some steps in the well completion process may produce waste. The most prominent is stimulation. Unused hydrochloric acid must be neutralized if acid stimulation is being used, and paraffins and any other dissolved materials brought to the surface from the formation must be disposed of as well. In addition, solid wastes such as waste cement and metal casing may remain from the casing process.

Production

The primary byproduct from the production process (and the dominant one on a volume basis in the industry) is produced water. Other wastes that may be generated during production include the residual wastes that remain after separation of the oil and natural gas.

Produced Water

The largest volume byproduct by far in the extraction process is water extracted with oil. In wells nearing the end of their productive lives, water can comprise 98 percent of the material brought to the surface (Wiedeman, 1996). The American Petroleum Institute estimates that over 15 billion barrels of water are produced annually. This is nearly eight barrels of water for every barrel of oil produced. Natural gas wells typically produce much lower volumes of water than oil wells, with the exception of certain types of gas resources such as coalbed methane or Devonian/Antrim shales (API, 1997).

Although many petroleum components are separated from the water easily, some components and impurities are water-soluble and difficult to remove. Some substances may be found in high concentrations, including chloride, sodium, calcium, magnesium and potassium. Others found are:

- Organic compounds: benzene, naphthalene, toluene, phenanthrene, bromodichloromethane, and pentachlorophenol;
- Inorganics: lead, arsenic, barium, antimony, sulfur, and zinc;
- Radionuclides: uranium, radon, and radium (EPA, 1992).

It should be noted that concentrations of these pollutants will vary considerably depending on the location of the well and the extent of treatment of the water. Geography can be a key factor in whether a substance may exist in produced water. For example, radionuclides are found only in some areas of the country.

The risks of water pollution due to produced water management differ for onshore and offshore operations, and are discussed separately.

Onshore operations, and coastal and shallow offshore areas, may pose a risk to the environment if produced water with high saline concentrations is not properly managed. The saline concentration of produced water varies widely. In some locations, the produced water can have salt concentrations of 200,000 mg/L (Stephenson, 1992). However, in some areas west of the 98th Meridian, produced water may contain low enough levels of salt that it may be used (upon meeting regulatory limits for oil and grease) for beneficial use for irrigation or livestock watering (EPA, 1992; Railroad Commission of Texas, 1999).

The discharge of produced water inappropriately onto soil can result in salinity levels too high to sustain plant growth. If introduced to a water supply, the water can be unusable for human consumption. The introduction of metals and organic compounds from produced water are also a concern. (See Section IV for more details on contaminants in produced water.) However, over 90 percent of onshore produced water is injected for enhanced recovery or disposal (Smith, 1999). This injection involves a closed system from the producing wellbore to the injection wellbore, so the potential for release to the soil is minimized.

Offshore operations may impact the area immediately surrounding the platform if produced water effluents are not properly treated and discharged. The concentration of metals, radionuclides, residual oily materials and high BOD in the produced water may be higher than the surrounding water. However, the impact is reduced significantly at greater distances from the well; research in the Gulf of Mexico has indicated that produced water can be diluted 100-fold within 100 meters of the discharge (Neff and Sauer, 1996).

Natural Gas Processing

Wastes are generated when natural gas undergoes dehydration and sweetening. For dehydration, triethylene glycol is the most common desiccant. Although glycol is reused, it becomes less effective over time and must be replaced periodically. Glycols are volatile and can be hazardous if inhaled as a vapor. At larger natural gas processing plants, the solid molecular sieves that are used also require periodic replacement.

The wastes from gas sweetening will vary depending on the method used. Possible wastes include spent amine solution, iron sponge, and elemental sulfur. When there is a market for sulfur, it is sold.

Air Emissions

There are several sources of air emissions in the production process. Leaking tubing, valves, tanks, or open pits will release volatile organic compounds (VOCs). When natural gas produced from the well is not sold or used on-site, it is usually flared, thereby releasing carbon monoxide, nitrogen oxides, and possible sulfur dioxide if the gas is sour (see Section III.C. for more information on flaring). Finally, production involves the use of machinery including pumps, heater-treaters, and motors which require fuel combustion. Emissions from these include nitrogen oxides, sulfur oxides, ozone, carbon monoxide, and particulates (EPA, 1992). Where electricity is available, electric-powered equipment may be used. Emissions from natural gas processing plants (SIC 1321) are larger than field production operations due to the greater scale and concentration of equipment. Even at gas plants most engines are powered by natural gas or electricity.

Other Wastes

The sand that is separated from produced water must be disposed of properly. Similar to the sand removed during the drilling process, this sand is often contaminated with oil and trace amounts of metals or other naturally occurring constituents.

Most oil and gas operations include tanks for the temporary storage of oil, natural gas liquids, and/or produced water. While stored, small solid particles that were entrained in the liquids can settle out, forming a sludge on the bottom of the tank. These "tank bottoms," or "basic sediment and water" (BS&W) wastes, may be periodically removed from the tank and disposed of. Some tanks may require cleaning a few times per year; others may require cleaning once every 10 years. The need for tank cleaning, and therefore the generation of these wastes, is dependent upon the characteristics of the fluids being handled and the operation. Because they are removed from hydrocarbon storage tanks, tank bottoms are likely to contain oil and smaller amounts of other constituents (see Section IV for an example of concentrations of contaminants in these sediments.)

Maintenance

The workover process requires many of the same inputs and produces similar outputs as the drilling process. In particular, workover fluid, which is similar to drilling fluid, is required to control downhole pressure. Also, emissions will result from the combustion of fuels to power the rig.

Workovers also use additional inputs and produce other pollutants, some of which are toxic. The compounds usually appear in the produced water when production resumes, or in the case of cleaning fluids, may be spilled from equipment at the surface.

Scale removal requires strong acids, such as hydrochloric or hydrofluoric acids. When carried to the surface in produced water, any acids not neutralized during use must be neutralized before being disposed, usually in a Class II injection well. Scale is primarily comprised of sodium, calcium, chloride and carbonate; however, trace contaminants such as barium, strontium, and radium may be present.

Also, corrosion inhibitors and stimulation compounds are flushed through the well. Corrosion-resistant compounds of concern include zinc carbonate and aluminum bisulfate. Stimulation may require acidic fluids.

In addition, painting- and cleaning-related wastes may be generated during workovers. Paint fumes and cleaning solvent vapor may produce gaseous emissions, paint and cleaning solvents with suspended oil and grease must be disposed of properly, and paint containers will require disposal as a solid.

Collectively, wastes produced by the industry other than drilling wastes and produced water are called associated wastes. The volume is usually small, about one barrel per well per year (DOE, 1993). Because associated wastes are those associated with chemical treatment or wells or produced fluids, post-treatment materials, and residual waste streams, they are more likely to have higher hydrocarbon or chemical constituent content than produced water or waste drilling fluids.

In 1985, API estimated that approximately 12 billion barrels of associated wastes were generated annually (Wakim, 1987). API estimates that in 1995, the annual volume of associated wastes is 22 millions barrels (API, 1997). The higher volume is attributed primarily to a difference in definitions between the two studies (i.e., the 1995 study includes wastes form gas plants that were not included in 1985). On a comparable basis, there has been only a slight increase in associated waste volumes over the past decade. This increase can be attributed primarily to aging wells requiring more stimulation or workover treatments to remain on production. Table 1 summarizes the types of associated wastes and their relative volume based on a 1985 API industry survey.

Table 1: Types of Associated Waste

Material	Process	Percent of Total Associated Waste Volume
Workover wastes (mud and other completion fluids, oil, chemicals, acid water, cement, sand)	Maintenance	34%
Produced sand, separator sludges	Production	21%
Other production fluid waste	Production	14%
Oily debris, filters, contaminated soils	All	12%
Cooling water, engine and other waste water	All	8%
Dehydration and sweetening unit wastes	Production	4%
Untreatable emulsions	Production	2%
Used solvents and cleaners	Maintenance	2%
Other production solid waste	Production	1%
Used lubricating or hydraulic oils	All	1%

Source: U.S. Department of Energy, 1993. (Based on a 1985 API survey)

Idle/Orphan Wells

Idle wells are wells that have ceased production (either temporarily or permanently) but have not been plugged. Generally the state regulatory agency knows the operator who is responsible for these wells, and in most states, wells require regulatory approval to be idle. However, a small percentage of these are orphan wells, for which no responsible party exists. This may be because the operator is unknown (in the case of wells drilled in the early part of the century) or because the operator has gone bankrupt and has no assets available.

Wells that have stopped production yet neither have state government approval nor have been plugged are uncommon. Approximately 134,000 of the nearly 2.7 million total wells drilled by 1995 in the United States are in this category (IOGCC, 1996). These wells may pose problems with respect to migrating reservoir fluid. With these wells, the mechanical integrity of the casing is not known, and therefore it may be possible for reservoir fluid to migrate to fresh water aquifers. In such cases, the primary contaminant would be saline formation water that could pollute fresh water aquifers and possibly surface waters.

It should be noted that not all of these wells will necessarily cause pollution; rather, the concern is that the risk posed by these wells is variable. Currently, most oil- and gas-producing states are handling the issue by prioritizing among these wells, and have established programs to plug dangerous orphan wells and clean up any contamination that may have already occurred. One way in which this prioritization is achieved is through area of review (AOR) studies that are required for the approval of new UIC wells. Under this requirement, the operator of the new well must study all active, idle and abandoned wells within an area (often a 1/4 mile radius) to determine whether they pose a risk of contamination (IOGCC, 1996).

Spills and Blowouts

Based on data from the U.S. Coast Guard and other sources, the American Petroleum Institute reported that in 1996, 1,276 onshore facilities reported spills of crude oil for a total of 131,000 gallons. This total would include spills from field operations, but also would include spills of crude oil at refineries, terminals, and other types of facilities. Spill volumes specifically for crude oil are not available. According to the Coast Guard, 78 percent of spills in 1996 were less than 10 gallons (API, 1998b).

Production facilities often have systems in place for handling larger accidents such as blowouts, and many onshore oil and gas operations must have a Spill Prevention Control and Countermeasures (SPCC) Plan in place for addressing spills. Under the CWA only spills above a certain threshold must be reported (see Section IV for more details on SPCC and CWA regulations). However, smaller spills appear to account for most reported crude oil releases. These are most likely to occur due to poor connections in filling or removing materials from tanks (Smith, 1999).

Offshore, the Marine Minerals Service collects data on oil spills. According to MMS, in 1995 there were 34 spills from production operations in the Gulf of Mexico, totaling 773 barrels. There was also one spill of one barrel of oil on the Pacific Coast (MMS, 1995).

In addition to oil spills, well blowouts can result in accidental releases of material. In a blowout, the pollutant can be produced water and oil, or drilling fluids and workover fluids, such that possible components of concern are salt, heavy metals, and oil. The produced water and oil mixture can be spread in a wide area around the rig possibly leaching through the soil to a fresh water aquifer or running off into nearby surface waters. Onshore, statistics on the number of blowouts annually are not available. Offshore, according to data from MMS, there was only one blowout in 1995, and 15 blowouts between 1991 and 1995. The total amount of oil spilled as a result of those blowouts was 100 barrels, all in 1992. It is assumed from the historical distribution that 14 percent of all blowouts could result in the spillage of crude oil or condensate, with 4 percent of the blowouts resulting in spills greater than 50 barrels. Since 1992, all blowouts have been controlled without any spills (MMS, 1995).

Accidental releases can also include air emissions. Crude oil contains organic compounds that may volatilize and be emitted before the spill can be cleaned up. In-situ burning of crude oil is one approach for cleaning up spills. Use of burning can result in emissions from the combustion, including particulates and carbon monoxide. Blowouts can result in the emission of methane (natural gas). If the well ignites, combustion outputs would be expected. In rare cases, process upsets at facilities that process sour natural gas could result in the release of hydrogen sulfide.

Table 2: Potential Material Outputs from Selected Oil and Gas Extraction Processes

Process	Air Emissions	Process Waste Water	Residual Wastes Generated
Well Development	fugitive natural gas, other volatile organic compounds (VOCs), Polyaromatic hydrocarbons (PAHs), carbon dioxide, carbon monoxide, hydrogen sulfide	drilling muds, organic acids, alkalis, diesel oil, crankcase oils, acidic stimulation fluids (hydrochloric and hydrofluoric acids)	drill cuttings (some oil-coated), drilling mud solids, weighting agents, dispersants, corrosion inhibitors, surfactants, flocculating agents, concrete, casing, paraffins
Production	fugitive natural gas, other VOCs, PAHs, carbon dioxide, carbon monoxide, hydrogen sulfide, fugitive BTEX (benzene, toluene, ethylbenzene, and xylene) from natural gas conditioning	produced water possibly containing heavy metals, radionuclides, dissolved solids, oxygen-demanding organic compounds, and high levels of salts. also may contain additives including biocides, lubricants, corrosion inhibitors. wastewater containing glycol, amines, salts, and untreatable emulsions	produced sand, elemental sulfur, spent catalysts, separator sludge, tank bottoms, used filters, sanitary wastes
Maintenance	volatile cleaning agents, paints, other VOCs, hydrochloric acid gas	completion fluid, wastewater containing well-cleaning solvents (detergents and degreasers), paint, stimulation agents	pipe scale, waste paints, paraffins, cement, sand
Abandoned Wells, Spills and Blowouts	fugitive natural gas and other VOCs, PAHs, particulate matter, sulfur compounds, carbon dioxide, carbon monoxide	escaping oil and brine	contaminated soils, sorbents

Sources: Sittig, 1978. EPA Office of Solid Waste, 1987.

III.C. Management of Wastestreams

The primary wastestreams are those associated with drilling wastes and produced water. As a result, most disposal options are oriented toward these two waste categories. The management of associated wastes and of gases is also briefly described.

Liquids

Underground Injection

Underground injection is the most common disposal method of produced water; over 90 percent of onshore produced water is disposed of through injection wells (API, 1997), but it is rare at offshore facilities. For disposal of produced water by underground injection, two options are available: to inject the water as a waste disposal method, or to use the produced water as part of a waterflooding effort for enhanced recovery. Water being disposed of typically is injected into known formations, such as a former producing formation. In a few Appalachian states, annular injection of produced water may be used, in which case the fluid is pumped into the space between tubing and casing (or uncased formation) within the well (EPA, 1992).

The second option, implemented especially in locations where formation pressure may be relatively low, is reinjecting produced water into the oil- and gas-producing formation. (See Figure 12 on page 29 for an illustration.) The volume of produced water used for enhanced recovery is approximately 57 percent of total produced water volumes (API, 1997). This method increases pressure in the formation to force oil toward the well and contributes to secondary recovery efforts. It requires that water be more thoroughly treated before injection; the water should be free of solids, bacteria, and oxygen, all of which could potentially contaminate the oil reservoir and, in the case of sulfur-reducing bacteria, could lead to increased hydrogen sulfide concentrations in the extracted oil. Please see Section VI.B, Sector-Specific Requirements for UIC regulations that apply to produced water underground injection.

Liquid wastes bought onshore may include produced water that fails NPDES toxicity requirements; water extracted from sludge; or treatment, workover, and completion fluids. At commercial waste treatment facilities liquid wastes are usually injected into disposal wells. As of February 1997, there are 94 disposal wells located in the Texas coastal zone and 17 in the Louisiana coastal zone. These wells could be used for disposal of OCS-generated liquid wastes (MMS, 1998).

Roadspreading

If the fluid has the characteristics of materials used for dust suppressants, road oils, deicing materials, or road compaction, the fluid may be used for roadspreading. In this procedure, water is applied to roads at approved rates, in order to prevent pooling or runoff and to minimize the risk of surface water or groundwater contamination. This practice may be subject to testing to ensure that the fluid is similar to the conventional road materials mentioned above, and also to ensure that the level of radioactive material is not above regulatory action levels (IOGCC, 1994). Roadspreading is declining as a disposal option, and accounts for less than 1 percent of produced water volumes (API, 1997).

Use of Produced Water for Irrigation

In areas west of the 98th meridian, produced water from onshore wells that are in the Agricultural and Wildlife Beneficial Use Subcategory may be used as a beneficial use with agriculture. In these cases, treated water that meets water quality standards may be released directly to agricultural canals for use in irrigation or livestock watering (EPA, 1992; Texas Railroad Commission, 1999). Beneficial use of produced water currently accounts for around 4 percent of onshore produced water volumes in the United States (API, 1997).

Evaporation or Percolation Pits

In this approach, produced water is placed in the pit and allowed to either evaporate to the air or percolate into the surrounding soil. These pits can only be used when the fluid will not adversely impact groundwater or surface water, and restrictions may be imposed on water salinity, hydrocarbon content, pH, and radionuclide content. This approach is declining because of potential environmental contamination of groundwater and the potential hazard posed to birds and waterfowl by residual oil in these open pits (IOGCC, 1994; Buckner, 1998). About 2 percent of produced water is currently disposed of using evaporation or percolation pits (API, 1997). Most of this volume is disposed of in percolation pits in arid portions of California.

Treat and Discharge

For this disposal method the water must meet standards for oil and grease content and pass a toxicity test prior to discharge. In 1997, 1 percent of onshore produced water was disposed of in this manner (API, 1997). Until recently, this method was also used at coastal facilities, but has been largely phased out since 1995. The only coastal area where discharge of produced water is currently allowed is Cook Inlet, Alaska.

Treatment and discharge is the primary method for disposing of produced water at offshore operations. Produced water discharges are not expected to take place at every platform or well. The trend in the Gulf of Mexico is for water treatment and separation of the well stream to occur only at designated locations. An industry survey of 1992 discharge monitoring reports submitted annually to USEPA (Shell Oil Company, 1994) found that only 29 percent of existing platforms contain water treatment systems and discharge their produced waters. As industry uses more sophisticated methods of developing shallow oil and gas fields and is required to conduct more complex treatment protocols, it is likely that operators will increasingly use central processing facilities (MMS, 1998).

Industry's projections (Deepstar, 1994) for deepwater are that the oil and gas produced in deepwater will most likely be piped from subsea completions through mixed line pipelines to large processing facilities primarily operating at the shelf break. These processing facilities will separate and process the production streams into oil, gas and water, and then discharge the treated water. The exception to this process would be whenever a floating production, storage and offloading system (FPSO) is chosen as the surface facility receiving oil and gas from subsea completions. An FPSO is a converted tanker used for a production and storage base, usually at a deepwater (greater than 400 meters) production site. These FPSO's, able to operate at any depth, would process the well stream prior to the transport of the products to shallower locations (MMS, 1998).

Table 3: Summary of 1995 Disposal Practices for Onshore Produced Water

Method	Percent of Onshore Produced Water
Injected for Enhanced Recovery	57%
Injection for Disposal	36%
Beneficial Use	4%
Evaporation and Percolation Ponds	2%
Treat and Discharge	1%
Roadspreading	<1%

Source: API, 1997.

Solids

The primary solid waste-generating process is drilling, and therefore the solid waste disposal processes are geared toward drilling waste. However, solid waste is also generated during production and maintenance. Production and maintenance wastes are usually transported offsite. Offshore, solids are often treated and discharged in accordance with Clean Water Act regulations.

In the Gulf of Mexico, offshore oil field wastes that are not discharged or disposed of onsite are brought onshore for disposal and taken to specifically designated commercial oil field waste disposal facilities. In Texas there are ten existing commercial oil field waste disposal facilities that receive all of the types of wastes that would come from the OCS operations (4 stationary treatment, 5 landfarms, and 1 commercial pit); in Louisiana there are seven facilities (5 land treatment, 1 incinerator, and 1 chemical stabilization facility); and in Alabama there are two landfarm/landtreatment facilities. Included in these numbers are one site in Texas and two sites in Louisiana that process naturally occurring radioactive material (NORM)-contaminated oil field wastes (MMS, 1998).

Reserve Pit

During drilling on land, a pit is usually constructed onsite to hold drill cuttings and extra drilling fluid. Depending on geology and hydrogeology, states might require reserve pits to be lined with geosynthetic or synthetic liners. Often the pit is intended only as a temporary holding vessel for drilling waste before being moved offsite for treatment and disposal; however, at some sites the reserve pit is used as the final disposal site. When used as a disposal method after drilling is completed, the liquid is removed (by suction or by evaporation if in a dry climate) and the solid remnants covered over with dirt. The liquids account for 62 percent of drilling waste by volume. Over two-thirds of the remaining drilling waste solids are disposed of by burying them onsite in the reserve pit (API, 1997).

Solidification

This is a modification of the reserve pit disposal method. When drilling is completed, a mixture of cement, flyash (from coal-fired utility boilers), and/or lime or cement kiln dust is added to the contents of the pit. The liquid in the pit does not necessarily need to be removed. The contents of the pit solidify into a concrete-like block, which immobilizes the heavy metal components. The process adds significantly to the bulk of the waste, but it prevents the mobilization of potential pollutants. In API's 1995 survey, less than 1 percent of drilling waste volumes were disposed of in this manner (API, 1997).

Landfarming or Landspreading

In this procedure, solids from the reserve pit (and potentially other solids from production) are broken up and thinly applied to soil, and tilled to mix the waste and soil. In theory, Volatile components evaporate off, metal ions bind to the clay, and heavy organic components are broken down by biological activity. State agencies do not use consistent terminology in referring to this process: some call it landfarming, others landspreading, and others use different terms. The disposal of solid wastes by spreading them on the land surface can occur either as a one-time application or in multiple applications. One-time application is most likely to be near the well site, and would most likely involve application of material from the reserve pit. Multiple applications of waste are often approved for centralized or commercial operations. In these cases, monitoring of soil constituents (e.g., pH, chlorides, and total hydrocarbons) is required by state agencies and once certain levels are reached, no more wastes may be applied on that site. In either one-time or multiple application operations, fertilizer may be added to enhance biodegradation of hydrocarbons. Land farming operations must be controlled to ensure that the hydrocarbons, salts and metals do not present a threat to groundwater or surface water, and that the hydrocarbon concentration does not inhibit biological activity. Approximately 10 percent of drilling waste solids are disposed of in landfarming operations (API, 1997; Smith, 1999).

Commercial Disposal
Offsite disposal of drilling wastes by commercial enterprises accounts for around 15 percent of drilling waste solids (API, 1997). This commercial disposal takes two formats. In major oil and gas producing areas of the country, dedicated facilities for managing exploration and production wastes exist. These facilities manage drilling waste and some associated waste streams using a range of processes from landfarming to slurry injection of solids to disposal in salt caverns. Drilling wastes from offshore that cannot be discharged (e.g., from oil-based muds) typically are barged to shore and disposed of in these commercial facilities. In areas of the country with less oil and gas activity, municipal or commercial landfills may accept drilling waste and certain other waste streams.

Reuse/Recycling
A growing share of drilling wastes are reused or recycled. It is currently estimated that around 10 percent of total drilling waste volume (solids and liquids) are reused or recycled. The liquids (mud) are reconditioned, with solids and other impurities removed, then used in the drilling of other wells. Because of the high cost of the base material, reuse of oil-based and synthetic-based muds is more common. Drilling waste is also used as landfill cover, roadbed construction, dike stabilization, and plugging and abandonment of other wells.

Associated Waste Disposal

Because associated wastes encompass such a diverse set of waste streams, generalizing about disposal options is difficult. What is appropriate for one stream may not be appropriate for another. Associated waste may be disposed of onsite or offsite. Some waste streams (e.g., waste solvents, unused acids, and painting wastes) are not unique to oil and gas exploration and production. These waste streams must be segregated from other wastes and managed the same as they would be at other industrial facilities. If these wastes exhibit hazardous characteristics they must be disposed of as RCRA hazardous wastes. (See Section VI.B. for more information on whether specific waste streams are exempt or non-exempt from RCRA hazardous waste requirements). Table 4 summarizes the general management of associated wastes across all waste streams.

Table 4: Management of Associated Wastes in 1995

Management Technique	Percent
Underground Injection	58%
Commercial Facility	9%
Evaporation	8%
Recycling/Beneficial Use	8%
Municipal or Commercial Facility	4%
Landspreading	4%
Roadspreading	3%
Crude Oil Reclaimer	2%
Incineration	2%
Other (including hazardous waste disposal)	3%

Source: API, 1997. Data are based on a survey that may not fully represent a few lower producing areas of the country.

Gases

Flaring

Although most gas emissions are minimized through prevention, flaring can be used to reduce the impact of gaseous releases that are unavoidable or are too small to warrant the cost of capture. Nearly all drilling rigs and production wells are equipped with a vent and flare to release unusual pressure, and some wells that produce only a small amount of natural gas will flare it when there is no on-site use for the gas (e.g., to power engines) and no pipeline nearby to transport the gas to market. Since natural gas has economic value, flaring it is usually a last resort. Approval of state regulatory agencies is required prior to flaring.

When a gas is flared, it passes through the vent away from the well, and is burned in the presence of a pilot light. Although it is preferable to prevent the emission in the first place, flaring has benefits over simple venting of unburned material. First, by burning the gas, the health and safety risks in the vicinity of the well posed by combustible and poisonous gases like methane and hydrogen sulfide are reduced. Second, flaring reduces the potential contribution to climate change; methane is a much more potent greenhouse gas than carbon dioxide, the primary product of the combustion.

V. WASTE RELEASE PROFILE

This section provides estimates and reported quantities of wastes released from oil and gas extraction industries. Unlike facilities covered by SIC codes 20-39 (manufacturing facilities), oil and gas extraction facilities are not required by the Emergency Planning and Community Right-to-Know Act to report to the Toxic Release Inventory (TRI). Because TRI reporting is not required for the oil and gas extraction industry, other sources of waste release data have been identified for this profile. EPA is considering expanding TRI reporting requirements in the future which may affect industries that are currently not required to report to TRI, such as oil and gas extraction.

Much of the published data on wastes generated at oil and gas extraction facilities is specific to the various oil producing regions of the United States, including onshore and offshore sites. In 1996, EPA developed effluent limitation guidelines for the Coastal Subcategory of the Oil and Gas Extraction Point Source Category. Much of the information presented below was collected as supporting technical information for the guidelines. Additional data reflecting the releases of onshore wells were provided by the Pennsylvania Department of Environmental Protection.

IV.A. Available Data on Produced Water

Produced water is the largest volume waste generated in oil and gas extraction operations. In 1985, the American Petroleum Institute (API) estimated that 20.8 billion barrels of produced water were generated per year by the U.S. onshore oil and gas production industry (Souders, 1998). API conducted an updated survey of the industry in 1995. Based on preliminary results, API estimates current produced water volumes at over 15 billion barrels annually (API, 1997). The decline can be attributed primarily to a 32 percent decrease in oil production over the decade. While natural gas production has risen, natural gas wells produce much less water than do oil wells.

The concentration of contaminants in produced water varies from region to region and depends on the depth of the production zone and the age of the well, among other factors. Since most contaminants found in produced water are naturally occurring, they will vary based on what is present in the subsurface at a particular location. Three tables are presented below that indicate both the relative concentrations of pollutants and the variation that can occur among samples from different locations and product streams. Table 5 presents the results of analyses performed on produced water from **-XX-** Venango County, Pennsylvania. Table 7 presents data from natural gas wells in the Devonian formation of Pennsylvania.

Table 5: Produced Water Effluent Concentrations – Gulf of Mexico (Coastal Waters)

Pollutant	Settling Effluent	Improved Gas Flotation Effluent
	Concentrations (Micrograms/L)	
Oil and Grease	26,600	23,500
Total Suspended Solids (TSS)	141,000	30,000
Priority Organic Pollutants		
2,4-Dimethylphenol	148	148
Benzene	5,200	1,226
Ethylbenzene	110	62.18
Naphthalene	184	92.02
Phenol	723	536
Toluene	4,310	827.80
Priority Metal Pollutants		
Cadmium	31.50	14.47
Chromium	180.00	180.00
Copper	236.00	236.00
Lead	726.00	124.86
Nickel	151.00	151.00
Silver	359.00	359.00
Zinc	462.00	133.85
Other Non-Conventional Pollutants		
Aluminum	1,410	49.93
Ammonia	41,900	41,900
Barium	52,800	35,561
Benzoic acid	5,360	5,360
Boron	22,800	16,473
Calcium	2,490,000	2,490,000
Chlorides	57,400,000	57,400,000
Cobalt	117	117
Hexanoic acid	1,110	1,110
2-Hexanone	34.50	34.50
Iron	17,000	3,146
Magnesium	601,000	601,000
Manganese	1,680	74.16
2-Methylnapthalene	78	77.70
Molybdenum	121	121
n-Decane	152	152
n-Dodecane	288	288
n-Eicosane	78.80	78.80
n-Hexadecane	316	316
n-Octadecane	78.80	78.80
n-Tetradecane	119	119
o-Cresol	152	152
p-Cresol	164	164
Strontium	287,000	287,000
Sulfur	12,200	12,200
Tin	430	430
Titanium	43.80	4.48
m-Xylene	147	147
o + p-Xylene	110	110
Vanadium	135	135
Yttrium	35.30	35.30
Lead 210	5.49e-07	5.49e-07
Radium 226	1.91e-04	1.91e-04
Radium 228	9.77e-07	9.77e-07

Source: EPA Office of Water, *Development Document for Final Effluent Limitations Guidelines and Standards for the Coastal Subcategory of the Oil and Gas Extraction Point Source Category*, October 1996, Table VIII-7.

R0076671

Table 6: Oil Well Brine (Produced Water) from Primary Recovery Operations – Venango County, Pennsylvania

Parameter	Number of Samples	Average	Minimum	Maximum	No. Samples < reporting limit
pH	28	6.4	5.2	7.4	
Osmotic pressure (milliosmoles)	18	1,445	340	2,740	2>2,000
Specific conductance (umhos/cm)	28	73,426	14,980	128.900	
Sulfates (mg/L)	13	96	1	584	10
Surfactants (mg/L)	22	1.1	0.1	2.5	2
Total Alkalinity (mg/L)	19	104	5.8	251	
Total dissolved solids (mg/L)	27	58,839	14,210	135,506	
Total suspended solids (mg/L)	19	130	20	614	
Oil & grease (mg/L)	16	18.6	2.74	78	3
Ammonia (mg/L)	17	9.3	2.22	17	
Hardness (mg/L)	27	13,075	2,199	30.720	
Calcium (mg/L)	26	3,602	10.8	6.750	
Bromide (mg/L)	17	283	57	538	
Chlorides (mg/L)	29	33,356	6,350	63.700	
Magnesium (mg/L)	28	670	87	1820	
Sodium (mg/L)	27	13,417	6	26.700	
Aluminum (µg/L)	15	730	156	1730	1
Arsenic (µg/L)	15	273	24	992	9
Barium (mg/L)	29	55.7	0.04	670	
Beryllium (µg/L)	11	11.4	0.2	95	11
Cadmium (µg/L)	5	36	0.3	150	19
Copper (µg/L)	16	78	15	264	9
Iron (mg/L)	27	34	3.97	140	
Lead (µg/L)	4	288	13.9	910	19
Manganese (µg/L)	27	1,294	175	7.500	
Nickel (µg/L)	9	150	26	790	16
Silver (µg/L)	8	2.676	0.59	21.100	12
Zinc (µg/L)	11	93	14	310	5
Lithium (µg/L)	22	1,418	273	3.660	1
Phenols (µg/L)	16	454	28	875	
Benzene (µg/L)	12	1,907	79	3.236	
Toluene (µg/L)	10	1,885	540	3.214	
Ethylbenzene (µg/L)	7	107	55	174	2
Xylene (µg/L)	11	1,057	200	2.117	

Source: Pennsylvania DEP, *Draft Oil Brine Characteristics Report*, 1999

R0076672

Table 7: Gas Well Brine (Produced Water) Characteristics – Devonian Formation of Pennsylvania

Parameter	Range	Number of Samples
pH	3.1 - 6.47	16
Specific Conductance (umhos/cm)	136,000 - 586,000	12
Pollutants (mg/L)		
Alkalinity	0 - 285	13
Bromide	150 - 1149	5
Chloride	81,500 - 167,448	22
Sulfate	<1.0 - 47	13
Surfactants	0.08 - 1200	13
Total dissolved solids	139,000 - 360,000	15
Total suspended solids	8 - 5484	5
Aluminum	<0.50 - 83	19
Arsenic	<0.005 - 1.51	5
Barium	9.65 - 1740	28
Cadmium	<0.02 - 1.21	19
Calcium	9400 - 51,300	19
Copper	<0.02 - 5.0	14
Iron	39.0 - 680	21
Lead	<0.20 - 10.2	18
Lithium	18.6 - 235	18
Magnesium	1300 - 3900	18
Manganese	3.59 - 65	21
Nickel	<0.08 - 9.2	18
Potassium	149 - 3870	16
Silver	0.047 - 7.0	4
Sodium	37,500 - 120,000	21
Zinc	<0.02 - 5.0	20

Source: Pennsylvania DEP, 1999.

IV.B. Available Data on Drilling Waste for the Oil and Gas Extraction Industry

According to API, 361 million barrels of drilling waste were produced in 1985. Due to a reduction in the number of wells drilled, for 1995 API preliminary findings indicate an estimated 146 million barrels of drilling waste (API, 1997). Drilling fluids (muds and rock cuttings) are the largest sources of drilling wastes. For offshore Gulf of Mexico, EPA estimates from 1993 assumed that 7,861 barrels of drilling fluids and 2,681 barrels of cuttings are discharged overboard per exploratory well, and 5,808 barrels of drilling fluids and 1,628 barrels of cuttings are discharged per development well (USEPA, 1993b). The different volumes are based on the average depths for the two types of wells. These volumes exclude the volumes of any drilling wastes not discharged offshore but transported to shore for disposal. Historically, on average, about 12 percent of the mud and 2 percent of the cuttings fail permit limits (USEPA, 1993b) and thus cannot be discharged. Table 8 below summarizes some of the characteristics of drilling waste in Cook Inlet, Alaska as reported in the *Development Document for Final Effluent Limitations Guidelines and Standards for the Coastal Subcategory of the Oil and Gas Extraction Point Source Category*. Table 9 presents the characteristics of drilling fluids used in the drilling of gas wells into the Devonian formation of Pennsylvania.

Table 8: Cook Inlet Drilling Waste Characteristics	
Waste Characteristics	**Value**
Percent of cuttings in waste drilling fluid	19%
Average density of dry cuttings	980 pounds per barrel
Average density of waste drilling fluid	420 pounds per barrel
Percent of dry solids in waste drilling fluid, by volume	11%
Average density of dry solids in waste drilling fluids	1,025 pounds per barrel
Drilling Fluid Pollutant Concentration Data	
Conventionals	**mg/kg drilling fluid**
Total Oil	142
Total Suspended Solids (TSS)	269,042
Priority Metals	
Cadmium	1.1
Mercury	0.1
Antimony	5.7
Arsenic	7.1
Beryllium	0.7
Chromium	240
Copper	18.7
Lead	35.1
Nickel	13.5
Selenium	1.1
Silver	0.7
Thallium	1.2
Zinc	200.5
Priority Organics	
Naphthalene	0.008
Fluorene	0.134
Phenanthrene	0.020
Non-Conventional Metals	
Aluminum	9,069.9
Barium	120,000
Iron	15,344.3
Tin	14.6
Titanium	87.5
Non-Conventional Organics	
Alkylated benzenes (a)	5.004
Alkylated naphthalenes (b)	0.082
Alkylated fluorenes (b)	0.290
Alkylated phenanthrenes (b)	0.034
Total byphenyls (b)	0.324
Total dibenzothiophenes	0.001
Source: EPA Office of Water, 1996, Table VII-4.	

Table 9: Drilling Fluids Characteristics – Devonian Gas Wells

Parameter	Average	Range	# Samples Above Detection Limits	# Samples Below Detection Limits
pH	9.57	3.1 - 12.2	61	
Osmotic pressure (mosm)	76	4.3 - 629	32	
Specific Conductance (umhos/cm)	4,788	383 - 38,600	62	
Pollutants (mg/L)				
Oil & grease	11.9	2.3 - 38.8	20	2
Alkalinity	276	18 - 1,594	60	0
Bromide	10.2	2 - 56.1	30	4
Chloride	1,547	12 - 14,700	62	0
Phenols	0.288	0.025 - 0.137	19	3
Sulfate	144	6 - 785	46	0
Surfactants	25	1.5 - 200	23	13
Total dissolved solids	3,399	386 - 24,882	61	0
Total suspended solids	87	2 - 395	34	0
Aluminum	4.601	0.170 - 16.9	17	16
Arsenic	0.032	0.00082 - 0.117	21	13
Barium	2.5	0.078 - 37.7	37	13
Calcium	290	8.7 - 1,900	60	0
Copper	0.049	0.012 - 0.268	12	22
Iron	145	0.08 - 3,970	41	4
Lead	0.785	0.07 - 3.46	5	29
Lithium	0.46	0.037 - 2.04	8	12
Magnesium	59	0.12 - 1,700	61	1
Manganese	2.284	0.01 - 46.6	40	20
Nickel	0.945	0.025 - 2.4	7	27
Silver	0.035	0.035	1	7
Sodium	777	53.7 - 5,800	59	0
Zinc	0.502	0.014 - 1.55	14	20

Source: Pennsylvania DEP, 1999.

IV.C. Available Data on Miscellaneous and Minor Wastes (Associated Wastes)

Associated wastes are a relatively small but significant category of waste from the oil and gas extraction industry. The term "associated wastes" encompasses a wide range of small volume waste streams essential to oil and gas extraction. Because of their nature, these waste streams are the most likely to contain constituents of concern. Preliminary data from a 1995 survey estimate that 22 million barrels of associated wastes are generated annually (API, 1997). Four particular associated waste streams are discussed below.

IV.C.1. Workover, Treatment, and Completion Fluids

Well maintenance, including workover, treatment, and completion, requires the use of fluids similar to drilling fluid and is the largest miscellaneous source of waste. These fluids may contain a range of chemicals (depending on the maintenance activity undertaken) and naturally occurring materials (i.e., trace metals). Because of the presence of these constituents, the wastes require proper disposal. Onshore, most of these wastes are disposed of through Class II injection wells. Offshore, they may be discharged if they meet the standards in applicable NPDES permits. Otherwise, they are barged to shore and typically disposed of in an injection well. Table 10 presents the relative amounts of liquid and solid wastes from well maintenance operations. Table 11 contains the range and average pollutant concentrations from workover, treatment and completion fluid samples collected from wells in Texas, New Mexico, and Oklahoma.

Table 10: Typical Volumes from Well Treatment, Workover, and Completion Operations

Operation	Type of Material	Estimated Waste Volume (barrels)
Completion and Workover	Completion/Workover Fluids	200 to 1000
	Formation Sand	1 to 50
	Filtration Solids	10 to 50
	Excess Cement	<10
	Casing Fragments	<1
Well Treatment	Neutralized Spent Acids	10 to 500
	Completion/Workover Fluids	10 to 200

Source: EPA Office of Water. 1996. Table IX-2.

R0076677

Table 11: Pollutant Concentrations in Treatment, Workover, and Completion Fluids

Pollutant Parameter	Pollutant Concentration (Micrograms/L)	
	Range	Average
Conventionals		
Oil and Grease	15,000 - 722,000	231,688
Total Suspended Solids	65,500 - 1,620,000	520,375
Priority Pollutant Organics		
Benzene	477 - 2,204	1,341
Ethylbenzene	154 - 2,144	1,149
Methyl Chloride (Chloromethane)	0 - 57	29
Toluene	298 - 1,484	891
Fluorene	0 - 123	62
Naphthalene	0 - 1,050	525
Phenanthrene	0 - 128	64
Phenol	255 - 271	263
Priority Pollutant Metals		
Antimony	0 - 148	29.60
Arsenic	0 - 693	166
Beryllium	0 - 25.1	8.64
Cadmium	7.6 - 82.3	26.08
Chromium	48 - 1,320	616.82
Copper	0 - 1,780	277.20
Lead	0 - 6,880	1,376
Nickel	0 - 467	115.52
Selenium	0 - 139	42.94
Silver	0 - 8	1.60
Thallium	0 - 67.3	13.46
Zinc	0 - 1330	362.94
Other Non-Conventionals		
Aluminum	0 - 13,100	6,468.40
Barium	66.5 - 3,360	498.10
Boron	4,840 - 45,200	15,042
Calcium	1,070,000 - 28,000,000	10,284,000
Cobalt	0 - 40.9	8.18
Cyanide	0 - 52	52
Iron	7,190 - 906,000	384,412
Manganese	187 - 18,800	5,146
Magnesium	10,400 - 13,500,000	5,052,280
Molybdenum	0 - 167	63
Sodium	7,170,000 - 45,200,000	18,886,000
Strontium	21,100 - 343,000	142,720
Sulfur	72,600 - 646,000	245,300
Tin	0 - 135	27
Titanium	0 - 283	74.58
Vanadium	0 - 4,850	1,156
Yttrium	0 - 131	41.92
Acetone	908 - 13,508	7,205
Methyl Ethyl Ketone (2-Butanone)	0 - 115	58
m-Xylene	335 - 3,235	1,785
o+p-Xylene	161 - 1,619	890
4-Methyl-2-Pentanone	198 - 5,862	3,028
Dibenzofuran	136 - 138	137
Dibenzothiophene	0 - 222	111
n-Decane	0 - 550	275
n-Docosane	237 - 1,304	771
n-Dodecane	0 - 1,152	576
n-Eicosane	0 - 451	226
n-Hexacosane	173 - 789	481
n-Hexadecane	0 - 808	404
n-Tetradecane	513 - 1,961	1,237
p-Cymene	0 - 144	72
Pentamethylbenzene	0 - 108	54
1-Methylfluorene	0 - 163	82
2-Methylnaphthalene	0 - 1,634	817

Source: EPA Office of Water, 1996, Table IX-7

IV.C.2. Minor Wastes

Smaller waste streams of concern for the oil and gas extraction industry that are discussed below are drainage from drilling and production sites, solids brought to the surface with oil and gas (produced sand, also referred to as tank bottoms), and domestic and sanitary wastes at coastal and offshore sites.

Deck Drainage

Drainage from the production site, or *deck drainage*, is a concern particularly in areas with high precipitation. When water from rainfall or from equipment cleaning comes in contact with oil-coated surfaces, the water becomes contaminated and must be treated and disposed of. The fluids can contain oil from leaking equipment, wastes from cleaning operations, and spilled chemicals from treatment processes. Some locations will collect deck drainage, treat it separately in a skim tank, and discharge it, while others might combine the water with produced water and dispose of the fluids together. In the coastal areas of the Gulf of Mexico, the average facility generates approximately 12,000 barrels of deck drainage each year, but this figure would be significantly lower for facilities in drier climates (EPA, 1996).

Produced Sand

Produced sand consists of the accumulated formation sands and other particles generated during production as well as the slurried particles used in hydraulic fracturing. The waste stream also includes sludges produced from chemical flocculation procedures during produced water treatment. Produced sand typically contains crude oil. The amount will vary based on the handling and separation processes used, but can comprise as much as 19 percent by volume (EPA, 1996). Table 12 presents an analysis of samples of basic sediment taken from pits containing produced water in Pennsylvania. Like for produced water, it should be noted that concentrations will vary for different locations, particularly with respect to Naturally Occurring Radioactive Material (NORM).

Table 12: Pollutant Concentrations in Produced Water Pit Sediments in Pennsylvania

Material	Range (mg/L)	Average (mg/L)	# Samples Above Detection Limits	# Samples Below Detection Limits
Oil and Grease (mg/kg)	640 - 540,000	68,056	49	0
Arsenic	<0.01 - 0.031		19	32
Barium	0.07 - 19.1	1.8	51	0
Cadmium	<0.05		0	51
Chromium	<0.05		0	51
Lead	<0.1 - 0.27		4	47
Mercury	<0.001		0	51
Selenium	<0.01 - 0.016		8	43
Silver	<0.05		0	51
Benzene	0.0006 - .25		25	21
Toluene	0.001 - 0.27		25	21
Ethylbenzene	0.0013 - 0.049		17	29
Naphthalene	0.001 - 0.076		5	41
Xylene	.0011 - 1.78		34	12
Naturally-Occurring Radioactive Materials				
Natural Uranium (µg/kg)	873.87-2,945.97	1,658.86	9	0
^{226}Radium (pCi/kg)	6.57 - 1,344.88	593.8196	23	0
^{228}Radium (pCi/kg)	13.8 - 1639.11	770.3883	23	0
^{54}Manganese (pCi/kg)	0		0	23
^{59}Iron (pCi/kg)	0		0	23
^{58}Cobalt+^{60}Cobalt (pCi/kg)	0		0	23
^{65}Zinc (pCi/kg)	0		0	23
^{95}Zirconium (pCi/kg)	0		0	23
^{95}Niobium (pCi/kg)	0		0	23
^{131}Iodine (pCi/kg)	0		0	23
^{137}Cesium (pCi/kg)	0 - 46	17.15789	19	4
^{140}Barium (pCi/kg)	0		0	23
^{140}Lanthanum (pCi/kg)	0		0	23
Thorium (total) (pCi/kg)	860 - 4,868	2,908.826	23	0

Source: PA DEP, *Characterization and Disposal Options for Oilfield Wastes in Pennsylvania*, 1994

Domestic and Sanitary Wastes

Domestic and sanitary wastes are issues at coastal and offshore sites. Domestic wastes are water from sinks, showers, laundry, and food preparation areas. Domestic waste also includes solid materials such as paper and cardboard which must be disposed of properly. Because domestic waste does not contain fecal coliform bacteria, most NPDES permits allow untreated discharge so long as floating solids are not produced. Sanitary wastes are generated from toilets, and must be either treated or stored for disposal on land. Most offshore facilities treat the wastes through a combination of chlorination and biological digesters or physical maceration, and discharge the waste at the site. Offshore facilities discharge an average of approximately 2,050 barrels of domestic/sanitary waste per facility per year (EPA, 1996).

IV.D. Other Data Sources

The Aerometric Retrieval System (AIRS) is an air pollution data delivery system managed by the Technical Support Division in EPA's Office of Air Quality Planning and Standards (OAQPS), located in Research Triangle Park, North Carolina. The AIRS is a national repository of data related to air pollution monitoring and control. The AIRS contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. Table 13 summarizes annual releases (from the industries for which Sector Notebook Profiles have been prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), particulate matter, all sizes reported in lieu of PM10 (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Table 13: Air Pollutant Releases by Industry Sector (tons/year)

Industry Sector	CO	NO_2	PM10	PT	SO_2	VOC
Metal Mining	4,951	49,252	21,732	9.478	1,202	119.761
Oil and Gas Extraction	**132,747**	**389,686**	**4,576**	**3,441**	**238,872**	**114,601**
Non-Fuel, Non-Metal Mining	31,008	21,660	44,305	16,433	9,183	138,684
Textiles	8,164	33,053	1,819	38,505	26,326	7,113
Lumber and Wood Products	139,175	45,533	30,818	18,461	95,228	74,028
Wood Furniture and Fixtures	3,659	3,267	2,950	3,042	84,036	5,895
Pulp and Paper	584,817	365,901	37,869	535,712	177,937	107,676
Printing	8,847	3,629	539	1,772	88,788	1,291
Inorganic Chemicals	242,834	93,763	6,984	150,971	52,973	34,885
Plastic Resins and Man-made Fibers	15,022	36,424	2,027	65,875	71,416	7,580
Pharmaceuticals	6,389	17,091	1,623	24,506	31,645	4,733
Organic Chemicals	112,999	177,094	13,245	129,144	162,488	17,765
Agricultural Chemicals	12,906	38,102	4,733	14,426	62,848	8,312
Petroleum Refining	299,546	334,795	25,271	592,117	292,167	36,421
Rubber and Plastic	2,463	10,977	3,391	24,366	110,739	6,302
Stone, Clay, Glass and Concrete	92,463	335,290	58,398	290,017	21,092	198,404
Iron and Steel	982,410	158,020	36,973	241,436	67,682	85,608
Metal Castings	115,269	10,435	14,667	4,881	17,301	21,554
Nonferrous Metals	311,733	31,121	12,545	303,599	7,882	23,811
Fabricated Metal Products	7,135	11,729	2,811	17,535	108,228	5,043
Electronics and Computers	27,702	7,223	1,230	8,568	46,444	3,464
Motor Vehicle Assembly	19,700	31,127	3,900	29,766	125,755	6,212
Aerospace	4,261	5,705	890	757	3,705	10,804
Shipbuilding and Repair	109	866	762	2,862	4,345	707
Ground Transportation	153,631	594,672	2,338	9,555	101,775	5,542
Water Transportation	179	476	676	712	3,514	3,775
Air Transportation	1,244	960	133	147	1,815	144
Fossil Fuel Electric Power	399,585	5,661,468	221,787	13,477,367	42,726	719,644
Dry Cleaning	145	781	10	725	7,920	40

Source: EPA Office of Air and Radiation, AIRS Database, 1997

R0076681

This page left intentionally blank.

POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

The Pollution Prevention Act of 1990 established a national policy of managing waste through source reduction, which means preventing the generation of waste. The Pollution Prevention Act also established as national policy a hierarchy of waste management options for situations in which source reduction cannot be implemented feasiblely. In the waste management hierarchy, if source reduction is not feasible, the next alternative is recycling of wastes, followed by energy recovery, with waste treatment as a last alternative.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the oil and gas extraction industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be used effectively. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Waste Management Plans

Pollution prevention opportunities are most effective when they are coordinated in a facility-wide waste management plan. The American Petroleum Institute (API) has published guidelines for waste management plans, in which pollution prevention is an integral part (API, 1991). The ten-step plan involves the following:

1. Company management approval: Management should establish goals for the waste management plan, identify key personnel and resources that are

committed to the plan, and develop a mission statement for its environmental policies.

2. Area Definition: The waste management plan should be designed for a specific area to account for differing regulations and conditions; in most cases, the area would be limited to within one state.

3. Regulatory Analysis: Federal, state and local laws, and landowner and lease agreements, should be evaluated. Based on these evaluations, operating conditions and requirements should be defined.

4. Waste Identification: The source, nature, and quantity of generated wastes within the plan's area should be identified, and a brief description of each type of waste should be written.

5. Waste Classification: Each waste stream should be classified according to its regulatory status, including whether it is a hazardous waste subject to regulation under the Resource Conservation and Recovery Act (RCRA).

6. List and Evaluate Waste Management and Disposal Options: List all waste management practices and determine the environmental acceptability of each option. Consider regulatory restrictions, engineering limitations, economics, and intangible benefits when determining their feasibility.

7. Waste Minimization: Analyze each waste-generating process for opportunities to reduce the volume generated or ways to reuse or recycle wastes. Note that the waste minimization or pollution prevention opportunities that are presented in this section can be used for this step.

8. Select Preferred Waste Management Practices: Choose the preferred management practices identified in Step 6 and incorporate waste minimization options from Step 7 wherever feasible. Specific instructions for implementation should be developed.

9. Prepare and Implement an Area Waste Management Plan: Compile all preferred waste management and minimization practices and write waste management summaries for each waste. Implement the plan on a field level.

10. Review and Update Waste Management Plan: Establish a procedure to periodically review and revise the plan.

V.A. Exploration

Several approaches or technologies can be used by exploration companies to drill more efficiently and to maximize the recovery of oil and natural gas. Oil and gas Exploration is not a waste-intensive activity per se, but efforts made by those involved with exploration can assist in minimizing the number of dry wells that are later drilled.

Drill Site Selection

The volume of drilling waste is directly related to the number of wells drilled. Thus, if fewer wells can be drilled to efficiently produce a discovered reservoir, and if the number of dry holes (wells drilled that do not find commercial quantities of oil or gas) can be minimized, then the total volume of drilling wastes will be reduced. Site selection is a key component of this reduction.

Modeling Software
New computer software is available that converts seismic data into models of subterranean formations. Until 15 years ago, modeling software was limited to large mainframe computers and was inaccessible for small-scale projects. In recent years, software has been created for use on personal computers that can incorporate the various components of remote sensing and logging. Three-dimensional models can now be produced from data that geophysicists previously would have had to analyze manually.

> The U.S. Department of Energy has created several significant computer programs for the oil and gas exploration industry. KINETICS models the chemical reactions that take place over millions of years that lead to the creation of oil and gas, and therefore assists in interpreting whether conditions at a site are favorable for oil. Programs like BOAST and MASTER can be used in wells already in production to model flow patterns to determine the best approach for secondary or tertiary recovery efforts. It is estimated that computer programs such as these can result in an increase of three billion barrels of domestic reserves, generate increased tax revenue for thc government, and reduce the drilling of unnecessary or unproductive wells (U.S. Department of Energy, 1998).

Iodine Sensing
Empirical evidence indicates that unusual concentrations of iodine on the earth's surface are nearly always associated with petroleum that seeps from subsurface formations. Although the process is still in the experimental stage, surface geochemical analyses can be performed to test for the presence of unusually high concentrations of iodine, which in turn indicates the presence of oil or gas. The iodine test can be used in conjunction with

traditional seismic processes to determine favorable drilling sites. Seismic tests measure for geological formations that can potentially contain large amounts of oil or gas, but can't directly detect these products. Conversely, high iodine levels may indicate that petroleum is present, but not that the geological structures are favorable for petroleum extraction. These two processes therefore can be used in conjunction with each other to better determine the probability of being able to produce oil at a given site before a well is drilled.

Drill Site Construction

Storm Water Runoff Impact Reduction

Measures that can be taken to reduce the impacts associated with storm water runoff can apply to all aspects of oil and gas exploration and production. The following are a few examples of such measures.

- Reduce exposure of materials such as drilling fluids and other chemicals stored on-site to rainfall and storm water runoff. This can be accomplished by storing drums and other materials under cover (such as in a trailer, in a shed or covering with tarps).
- Utilize best management practices (BMPs) such as diversion dikes, containment diking, and curbing to reduce exposure of storm water runoff to cuttings and other waste storage areas.
- Utilize BMPs such as sediment traps, swales, and mulching during construction activities (such as during road building or construction of buildings) to reduce loss of sediment and contamination of runoff.
- Insure that adequate materials and equipment are available to contain and control spills in order to prevent contamination of runoff. An effort should be made here to go beyond any SPCC requirements and be prepared to contain and control all spills (of any waste) on site.

Two references that may be useful for oil and gas exploration and production operations to prevent contamination of storm water runoff are 1) Storm Water Management for Industrial Activities - Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-006) and 2) Storm Water Management for Construction Activities - Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005).

Downhole Analysis

Recently, several technologies have emerged that allow for more accurate analysis of an oil or gas-bearing formation via equipment lowered into the wellbore of producing wells. These either can lead to improvements in production of the well in question, or assist in determining the best location for an additional well. In either case, the technology helps to reduce the number of wells drilled that do not produce.

Formation Analysis Through Old Well Casings
Some of the geophysical logging procedures and tools now in use for new wells were not available for wells drilled 30 years ago. Therefore, data for the zones between the surface and the production zone of the well may be incomplete. Typically the metal casing limits analysis of the formations in these sealed-off zones. New tools have been developed that allow surveying through casing and that may lead to the discovery of production zones that were missed during the original drilling. The procedure can extend the life of old wells and reduce the need for drilling new ones.

Crosswell Seismic Imaging
Geological imaging techniques via the surface are limited by the thousands of feet of rock between the equipment and the potential production zone. As a result, the best resolution obtainable is approximately 50 feet. With crosswell seismic imaging, sound wave generators and receivers are lowered into several wellbores in a production field. Because the waves need to travel a shorter distance between the generator and receivers, the resolution can be as accurate as five feet. This process can be useful in ensuring that additional wells drilled in a producing field are placed accurately.

V.B. Well Development

Drilling

Closed Loop Drilling Fluid System
When drilling a well that will be shallow and likely will not encounter unusual zones of pressure, a closed system for drilling fluids can be used. At a conventional drilling site, drilling fluid is circulated through the wellbore, then deposited in a reserve pit dug next to the well. This pit is open to the atmosphere, and serves to store excess fluid and to separate out contaminants. While the large storage capacity is important for wells that encounter high pressure and therefore might experience fluctuations in the amount of fluid needed, a reserve pit can be the source of considerable costs at a drilling site. The pit itself must be constructed at the beginning of drilling, and must be closed properly when drilling is completed. Also, because the pit may release higher levels of VOCs and can leak liquids into surface or groundwater, there are increased health, environmental, and financial risks.

In a closed-loop drilling fluid system, the reserve pit is replaced with a series of storage tanks. The tanks represent an additional cost, but because they preclude the need for constructing a pit, reduce the amount of environmental releases, and result in more efficient use of drilling fluid, the technology can save the operator money when conditions allow its use.

A small independent operator in Texas was concerned that reserve pits for drilling fluid were increasing waste management costs and exposing it to liability for surface and ground water contamination. Because the wells to be drilled were relatively shallow and few complications were expected, the operator negotiated with the drilling contractors to use a closed-loop fluid system. The operator realized savings of about $10,000 per well because reserve pits were not constructed and waste management costs were reduced. The operator's liability was also reduced (Texas Railroad Commission, 1997).

Pit Design

If the closed-loop drilling system is not used for drilling fluids, another approach may be to use a V-shaped pit instead of the traditional rectangular pit. The open end of the "V" faces the drilling rig and the cross-sectional view resembles a squared-off funnel (about 10 feet deep with the upper 5 feet having slanted walls to a width of about 20 feet). Because the fluid must travel the full length of the pit, this design prevents mud from channeling between the discharge point and the suction point, and reduces the amount of water that needs to be added to maintain the desired fluid characteristics. In addition, because the V-shaped pit is long and narrow, it is easier to construct and leaves a smaller "footprint" at the site.

A company installed a V-shaped reserve pit and compared the costs with those incurred at similar-sized wells using a traditional pit. The company determined that pit construction time was reduced by about 40 percent, water costs for the well were reduced by about 38 percent, and pit liner costs were reduced by about 43 percent. The total cost savings were about $10,800 per well (Texas Railroad Commission, 1999).

Substitution of Drilling Fluid Additives

Some traditional drilling fluid additives are toxic and require extra care in disposal. In response, the drilling fluid industry has developed replacements for some of the more toxic compounds. These include:

- Replacement of chrome lignosulfonate dispersants with chrome-free lignosulfonates and polysaccharide polymers.

- Use of amines instead of pentachlorophenols and paraformaldehyde as biocides.

- Lubrication with mineral oil and lubra-beads instead of diesel oil.

Substitutions such as those described above can minimize the toxicity of drilling wastes and reduce the risks and costs associated with drilling fluid disposal.

Material Balance and Mud System Monitoring
Monitoring devices used at various points in the drilling fluid circulation system may be used to check for the decrease of fluid levels or other changes in fluid characteristics. Such devices may reduce the need for the addition of water and additives to the fluid, thereby reducing the costs and waste associated with drilling fluid.

Removal of Solids from Drilling Fluid
Careful removal of drill cuttings and other contaminating solids can reduce the need to dilute or replace drilling fluid. Furthermore, if the separated solids are treated thoroughly to remove moisture, the weight of waste can be significantly reduced. In addition to using shale shakers, which are always used to remove rocks and larger fragments, drilling rigs can reduce waste by including several optional components in their mud treatment systems. Desanders and desilters separate increasingly smaller particles. Centrifuges remove the smallest suspended pieces. Finally, mud cleaners break oil-water emulsions and remove many dissolved components. If these devices are in optimal working condition, the drilling mud can be nearly free of suspended materials, and the solid waste can be less than 30 percent moisture by weight.

Polycrystalline Diamond Compact (PDC) Drill Bit
Pulling the drill string to replace the drill bit is one of the more inefficient and potentially dangerous procedures in drilling. Quite a bit of time and energy can be wasted in pulling the entire drill string to the surface and lowering it back into the wellbore. In addition, it is when the drill string is being raised and lowered that well blowouts are an increased risk if not properly done. It is therefore desirable for both efficiency and blowout prevention to minimize drill bit replacement.

PDC bits have been viable commercially for about a decade, and are the most durable bits available. The bit is primarily steel with interlocked diamond studs. The bits typically last between 230 and 260 drilling hours, but have lasted over 1,000 hours without replacement. Because of their durability, diamond bits account for one-third of the drill bit market, and can save drilling companies as much as $1 million per well (U.S. Department of Energy, 1998).

Downhole Drilling Telemetry
Traditionally, drillers have determined the position of the drill bit by removing the drill string from the well, lowering an instrument into the

wellbore, retrieving the instrument, then lowering the drill string back into the wellbore. This process is inefficient and increases the risk of a blowout.

The Department of Energy has helped to develop a wireless system that sends pulses through the drilling mud from the drill bit to the surface, in a process called *mudpulse telemetry*. The technology presents several benefits for wells in which its use is practical: data can be collected during drilling, the data are more complete than those from periodic measurements because the pulsing can occur continuously, and advance warnings can be received of impending drill hazards. Without considering the benefit of decreased environmental and health risks, mudpulse technology saves the industry over $400 million per year.

Horizontal Drilling

Oil and natural gas bearing formations typically have a small vertical profile (i.e., are confined to a narrow range of depth), but are spread over a large horizontal area. As a result, wellbores that intersect the oil-producing formation at an angle can drain more of the formation and reduce the need to drill additional wells compared to purely vertical wells.

Horizontal drilling is costly, because it requires advanced geological sensing equipment and constant attention to the placement of the drill bit. However, the increased cost is often more than offset by increased production and the reduced need for drilling multiple wells.

In the Dundee Formation of Michigan, as much as 85 percent of the known oil remained in the formation after many years of production. Many wells were on the verge of being plugged, with production near five barrels of oil per day per well. A DOE co-sponsored project drilled a horizontal well in the formation, which produced 100 barrels per day, and had estimated recoverable reserves of 200,000 barrels of oil. The program attracted other well developers, and 20 to 30 additional horizontal wells are being drilled in the formation. It is estimated that the application of horizontal drilling to this formation may yield an additional 80 to 100 million barrels of oil (Department of Energy, 1998).

Reuse of Drilling Fluids

Drilling fluid is often disposed of when a well is completed, and fresh fluid used for any adjacent wells. Filtration processes have allowed drilling fluid to be reconditioned, so that it can be used for multiple wells before being discarded. Other possible uses for used drilling fluids are to plug unproductive wells or to spud in new wells. Reuse of oil-based and synthetic-based drilling fluids to drill additional wells is common because of the high cost of the base fluids.

One drilling company in Alaska sought to filter and recondition its drilling fluid in order to use it for several wells. The fluid was used on average over two times, resulting in a decrease of fluid used from 50,000 barrels of fluid to 22,000 barrels. Because the cost of filtering is only six percent of the cost of purchasing new fluid, the fluid treatment system reduced the fluid costs for this operator from $7 million to $3.25 million (SAIC, 1997).

Preventive Maintenance and Leak Containment

Engines, tanks, pumps and other equipment used in the drilling process may leak lubricating oil or fuel. Soil contamination and waste generation may be avoided and valuable chemicals may be recovered by performing regular preventive maintenance and installing leak containment devices. Examples of preventive maintenance include routine checks and replacement of leaking valves, hoses, or connections, while containment measures may include the installation of drip pans underneath engines, containers, valves, and other potential sources of leaks. These practices and devices are important pollution prevention options at production and maintenance operations as well as at drilling sites.

Inventory Control

Facilities may maintain an excess on-site volume of chemicals and materials. This may lead to unnecessary regulatory compliance concerns, operating costs, and waste generation. By tracking the inventory of chemicals and materials, particularly with the use of computer programs, an operator may use materials more efficiently and reduce waste generation. In addition, an operator may negotiate with vendors to accept empty and partially-filled containers for reclamation and reuse, because commercial chemical products that are returned to a vendor or manufacturer may not be considered solid wastes.

An operation encompassing drilling, gas production, and compression activities determined that its on-site supply of chemicals was excessive and that much of its hazardous waste generation was unnecessary. The company made several changes: it identified alternative, less toxic chemicals; eliminated the use of organic solvents; identified processes for which individual chemicals could be used in multiple situations; established a purchasing procedure in which a new chemical is purchased only after evaluating information including material safety data sheets (MSDSs) and other information sources supplied by vendors; and tracked all purchased chemicals to ensure efficient usage. As a result of the program, the company eliminated the use of 32 unnecessary chemicals and products, reduced regulatory concerns, minimized waste disposal costs, and achieved the cooperation of vendors, who worked to supply the company with satisfactory chemicals (Texas Railroad Commission, 1999).

Completion

Lead-Free Pipe Dope

Pipe dope is used in drill string connections. The American Petroleum Institute (API)-specified pipe dope contains approximately 30 percent lead, which raises human health and environmental concerns. New lead-free, biodegradable pipe dopes are now available, however, which may be used when conditions do not require the use of the API-specified material. In particular, the use of pipe dope on thread protectors may allow for the recycling of thread protectors with fewer regulatory concerns.

Cementing "On-the-Fly"

When well casing is cemented in, the cement used is often pre-mixed with additives to specification. There may be a substantial surplus of unused, pre-mixed cement if the quantity required for the project was overestimated. One solution used by some service companies is to mix neat (concentrated) cement with additives on-the-fly, through the use of automatic density control systems. The mixing process can be stopped as soon as the cementing job is complete, and the unused raw materials can be used at a later cementing job rather than disposed of as waste. Cementing on-the-fly is becoming common practice.

V.C. Petroleum Production

Produced Water Management

Produced water constitutes the vast majority of oil and gas extraction waste, and traditionally the volume has been fixed and unavoidable. However, there have been developments that might help to reduce the amount of produced water that is brought to the surface, and reduce the wastes associated with treating produced water that does reach the surface.

Downhole Produced Water Separation

A new procedure made possible by the miniaturization of motors is the separating and pumping of produced water downhole, without bringing it to the surface. There are three significant variations, but in each case excess water is separated from the desired product in the wellbore and injected into another geological formation, typically below the production zone.

In formations where oil and water are mostly separate, two perforations in the well can be made; oil is removed through one and transported to the surface, and water is removed through the other perforation and injected in the disposal zone. It should be noted that the water disposal system must be monitored to ensure that oil is not lost.

In another method, a hydrocyclone is used downhole to separate free water from any oil- or gas-containing fluid by centrifugal force. The water is injected into a disposal zone, and the product is pumped to the surface.

Finally, in gas wells, simple gravity can be used to remove a substantial amount of water. Gas rises to the surface of the separation device, and water is injected from the bottom into a lower disposal zone.

With these methods, some water is always still brought to the surface. Also, the technology is still in development. Nevertheless, downhole separation can be an effective and economically attractive method of reducing produced water volumes.

Produced Water Filter Management

Many wells employ filters to remove some waste from produced water before the water is injected into an underground well. Because the water may contain varying amounts of filterable components, the filters must be changed regularly in order to prevent the system from backing up. Many wells replace the filters at fixed intervals; for example, twice a month. However, it is possible to reduce the frequency of filter changes by measuring the difference in pressure between the input and output sides of the filter, and only changing the filter when a certain pressure is reached. Costs are incurred when valves are installed, but the savings involved in labor, filters, and filter disposal often offset the cost of valve installation.

> A small independent operator wanted to reduce the number of filters used for its produced water injection system. Previously, the operator had changed the filters twice a month at its 36 injection wells, at a cost of $4,148 per year (1,700 filters at $2.44 per filter). The operator installed valves on the filter units, at a total cost of $1,800. The following year, the operator only generated 28 waste filters, and saved about $4,000 per year in filter purchases, plus additional labor time and waste management costs (Texas Railroad Commission, 1997).

Natural Gas Conditioning

Reducing Glycol Circulation Rates

Glycol is used to remove water from natural gas. However, methane and VOCs are removed as well, in proportion to the amount of glycol circulated through the system. These methane and VOC components are removed from the glycol during a reconditioning process, and may be either returned to the production stream or vented to the atmosphere.

Research by the EPA voluntary industry partnership Natural Gas STAR has indicated that operators often maintain a circulation rate that is at least two times higher than is needed to attain mandated water content levels. Therefore, it is desirable to perform calculations to determine the minimum circulation rate needed. Savings can be realized on several fronts:

- Less salable methane lost to the atmosphere
- Less glycol needed
- Improved dehydrator unit efficiency
- Lower fuel pump use.

The potential savings for a dehydrator unit can range from $260 to $26,280 per year (Natural Gas STAR, 1997).

Adjusting Pneumatic Devices

For both oil and gas field operations pressurized natural gas is used regularly in pneumatic devices to regulate pressure, control valves, and equilibrate liquid levels. Leaks and releases from this practice, particularly from inefficient or "high-bleed" devices, are the single largest source of methane emissions by the industry. Methane is released at the estimated rate of 31 billion cubic feet (Bcf) per year from pneumatic devices. Several strategies exist to reduce such emissions, including the replacement of high-bleed devices with equivalent low-bleed ones and maintenance of existing devices to replace leaking seals and tune valves. Natural Gas STAR estimates that partners of the program have saved 11.2 Bcf to date through improvements to pneumatic devices, saving approximately $22.4 million. For most of the improvements, the payback period is between six months and a year (Natural Gas STAR, 1997).

Energy-Efficient Production

Automatic Casing Swab

In wells where natural formation pressure is insufficient to lift the product to the surface, it might be possible to install a small device downhole to delay the purchase of costly pumping or injection equipment. The Automatic Casing Swab (ACS) seals off the production zone of the well, which causes pressure to build up in the formation. At a threshold pressure, the ACS opens, and product flows to the surface without mechanical assistance. When the flow slows and pressure decreases, the ACS closes until pressure increases again. The device was created by the Sandia National Laboratories under a grant from DOE, and as of the end of 1997 has been applied to 350 wells. These wells are producing more than 3.5 million cubic feet of natural gas per year that otherwise would have been uneconomical to extract. The device may also lead to decreased energy consumption in other wells in situations where it reduces the need for energy-intensive mechanical pumps.

Solid Waste Reduction

Oily Sludge Minimization

When oil first is brought to the surface, fine particles, oil, and water form a stable sludge that settles out in storage tanks and separation equipment. There are two approaches to minimizing the loss of product that occurs when oil becomes entrained in the sludge: preventing the formation of sludge and treating the sludge to recover the oil.

Two significant methods can minimize the formation of sludge in a storage tank at a production site. First, recirculating pumps can be installed in tanks. By increasing circulation, heavier components remain in suspension longer and do not collect on the bottom of the tanks as quickly. Second, eliminating air contact with oil in the tanks can reduce the formation of sludge. Oxygen can play a role in the formation of sludge, so minimizing the introduction of atmospheric oxygen can reduce sludge levels. Furthermore, reducing contact to the atmosphere can minimize emissions of VOCs.

In many locations, recyclers can treat sludge to remove oil at a crude oil reclamation plant. Crude oil reclamation serves two purposes; the extracted oil can be sold, and disposal costs for sludge is minimized because much of the liquid component is removed. In addition, salable material that has solidified, e.g., paraffin, may be reclaimed during this process. The separation process typically is performed with the use of centrifuges, heat, or filters. One example is a filter press, which presses solids into a cake and extracts oil and water as an aqueous filtrate. The water and oil are then separated further.

A facility on the West Coast installed a filter press to retrieve oil from sludge and reduce disposal costs. The press reduced the volume of waste from 44,900 to 13,500 barrels per year, a reduction of 70 percent. Disposal costs were reduced by $564,200 per year. Approximately 81 percent of the oil in the sludge was recovered, so that at a price of $15 per barrel, the recovered oil represented additional revenues of $108,000 per year. Based on a capital cost for the press of approximately $3,000,000 and operating costs of $400,000 per year, the system is saving approximately $272,000 per year and the capital cost has a payoff period of about 3.5 years.

V.D. Maintenance

Maintenance procedures, particularly workovers, may be a source of potential pollutants for industry including acids, VOCs, and solutions with high concentrations of salts and metals. The following opportunities describe steps that can minimize the need for workovers, or help notify operators when maintenance is necessary to limit releases.

Preplanning

Careful preplanning efforts undertaken prior to a workover may reduce the amount of materials necessary at the site, and therefore may reduce waste and the chance of spilling. For example, by estimating the amount of acid required for acid stimulation based on the known reservoir conditions, the transportation, storage, and disposal of excess acid may be reduced.

Paraffin and Scale Accumulation Prevention

The buildup of paraffins in production equipment, particularly in older wells, is a serious concern, and when untreated, paraffin buildups can damage pumping equipment and rupture flowlines. Therefore, it is desirable to minimize the buildup of paraffins. One possible solution is the installation of a magnetic fluid conditioner (MFC), which creates a strong permanent magnetic field around the pump. This magnetic field alters the solubility and viscosity of crude oil, so that paraffin, scale, and other contaminants do not precipitate in the flowlines. The device requires a significant capital investment, must be custom-made for each well, and is not always successful. but the reduced frequency of maintenance and the reduced risk of flowline rupture (and the associated mitigation costs) can make an MFC a wise choice for wells with paraffin and scale buildup problems.

A small independent operator was suffering from damaged pumping equipment and ruptured flowlines as a result of paraffin buildup, and had to treat the well every ten days with solvent/hot oil to remove the deposits. The operator installed an MFC in the well for $5,000. Seven weeks later for an unrelated reason, the operator pulled the tubing from the well, and minimal paraffin deposition was observed. The investment was recovered in six months due to reduced maintenance costs, and because flow had improved, revenue increased as well (Texas Railroad Commission, 1997).

High-level alarm

A helpful device for preventing releases and loss of product is an alarm and automatic shut-off that shuts-in production equipment when an irregularity is detected. The equipment can only be restarted manually, to ensure that the problem is addressed. A facility-wide alarm is particularly important when the operator is offsite and the well is only monitored periodically.

Microbially-Treated Produced Water

The separation of oil from produced water is not completely efficient; oil concentrations in produced water can be at least 10 ppm. This oil can clog disposal wells and increase electricity costs because injection pumps must contend with increased pressure in these clogged wells. If oil-eating microbes are introduced to the produced water, oil content can be reduced. injection wells may become clogged less frequently (thereby reducing workover costs), and electricity costs are reduced because the pump can work more efficiently.

> A small operator wanted to reduce the frequency of workovers and trim electricity costs due to oil clogging in two injection wells. For approximately $150 per month for the two wells, the company added oil-scavenging microbes to the produced water. The operator realized a reduction of $400 per month in electricity costs due to the reduced pressure in the injection well, for a net savings of $250 per month. The procedure also has helped to minimize the number of injection well workovers.

Coiled Tubing Units

As mentioned in previous sections, pulling the drill string or production tubing can increase the chance of a blowout or other spills. Coiled tubing units allow workovers to be performed while keeping production tubing in place. By using coiled tubing units during workovers, the use of a workover rig and the pulling of production tubing are avoided.

Product Substitution

Many materials used in the workover process, particularly solvents used for cleaning and for paints, are classified as hazardous wastes when spent. Alternatives are available that are not classified as hazardous waste, and which are safer for the environment and present fewer regulatory concerns. Alternatives for cleaning solvents include citrus-based cleaning compounds and steam, or a substitute for the solvent Varsol (also called petroleum spirits or Stoddard solvent) is available as a "high flash point Varsol," thereby sufficiently reducing the solution's ignitability hazardous waste characteristic. For solvent-based paints, a common substitution is the use of water-based paints, which reduce or eliminate the need for solvents and organic thinners.

Chemical Metering or Dosing Systems

The dispensing of some workover fluids, such as corrosion inhibitors, by an occasional bulk addition can result in the inefficient use of the chemical and an inadequate workover job. As an alternative, an automatic dosing system that releases a small, continuous stream of fluid can reduce the amount of needed fluid and may improve workover results.

This page left intentionally blank.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A contains a general overview of major statutes
- Section VI.B contains a list of regulations specific to this industry
- Section VI.C contains a list of pending and proposed regulatory requirements.

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either "toxic" pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and "indirect" dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA section 402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and 1 territory to administer the NPDES program), contain industry-specific, technology-based and water quality-based limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges
In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR Part 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels. and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment: SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA section 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under section 307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands

Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in Section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. EPA's authority under Section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the Section 404 program to the states.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water Resource Center, at (202) 260-7786.

Oil Pollution Prevention Regulation

Section 311(b) of the CWA prohibits the discharge of oil. in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of Section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990 Congress passed the Oil Pollution Act which amended Section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. 40 CFR Part 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with DPCC plans, required by the state, provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to 1 million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past 5 years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. FRPs that meet EPA's requirements can be combined with U.S. Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346. Additional documents *and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.*

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

Part C of the SDWA mandates EPA to protect underground sources of drinking water from inadequate injection practices. EPA has published regulations codified in 40 CFR Parts 144 to 148 to comply with this mandate. The Underground Injection Control (UIC) regulations break down injection wells into five different types, depending on the fluid injected and the formation that receives it. The regulations also include construction. monitoring, testing, and operating requirements for injection well operators. All injection wells have to be authorized by permit or by rule depending on their potential to threaten Underground Sources of Drinking Water (USDW). RCRA also regulates hazardous waste injection wells and a UIC permit is considered to meet the requirements of a RCRA permit. EPA has authorized delegation of the UIC for all wells in 35 states, implements the program in 10 states and all Indian lands, and shares responsibility with 5 states.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area. and for a state-implemented Wellhead Protection program. designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1) delineating the source water protection area, (2) conducting a contaminant source inventory, (3) determining the susceptibility of the public water supply to contamination from the inventories sources, and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR Part 262.34) without a permit or interim status. Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit.

Subtitle C permits are required for treatment, storage, or disposal facilities. These permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA identification number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum products (including gasoline, diesel, and used oil) and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

EPA's RCRA, Superfund, and EPCRA Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR Part 302.4. A release report may trigger a response by EPA or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating certain emergency

response activities and for appointing Local Emergency Planning Committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA section 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA section 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA section 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR Part 302) or an EPCRA extremely hazardous substance.

- **EPCRA sections 311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA section 313** requires certain covered facilities, including SIC codes 20 through 39 and, the seven industry groups added in 1997 (including metal mining (SIC code 10, except for SIC codes 1011, 1081, and 1094), coal mining (SIC code 12, except for SIC code 1241 and extraction activities), electrical utilities that combust coal and/or oil (SIC codes 4911, 4931, and 4939), RCRA Subtitle C hazardous waste treatment and disposal facilities (SIC code 4953), chemicals and allied products wholesale distributors (SIC code 5169), petroleum bulk plants and terminals (SIC code 5171), and solvent recovery services (SIC code 7389)), which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under section 110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone were proposed in 1996 and will become effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (see 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of sources that emit any of 188 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996.

EPA's Clean Air Technology Center, at (919) 541-0800 or www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996 *or www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Hotline, at (800) 535-0202 or www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA section112(r); and information on air toxics can be accessed through the Unified Air Toxics website at www.epa.gov/ttn/uatw. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.*

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration
Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enables the agency to take enforcement actions against facilities that are not in compliance with FIFRA.

Product Registration
Under section 3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the U.S. must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site i.e., where the product may be used and the amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process often requires either the citation or submission of extensive environmental, health and safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of

R0076712

a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA section 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be requested to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA section 3(c)(2)(B).

Use Restrictions

As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration

Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (section 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions

A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR Parts 163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension

EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order which makes the suspension immediately effective.

Imports and Exports

Under FIFRA section 17(a), pesticides not registered in the U.S. and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified at 40 CFR Parts 168.65, 168.75, and 168.85.

Under FIFRA section 17(c), imported pesticides and devices must comply with U.S. pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA section 17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. U.S. Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to U.S. Customs when the shipment arrives in the U.S. NOA forms can be obtained from contacts in the EPA Regional Offices or *www.epa.gov/oppfead1/international/noalist.htm*.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture and Ecosystem Division es.epa.gov/oeca/agecodiv.htm, or The National Agriculture Compliance Assistance Center, (888) 663-2155 or es.epa.gov/oeca/ag. Other sources include the National Pesticide Telecommunications Network, (800) 858-7378, and the National Antimicrobial Information Network, (800) 447-6349.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA section 5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA section 6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under section 6 authority are asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs).

Under TSCA section 8(e), EPA requires the producers and importers (and others) of chemicals to report information on a chemicals' production, use, exposure, and risks. Companies producing and importing chemicals can be required to report unpublished health and safety studies on listed chemicals and to collect and record any allegations of adverse reactions or any information indicating that a substance may pose a substantial risk to humans or the environment.

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added Section 6217 (16 U.S.C. section 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The Section 6217 program is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Agency (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under Section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters*, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds, www.epa.gov/owow, or from the Watershed Information Network www.epa.gov/win. The NOAA website, www.nos.noaa.gov/ocrm/czm/, also contains additional information on coastal zone management.

VI.B. Industry Specific Requirements

The onshore and offshore segments of the oil and gas extraction industry are subject to different sets of regulations. Onshore, releases primarily are under the authority of EPA. Federal land leases are managed by the Bureau of Land Management (BLM) in the Department of the Interior (DOI). States also impose regulations and play a crucial role in exploration and production solid waste regulation because of the RCRA exemption. Offshore, on the Outer Continental Shelf (OCS), the Minerals Management Service (MMS) of DOI is the designated regulatory agency. MMS oversees leasing operations and shares responsibility for environmental regulation with EPA.

Because of these differences, onshore and offshore regulations are discussed in separate sections. In addition, regulatory differences associated with stripper wells (wells that produce less than 10 barrels of oil per day) and selected state regulations are presented.

VI.B.1. Onshore Requirements

Laws Regulating Oil and Gas Exploration and Production on Federal Lands

Many regulations controlling the location of onshore oil and gas production stem from the Federal Land Policy and Management Act (FLPMA) of 1976. Production is barred at national monuments, national rivers, and areas of critical environmental concern. On Federal land where oil production is allowed, the Bureau of Land Management (BLM), under the Department of the Interior (DOI), is authorized under 43 CFR Parts 3160-92 to regulate the siting, drilling and production activities; an exception is on lands within the National Forest System, where BLM must obtain the consent of the Secretary of Agriculture. Oil and gas production regulation is achieved through the distribution of leases and the issuance of drilling permits. Most procedures are established under the Federal Oil and Gas Leasing Reform Act of 1987. Included in this Act are bonding regulations, presented in 43 CFR Part 3104, that require submission of a surety or personal bond to ensure compliance with requirements for the plugging of wells, reclamation of the leased areas, and restoration of any lands or surface waters adversely affected by lease operations. The BLM is revising its regulations. A proposed rule was promulgated in early 1999.

National Environmental Policy Act (NEPA)
NEPA requires that all Federal agencies prepare detailed statements assessing the environmental impact of, and alternatives to, major Federal actions that may "significantly affect" the environment. An environmental impact statement (EIS) must provide a fair and full discussion of significant environmental impacts and inform both decision-makers and the public about

the reasonable alternatives that would avoid or minimize adverse impacts on the environment; EISs must explore and evaluate all reasonable alternatives, even if they are not within the authority of the lead agency. NEPA authorities are solely procedural; NEPA cannot compel selection of the environmentally preferred alternative. For offshore operations new sources require NEPA analysis.

Federal actions specifically related to oil and gas exploration and production that may require EISs include Federal land management agency (e.g., BLM and Forest Service) approval of plans of operations for exploration or production on Federally-managed lands. All affected media (e.g., air, water, soil, geologic, cultural, economic resources, etc.) must be addressed. The EIS provides the basis for the permit decision; for example, an NPDES permit may be issued or denied based on EPA's review of the overall impacts, not just discharge-related impacts, of the proposed project and alternatives. Issues may include the potential for surface or groundwater contamination, aquatic and terrestrial habitat value and losses, sediment production, mitigation, and reclamation.

Clean Air Act (CAA)

The oil and gas production industry is subject to recently-promulgated National Emission Standards for Hazardous Air Pollutants (NESHAP) (Federal Register, Vol. 64, No. 116, June 17, 1999). The regulation calls for the application of maximum achievable control technology (MACT) in order to reduce the emissions of hazardous air pollutants (HAP) at facilities classified as major sources. The primary HAPs released by the industry are benzene, toluene, ethyl benzene, and mixed xylenes (BTEX) and n-heptane. The technology requirements involve the following emission points: process vents on glycol dehydration units, storage vessels with flash emissions, and equipment leaks at natural gas processing plants. Additional requirements include the installation of air emission control devices, and adherence to test methods and procedures, monitoring and inspection requirements, and recordkeeping and reporting requirements.

In addition, New Source Performance Standards (NSPS) may affect exploration and production facilities. Standards apply to devices used at these facilities, including gas turbines, steam generators, storage vessels for petroleum liquids, volatile organic liquid storage vessels, and gas processing plants (see 40 CFR Part 60). Requirements will depend on whether the region in which the particular facility is located is in compliance with the National Ambient Air Quality Standards (NAAQS) and whether Prevention of Significant Deterioration (PSD) requirements apply (EPA, 1992).

Clean Water Act

Onshore exploration and production facilities may be subject to four aspects of the CWA: national effluent limitation guidelines, stormwater regulations, and wetlands regulations, and Spill Prevention Control and Countermeasure (SPCC) requirements.

National effluent limitation guidelines have been issued for two subcategories of onshore (non-stripper) wells. The Onshore Subcategory guidelines prohibit the discharge of water pollutants from any source associated with production, field exploration, drilling, well completion, or well treatment (40 CFR Part 435.30). Agriculture and Wildlife Water Use Subcategory guidelines apply to facilities in the continental United States west of the 98th meridian for which produced water may be used beneficially for irrigation or wildlife propagation. For facilities in this subcategory, produced water may be discharged into navigable waters so long as it does not exceed limitations for oil and grease, and is put to use for agricultural purposes. Discharge of waste pollutants excluding produced water is prohibited (40 CFR Part 435.50).

Oil and gas exploration and production facilities are exempt from CWA stormwater Phase I regulations under most conditions, but there are two exceptions: (1) if the facility has a reportable quantity spill that could be carried to waters of the United States via a storm event, or (2) if the stormwater runoff violates a water quality standard. (See 40 CFR Parts 117 and/or 302 for reportable quantities of hazardous substances or Part 110 for the reportable quantity of spilled oil.) If either of these two scenarios should happen, the facility would be required to apply for a Multi-Sector General Permit (MSGP) stormwater permit and develop a pollution prevention plan. However, if a reportable quantity spill were to be cleaned up quickly or containment were so total that there would be no threat of a product release as a result of storm water event, there would be no permit requirement. In addition, coverage is mandatory under the Construction General Permit (CGP) for earth-disturbing activities of five acres or more. This is relevant during exploration or site expansion efforts (EPA Region VI Stormwater Hotline, 1999; Rittenhouse, 1999). See Section VI.C. for proposed Phase II regulations that may impact the industry.

Wetlands

During the course of petroleum exploration wetlands may be encountered. Under the CWA wetlands are defined by the frequency and length of time they are saturated with water, by the type of vegetation they support, and by soil characteristics. Also by definition wetlands are part of the "waters of the United States" and as such all discharges of pollutants to wetlands require a CWA permit. However, the CWA regulates not only the discharges of dissolved pollutants but also the discharge of solids, dredge and fill materials or dirt to waters of the United States. Permits are required for the filling of wetlands (dredging is regulated under the 1899 Rivers and Harbors Act). Permits are of two types: general (a standard permit for certain classes of activities) or site-specific.

Enforcement of the CWA provisions for wetlands is overseen by the Army Corps of Engineers, EPA and in some cases the States. Most of the day to day administration of the program is implemented by the Corps of Engineers (COE). The COE issues and enforces permits, and is also responsible for delineating wetlands. EPA regions comment on permits and can enforce the provisions of the Act. EPA also helps to develop environmental criteria for wetlands. The COE can approve a state to operate the CWA wetlands program (only Maryland and New Jersey are currently approved). If a state is authorized to operate the CWA wetlands program it may issue a permit in addition to the COE issued permit. Any state can comment on wetland permits prior to issuance.

Spill Prevention Control and Countermeasure Plans

An oil and gas production, drilling, or workover facility will be subject to Spill Prevention Control and Countermeasure (SPCC) requirements if it meets the following specifications: the facility could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and have (1) a total underground buried storage capacity of more than 42,000 gallons; (2) a total aboveground oil storage capacity of more than 1,320 gallons; or (3) an aboveground oil storage capacity of more than 660 gallons in a single container. SPCC applicability is dependent on the tank's maximum design storage volume and not "safe" operating or other lesser operational volumes. For purposes of the regulation, an onshore production facility may include all wells, flowlines, separation equipment, storage facilities, gathering lines, and auxiliary non-transportation-related equipment and facilities in a single geographical oil or gas field operated by a single operator.

All facilities subject to SPCC requirements must prepare a site-specific spill prevention plan that incorporates requirements specified in 40 CFR Part 112.7. For production facilities, these include considerations for the following processes and procedures:

- Drainage
- Tank materials
- Secondary containment
- Visual inspection of tanks
- Fail-safe engineering methods for tank battery installations
- Tank repair and maintenance

- Facility transfer operations
- Inspection and testing measures
- Record-keeping
- Security
- Personnel training.

In addition, the plan must discuss spill history and spill prediction (i.e., the anticipated direction of flow). The SPCC plan must be approved by a Registered Professional Engineer who is familiar with SPCC requirements, be fully implemented, and be modified when changes are made to the facility (e.g., installation of a new tank). Regardless of whether changes have been made to the facility, the plan must be reviewed at least once every three years, and amended if new, field-proven technology may reduce the likelihood of a spill.

The SPCC plan must also address oil drilling and workover facility equipment. This portion of the plan requires that the equipment be positioned or located so as to prevent spilled oil from reaching navigable waters, that catchment basins or diversionary structures be in place, and that blowout preventers (BOPs) are installed according to state regulatory requirements.

A portion of SPCC-regulated facilities may also be subject to Facility Response Planning (FRP) requirements if they pose a threat of "substantial harm" to navigable waters. The determination of a "substantial harm" facility is made on the basis of meeting either of two sets of criteria – one involving transfer over water, and the other involving oil storage capacity or other factors. If the facility were subject to FRP requirements, it would be required to develop a facility response plan which would involve, among other requirements, identification of small, medium and worst-case discharge scenarios and response actions; a description of discharge detection procedures and equipment; detailed implementation plans for containment and disposal; diagrams of facility and surrounding layout, topography, and evacuation paths; and employee training, exercises, and drills.

Safe Drinking Water Act (SDWA)

The Underground Injection Control (UIC) program of the SDWA regulates injection wells used in the oil and gas production process for produced water disposal or for enhanced recovery. Wells used in this industry for produced water are classified as Class II. Minimum UIC Class II well requirements, as outlined in 40 CFR Part 144, involve specific construction, operation, and closure standards, as well as provisions for ensuring that the owner, operator and/or transferor of the well maintain financial responsibility and resources to plug and abandon the well. Included are casing and cementing requirements based on the depth to the injection zone, location of aquifers, and estimated injection pressures as well as other possible considerations. Operational standards involve regular (at least once every five years) mechanical integrity tests (MITs); monitoring of injection pressure, flow rate, and volume; monitoring of the nature of injected fluid as needed; and annual reporting of monitoring results. Finally, closure procedures must be performed in accordance with an approved plugging and abandonment plan, which includes the placement and composition of cement plugs, the amount of casing to be left in the hole, the estimated cost of plugging, and any proposed tests or measurements. Additional requirements may be imposed in states that have been delegated implementation of the UIC program.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

The "petroleum exclusion" is an important exemption under CERCLA requirements for the oil and gas extraction industry. Under the "hazardous substance" definition, "petroleum, including crude oil or any fraction thereof," is exempted unless specifically listed or designated under CERCLA (CERCLA section 101 (14)). Subsequent interpretation has concluded that listed hazardous substances that are normally found in crude oil, such as benzene, do not invalidate the exemption unless the concentration of these substances is increased by contamination or by addition after refining. However, specifically listed waste oils (e.g., F010, and K042 through K048) are subject to reporting requirements if spilled in excess of their established Reportable Quantities (RQs) (EPA, 1998).

Emergency Planning and Community Right-to-Know Act (EPCRA)

The oil and gas extraction industry is currently not required to report to TRI under EPCRA section 313, which requires facilities under certain SIC codes to submit annual reports of toxic chemical releases to the Toxic Release Inventory (TRI). (Please see Section VI.C., Pending and Proposed Regulatory Requirements, of this document, however, for possible future changes to this status.) However, oil and gas extraction facilities are generally responsible for other reporting obligations of EPCRA if the facility stores or manages threshold levels of specified chemicals.

Resource Conservation and Recovery Act (RCRA)

Under the 1980 Amendments to RCRA, Congress conditionally exempted certain categories of solid waste from regulation as hazardous wastes under RCRA Subtitle C including drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas. The Amendments required EPA to study these wastes to determine whether their regulation as hazardous wastes was warranted and to submit a report to Congress. In its report to Congress and in a July 1988 regulatory determination (53 FR 25446, July 6, 1988), the Agency stated that regulation as hazardous wastes under Subtitle C was not warranted and that these wastes could be controlled under other federal and state regulatory programs including a tailored RCRA Subtitle D program.

Specifically, EPA's regulatory determination for exploration and production (E&P) wastes found that the following wastes are exempt from RCRA hazardous waste management requirements. The list below identifies many, but not all, exempt wastes. In general, E&P exempt wastes are generated in "primary field operations," and not as a result of maintenance or transportation activities. Exempt wastes are typically limited to those that are intrinsically related to the production of oil or natural gas.

- Produced water;
- Drilling fluids;
- Drill cuttings;
- Rigwash;
- Drilling fluids and cuttings from offshore operations disposed of onshore;
- Well completion, treatment, and stimulation fluids;
- Basic sediment and water, and other tank bottoms from storage facilities that hold product and exempt waste;
- Accumulated materials such as hydrocarbons, solids, sand, and emulsion from production separators, fluid treating vessels, and production impoundments;
- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes;
- Workover wastes;
- Gas plant sweetening wastes for sulfur removal, including amine, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge;
- Cooling tower blowdown;
- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream);
- Packing fluids;
- Produced sand;
- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation;
- Hydrocarbon-bearing soil;
- Pigging wastes from gathering lines;
- Wastes from subsurface gas storage and retrieval, except for the listed non-exempt wastes;
- Constituents removed from produced water before it is injected or otherwise disposed of;

- Liquid hydrocarbons removed from the production stream but not from oil refining;
- Gases removed from the production stream, such as hydrogen sulfide and carbon dioxide, and volatilized hydrocarbons;
- Materials ejected from a producing well during the process known as blowdown;
- Waste crude oil from primary field operations and production; and
- Light organics volatilized from exempt wastes in reserve pits or impoundments or production equipment.

On March 22, 1993, EPA provided "clarification" regarding the scope of the E&P waste exemption for waste streams generated by crude oil and tank bottom reclaimers, oil and gas service companies, crude oil pipelines, and gas processing plants and their associated field gathering lines. (See 58 FR 15284-15287.) EPA stated that certain waste streams from these operations are "uniquely associated" with primary field operations and as such are within the scope of the RCRA Subtitle C exemption. EPA's clarification cautioned, however, that these wastes may not be exempt if they are mixed with non-exempt materials or wastes.

EPA's 1988 regulatory determination lists the following wastes as non-exempt. The list below identifies many, but not all non-exempt wastes, as well as transportation (pipeline and trucking) activities. While the following wastes are non-exempt, their regulatory status as "hazardous wastes" is dependent upon a determination of their characteristics or whether they are specifically listed as RCRA hazardous waste.

- Unused fracturing fluids or acids;
- Gas plant cooling tower cleaning wastes;
- Painting wastes;
- Oil and gas service company wastes, such as empty drums, drum rinsate, vacuum truck rinsate, sandblast media, painting wastes, spent solvents, spilled chemicals, and waste acids;
- Vacuum truck and drum rinsate from trucks and drums transporting or containing non-exempt waste;
- Refinery wastes;
- Liquid and solid wastes generated by crude oil and tank bottom reclaimers;
- Used equipment lubrication oils;
- Waste compressor oil, filters, and blowdown;
- Used hydraulic fluids;
- Waste solvents;
- Waste in transportation pipeline-related pits;
- Caustic or acid cleaners;
- Boiler cleaning wastes;

- Boiler refractory bricks;
- Incinerator ash;
- Laboratory wastes;
- Sanitary wastes;
- Pesticide wastes;
- Radioactive tracer wastes; and
- Drums, insulation, and miscellaneous solids.

EPA did not specifically address, in its 1988 regulatory determination, the status of hydrocarbon-bearing material that is recycled or reclaimed by reinjection into a crude stream. However, under existing EPA regulations, recycled oil, even if it were otherwise hazardous, could be reintroduced into the crude stream, if it is from normal operations and is to be refined along with normal process streams at a petroleum refinery facility (40 CFR Part 261.6 (a)(3)(vi).).

The Agency also determined that produced water injected for enhanced recovery is not a waste for purposes of RCRA regulation and therefore is not subject to control under RCRA Subtitle C or Subtitle D. Produced water used in this manner is considered beneficially recycled and is an integral part of some crude oil and natural gas production processes. Produced water injected in this manner is already regulated by the Underground Injection Control program under the SDWA. However, if produced water is stored in surface impoundments prior to injection, it may be subject to RCRA Subtitle D regulations.

It is important to note that some states have adopted hazardous waste regulations which differ from those that EPA has promulgated. While different in many specific areas, those state programs, by law, still must be at least as stringent as the federal programs.

Endangered Species Act (ESA)

The ESA provides a means to protect threatened or endangered species and the ecosystems that support them. It requires Federal agencies to ensure that activities undertaken on either Federal or non-Federal property do not have adverse impacts on threatened or endangered species or their habitat. In a 1995 ruling, the U.S. Supreme Court upheld interpretations of the Act that allow agencies to consider impact on habitat as a potential form of prohibited "harm" to endangered species. Agencies undertaking a Federal action (such as a BLM or MMS review of proposed oil and gas extraction production operations) must consult with the U.S. Fish and Wildlife Service, and an EIS must be prepared if "any major part of a new source will have significant adverse effect on the habitat" of a Federally- or State-listed threatened or endangered species.

VI.B.2. Offshore Requirements

This section describes laws and regulations applying to offshore production facilities that differ from those presented above for onshore facilities. It should be noted that several regulations presented in the onshore section will apply to offshore sites as well. Offshore facilities are: 1) those which are found within the Federal jurisdiction of the Outer Continental Shelf and are operated under Minerals Management Service (MMS) leases, and 2) those that are found in territorial seas and are operated under state leases. Facilities in the territorial seas are operated under both state and federal regulations and therefore some regulations discussed below may not be applicable. In addition, coastal facilities, which are generally landward of the inner boundary of the territorial seas (approximated by the shoreline) are operated under state regulations and therefore some regulations discussed below may not be applicable.

Offshore Jurisdictions

The Outer Continental Shelf (OCS) consists of the submerged lands, subsoil, and seabed, lying between the seaward extent of the states' jurisdiction and the seaward extent of federal jurisdiction. The continental shelf is the gently sloping undersea plain between a continent and the deep ocean. The United States OCS has been divided into four leasing regions. They are the Gulf of Mexico Region, the Atlantic OCS Region, the Pacific OCS Region, and the Alaska OCS Region. State jurisdiction is defined as follows. Texas and the Gulf Coast of Florida are extended 3 marine leagues (approximately 9 nautical miles) seaward from the baseline from which the breadth of the territorial sea is measured. Louisiana is extended 3 imperial nautical miles (imperial nautical miles are 6,080.2 feet) seaward of the baseline from which the breadth of the territorial sea is measured. All other states' seaward limits are extended 3 nautical miles (approximately 3.3 statute miles) seaward of the baseline from which the breadth of the territorial sea is measured. Federal jurisdiction is defined under accepted principals of international law. The seaward limit is defined as the farthest of 200 nautical miles seaward of the baseline from which the breadth of the territorial sea is measured.

Outer Continental Shelf Lands Act (OSCLA)

OCSLA establishes Federal jurisdiction over submerged lands on the Outer Continental Shelf (OCS) and requires the Secretary of the Interior to administer mineral leasing, exploration, and development on the OCS. Under the Act, leases are granted to the highest qualified responsible bidder(s), on the basis of sealed competitive bids. Objectives of the OCSLA include allowing for expeditious and orderly development of OCS resources, encouraging the development of new technology to minimize the likelihood of accidents or events that might damage the environment or endanger life or health, and ensuring that a State's regulatory protection for land, air, and water uses are considered within its jurisdiction (MMS, 1999; National Research Council, 1996).

In offshore locations, the production is limited under Title III of the Marine Protection, Research, and Sanctuaries Act (MPRSA), which provides for the designation of sanctuaries for areas of conservation, recreational, ecological, or aesthetic value. The Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) prohibit the taking of species, and can also limit the placement of offshore wells.

Clean Air Act

In offshore areas, both the CAA and regulations of the MMS govern air quality. Coastal areas and the offshore regions of the Pacific, Atlantic, and Arctic Oceans, as well as the region of the Gulf of Mexico adjacent to Florida, are subject to the CAA. Important regulations include the NESHAP and NSPS standards described above for onshore facilities.

The sections of the Gulf of Mexico adjacent to Texas, Louisiana, Mississippi, and Alabama are exempt from the 1990 CAA amendments, and instead must adhere to MMS air quality standards. These standards set limits for VOC, CO, NO_2, SO_2, and Total Suspended Particulate (TSP) pollutants, and require limits for sources that significantly affect the quality of a nonattainment area (30 CFR Part 250.45).

Additional MMS air regulations apply to offshore sites. Blowout prevention regulations (in the form of safety practices and equipment requirements) attempt to reduce accidental releases. The venting and flaring of natural gas is limited under MMS rules so that natural gas may be released only when required for safety or when the volume is small (Sustainable Environmental Law and 30 CFR Part 250.175).

Clean Water Act

In offshore locations, facilities must acquire National Pollutant Discharge Elimination System (NPDES) permits before any pollutant can be discharged from a point source in U.S. waters. Standards differ for the offshore and coastal subcategories. For offshore facilities, permits require the use of best available technology economically achievable (BAT) or best conventional pollutant control technology (BCT). Discharges from coastal facilities, which are landward of the inner boundary of the territorial seas, are mostly prohibited (Jordan, 1998; note that the definition of the coastal category for the purposes of the CWA is different than that for mineral rights, presented in Section II). An exception to the coastal discharge prohibition is for facilities in Cook Inlet, Alaska, where discharges may be made in accordance with BPT, BAT, or BCT effluent limitations.

Facilities located offshore of EPA Region 6 (and some in Regions 9 and 10) are subject to a general CWA permit that covers all facilities in certain geographic locations. Offshore exploration and production facilities in Regions 4, 9 and 10 are also permitted individually in some cases. EPA Regions 6 and 9 have an MOA with MMS whereby MMS agrees to conduct CWA preliminary inspections for EPA.

In addition to NPDES permitting requirements, offshore facilities may be subject to CWA Section 403. This section is intended to ensure that no unreasonable degradation of the marine environment occurs as a result of permitted discharges, and to ensure that sensitive ecological communities are protected. Requirements may involve ambient monitoring programs to determine degradation of marine waters, alternative assessments designed to further evaluate the consequences of various disposal options, and pollution prevention techniques designed to further reduce the quantities of pollutants requiring disposal and thereby reduce the potential for harm to the marine environment. If section 403 requirements for protection of the ecological health of marine waters are not met, an NPDES permit will not be issued.

Spill Prevention Control and Countermeasure Plans

Many aspects of SPCC rule described above for onshore facilities apply to offshore facilities as well. 40 CFR Part 112.7(e)(7) provides additional spill prevention and control measures to be addressed in SPCC plans for offshore facilities. These include:

- Oil drainage collection equipment around pumps, joints, valves, separators, tanks, etc.
- Adequately-sized sump systems
- Dump valves installed with oil-water separators and treaters
- High-level sensing devices for atmospheric storage tanks and corrosion protection for all tanks
- High pressure sensing device and shut-in valve for pipelines appurtenant to the facility.

Oil Spill Contingency Plans

Pursuant to 30 CFR 250.203, 250.204 and 254, a lessee is required to submit an Oil Spill Contingency Plan (OSCP) to MMS for approval. This plan identifies the response capabilities of lease and pipeline operators in the event an accidental oil spill occurs during drilling or production activities.

Additionally, the Oil Pollution Act of 1990 authorizes the MMS to require Oil Spill Contingency Plans from oil and gas lessees operating in state waters seaward of the coastline. Operators must join a cooperative with oil spill equipment available to members, or obtain a letter of agreement for rental of oil spill equipment. Oil Spill Coordinators must be trained. The entire Oil Spill Response Team must attend annual drills. The Plan requires annual review and update.

VI.B.3. Stripper Well Requirements

Stripper wells are identified as an individual subcategory in Clean Water Act NPDES requirements. In addition, stripper wells may be exempt from requirements under other statutes or regulations by virtue of their low production volume. For example, they may not meet the threshold of a major source of HAP for NESHAP requirements, or they may have less than the specified storage volume for SPCC rules. States and Federal agencies may also provide incentives to stripper well operators to maximize the number of these marginally profitable wells that remain operational. Reductions of severance taxes are available in some states, and BLM offers royalty rate reductions for qualifying stripper wells (Williams and Meyers, 1997; 43 CFR Part 3103.4-2).

Clean Water Act

Stripper wells are defined as onshore wells that produce less than 10 barrels of oil per day, are operating at the maximum feasible rate of production, and operate in accordance with recognized conservation practices (40 CFR Part 435.60) They are currently exempt from onshore point source discharge restrictions discussed above in Section VI.B.1. As a result, technology-based limitations instead are developed on a case-by-case basis or in a state-wide general permit.

VI.B.4. State Statutes

In addition to the federal laws described above, most oil-producing states develop other laws affecting oil and gas extraction and production. These include permitting, bonding, temporary abandonment, and plans for plugging orphan wells. Each oil-producing state has a regulatory body, and most require operators to obtain a well permit before drilling. Historically, permitting has been required in these places in order to ensure an efficient and safe mechanism for withdrawing oil from reservoirs by preventing wells from being drilled too close together (Williams and Meyers, 1997).

Nearly all oil-producing states require some form of security or financial assurance for those operators seeking a permit, in order to ensure proper plugging and abandonment. The form of assurance varies from state to state, but the most commonly accepted are surety bonds, certificates of deposit, and cash. The amount of money required for security can vary as well; the amounts range from $10,000 in Kentucky and Tennessee to a minimum of $200,000 in Alaska (IOGCC, 1996).

Laws for temporary abandonment of wells differ among states. (See Section III.B. for a discussion of temporary abandonment.) In general, States are reluctant to require plugging of wells that have significant potential for oil production (and state revenues), yet they seek to avoid problems associated with inactive and unattended wells. As a result, most states require inactive wells to gain state approval for temporary abandonment. (The term temporary abandonment is used for wells that are inactive with state approval.) Most states allow some period of time of inactivity (usually six months to one year) without approval. At this point, however, states may require a statement of future use from the operator; this statement might include extensive geological and engineering information and a schedule for returning the well to production. As part of a temporary abandonment permit, a state may require periodical mechanical integrity tests (MITs) to ensure that the temporarily abandoned well does not pose a threat to the environment (IOGCC, 1996).

Finally, many states have established plugging funds to ensure that wells that pose a threat to the environment but are without financial assurance are properly plugged. These wells, often called orphan wells (see Section III.C.), are identified and prioritized by any number of methods, and are plugged as funds become available and procurement issues are settled. Funding sources vary among states; in some states, such as Arkansas, California, and Mississippi, funding comes directly from the government's general fund or from the regulatory body's budget, while in others the programs are funded through permit fees, portions of oil taxes, bond forfeitures, or penalties (IOGCC, 1996).

In 1990, the Interstate Oil and Gas Compact Commission (IOGCC) developed guidelines for state oil and gas exploration and production waste management program. In 1991, IOGCC began reviewing state programs against the guidelines. State reviews were conducted by stakeholder teams. Review teams wrote reports of their findings, including strengths and weaknesses, and made recommendations for program improvements. Seventeen state programs were reviewed between 1991 and 1997. These reports are an excellent source of state-specific regulations and programs. State reviews can be obtained from IOGCC by calling (405) 525-3556 and from the IOGCC Website at *www.iogcc.oklaosf.state.ok.us/.* The state review program has subsequently been managed by STRONGER, Inc., a non-profit corporation. For more information on IOGCC and STRONGER, Inc., see Section VIII.A.2., State Activities.

VI.C. Pending and Proposed Regulatory Requirements

Clean Water Act (CWA)

Proposed Phase II NPDES Storm Water Regulations
Under this proposal, construction sites between one and five acres would be regulated under the NPDES storm water program. The oil and gas exploration and production industry might be impacted by this rule during onshore drilling site preparations. Possible requirements include: the submission of a Notice of Intent (NOI) that would include general information and a-certification that the activity will not impact endangered or threatened species, development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) and use of best management practices (BMP) to minimize the discharge of pollutants from the site, and submission of a Notice of Termination (NOT) when final stabilization of the site has been achieved as defined in the permit. Finalization of the rule is anticipated in November 1999 (George Utting, EPA, Office of Water, (202) 260-9530 or John Kosco, EPA, Office of Water, (202) 260-6385).

Proposed Effluent Limitations Guidelines and Standards for Synthetic-Based Drilling Fluids
This proposed rule would amend the technology-based effluent limitations guidelines and standards for the discharge of pollutants from oil and gas drilling operations associated with the use of synthetic-based drilling fluids (SBFs) and other non-aqueous drilling fluids into the waters of the United States. This proposed rule would apply to existing and new facilities in the offshore subcategory and the Cook Inlet portion of the coastal subcategory of the oil and gas extraction point source category. The final rule is scheduled for December 2000. (Carey A. Johnston, EPA, Office of Water, (202) 260-7186).

Revisions to the Oil Pollution Prevention Regulation
Three separate proposals, in 1991, 1993, and 1997, had been offered to amend the text of 40 CFR Part 112, which includes requirements for sites to develop spill prevention control and countermeasures (SPCC) plans. The current proposed rule is a consolidation of the three proposals. The goals of the new rule are to give more flexibility with paperwork and to reduce the burden of information collection for some facilities. Two considerations will be emphasized during the rule development: the importance of good engineering practices and the value of site-specific flexibility. A final rule is

R0076731

expected during Spring, 2000. (Hugo Fleischman, EPA, Office of Solid Waste and Emergency Response, (703) 603-8769).

Emergency Planning and Community Right-To-Know Act (EPCRA)

Addition of Oil and Gas Exploration and Production to the Toxic Release Inventory

A long-term consideration is the addition of the oil and gas extraction industry to regulation under EPCRA section 313, which requires reporting to the Toxics Release Inventory (TRI). The possible addition of the industry was considered carefully in 1996, but was not added at that time. The proposal may enter the proposed rule stage in December, 2000, but no definite schedule had been set at the time of the publication of this document. (Tim Crawford, EPA, Office of Prevention, Pesticides, and Toxic Substances. (202) 260-1715).

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

Until recently, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small

businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and reflect solely EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (April 1, 1992 to March 31, 1997) and the other for the most recent twelve-month period (April 1, 1996 to March 31, 1997). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across EPA Regions for certain sectors.[3] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to link separate data

[3] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

R0076734

records from EPA's databases. This allows retrieval of records from across media or statutes for any given facility, thus creating a "master list" of records for that facility. Some of the data systems accessible through IDEA are: AFS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System, Office of Solid Waste and Emergency Response), and TRIS (Toxics Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of Toxic Release Inventory (TRI) reporters within the listed SIC code range. For industries not covered under TRI reporting requirements (oil and gas extraction, metal mining, nonmetallic mineral mining, electric power generation, ground transportation, water transportation, and dry cleaning), or industries in which only a very small fraction of facilities report to TRI (e.g., printing), the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a one-year or five-year period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. A facility with multiple enforcement actions is only counted once in this column, e.g., a facility with 3 enforcement actions counts as 1 facility.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times, e.g., a facility with 3 enforcement actions counts as 3.

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions recorded as state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This ratio is a rough indicator of the relationship between inspections and enforcement. It relates the number of enforcement actions and the number of inspections that occurred within the one-year or five-year period. This ratio includes the inspections and enforcement actions reported under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA). Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. Also, this ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation

R0076736

status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Oil and Gas Extraction Industry Compliance History

Table 14 provides an overview of the reported compliance and enforcement data for the oil and gas extraction industry over the past five years (April 1992 to April 1997). These data are also broken out by EPA Regions thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Over half of the inspections (3,094) and a majority of the enforcement actions (175) during the five year period were conducted in Region VI, which comprises Texas, Oklahoma, Louisiana, New Mexico, and Arkansas. More than half of the oil and gas production activity for the nation is centered in these states.

- Region II has among the fewest facilities, but held the most inspections per facility (an average of an inspection per 12 months at each facility) and had the highest enforcement to inspection ratio (0.17).

- Region VIII had the least frequent inspections (an average of 69 months between inspections) and one of the lowest enforcement to inspection ratios (0.04).

- Nearly 80 percent of the enforcement actions were state-led. The only Region where the majority of actions were federally-led was Region X, in which many oil fields are on Federal land in Alaska.

Table 14: Five-Year Enforcement and Compliance Summary for the Oil and Gas Industry									
A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Region	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
I	3	2	5	36	0	0	0%	0%	--
II	20	12	100	12	2	17	94%	6%	0.17
III	100	26	159	38	6	7	100%	0%	0.04
IV	179	107	590	18	0	0	0%	0%	--
V	66	35	166	24	2	2	50%	50%	0.01
VI	2,666	1,097	3,094	52	93	175	75%	25%	0.06
VII	50	27	114	26	0	0	0%	0%	--
VIII	1,291	432	1,120	69	18	49	84%	16%	0.04
IX	208	124	584	21	20	48	96%	4%	0.08
X	93	40	139	40	8	11	18%	82%	0.08
TOTAL	4,676	1,902	6,071	46	149	309	79%	21%	0.05

VII.B. Comparison of Enforcement Activity Between Selected Industries

Tables 15 and 16 allow the compliance history of the oil and gas sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Tables 15 and 16 permit the identification of trends in compliance and enforcement records of the various industries by comparing data covering the last five years (April 1992 to April 1997) to that of the past year (April 1996 to April 1997). Some points evident from the data are listed below.

- Oil and gas extraction facilities are inspected much less frequently (46 months between inspections on average) than facilities in most other industries included in the following tables, and the enforcement to inspection ratio (0.05) is among the lowest of the included industries.

- Oil and gas extraction facilities have the lowest percentage of facilities with one or more violations (15 percent) and have one of the lowest percentages of facilities with enforcement actions (three percent).

- The one-year enforcement to inspection ratio (0.03) is significantly less than the five-year ratio (0.05), indicating that enforcement actions may be becoming less frequent per given number of inspections.

Tables 17 and 18 provide a more in-depth comparison between the oil and gas extraction industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Tables (Tables 15 and 16), the data cover the last five years (Table 17) and last one year (Table 18) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- The vast majority of both inspections and actions were performed under the Clean Air Act, much more so than in other industries.

- RCRA accounted for a relatively low percentage of the industry's inspections and enforcement actions compared to other industries.

- The inspections performed under RCRA yielded proportionately more actions than those performed under either CAA or CWA.

Table 15: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Metal Mining	1,232	378	1,600	46	63	111	53%	47%	0.07
Coal Mining	3,256	741	3,748	52	88	132	89%	11%	0.04
Oil and Gas Extraction	**4,676**	**1,902**	**6,071**	**46**	**149**	**309**	**79%**	**21%**	**0.05**
Non-Metallic Mineral Mining	5,256	2,803	12,826	25	385	622	77%	23%	0.05
Textiles	355	267	1,465	15	53	83	90%	10%	0.06
Lumber and Wood	712	473	2,767	15	134	265	70%	30%	0.10
Furniture	499	386	2,379	13	65	91	81%	19%	0.04
Pulp and Paper	484	430	4,630	6	150	478	80%	20%	0.10
Printing	5,862	2,092	7,691	46	238	428	88%	12%	0.06
Inorganic Chemicals	441	286	3,087	9	89	235	74%	26%	0.08
Resins and Manmade Fibers	329	263	2,430	8	93	219	76%	24%	0.09
Pharmaceuticals	164	129	1,201	8	35	122	80%	20%	0.10
Organic Chemicals	425	355	4,294	6	153	468	65%	35%	0.11
Agricultural Chemicals	263	164	1,293	12	47	102	74%	26%	0.08
Petroleum Refining	156	148	3,081	3	124	763	68%	32%	0.25
Rubber and Plastic	1,818	981	4,383	25	178	276	82%	18%	0.06
Stone, Clay, Glass and Concrete	615	388	3,474	11	97	277	75%	25%	0.08
Iron and Steel	349	275	4,476	5	121	305	71%	29%	0.07
Metal Castings	669	424	2,535	16	113	191	71%	29%	0.08
Nonferrous Metals	203	161	1,640	7	68	174	78%	22%	0.11
Fabricated Metal Products	2,906	1,858	7,914	22	365	600	75%	25%	0.08
Electronics	1,250	863	4,500	17	150	251	80%	20%	0.06
Automobile Assembly	1,260	927	5,912	13	253	413	82%	18%	0.07
Aerospace	237	184	1,206	12	67	127	75%	25%	0.10
Shipbuilding and Repair	44	37	243	9	20	32	84%	16%	0.13
Ground Transportation	7,786	3,263	12,904	36	375	774	84%	16%	0.06
Water Transportation	514	192	816	38	36	70	61%	39%	0.09
Air Transportation	444	231	973	27	48	97	88%	12%	0.10
Fossil Fuel Electric Power	3,270	2,166	14,210	14	403	789	76%	24%	0.06
Dry Cleaning	6,063	2,360	3,813	95	55	66	95%	5%	0.02

Table 16: One-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations: Number	Facilities with 1 or More Violations: Percent*	Facilities with 1 or more Enforcement Actions: Number	Facilities with 1 or more Enforcement Actions: Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Metal Mining	1,232	142	211	102	72%	9	6%	10	0.05
Coal Mining	3,256	362	765	90	25%	20	6%	22	0.03
Oil and Gas Extraction	**4,676**	**874**	**1,173**	**127**	**15%**	**26**	**3%**	**34**	**0.03**
Non-Metallic Mineral Mining	5,256	1,481	2,451	384	26%	73	5%	91	0.04
Textiles	355	172	295	96	56%	10	6%	12	0.04
Lumber and Wood	712	279	507	192	69%	44	16%	52	0.10
Furniture	499	254	459	136	54%	9	4%	11	0.02
Pulp and Paper	484	317	788	248	78%	43	14%	74	0.09
Printing	5,862	892	1,363	577	65%	28	3%	53	0.04
Inorganic Chemicals	441	200	548	155	78%	19	10%	31	0.06
Resins and Manmade Fibers	329	173	419	152	88%	26	15%	36	0.09
Pharmaceuticals	164	80	209	84	105%	8	10%	14	0.07
Organic Chemicals	425	259	837	243	94%	42	16%	56	0.07
Agricultural Chemicals	263	105	206	102	97%	5	5%	11	0.05
Petroleum Refining	156	132	565	129	98%	58	44%	132	0.23
Rubber and Plastic	1,818	466	791	389	83%	33	7%	41	0.05
Stone, Clay, Glass and Concrete	615	255	678	151	59%	19	7%	27	0.04
Iron and Steel	349	197	866	174	88%	22	11%	34	0.04
Metal Castings	669	234	433	240	103%	24	10%	26	0.06
Nonferrous Metals	203	108	310	98	91%	17	16%	28	0.09
Fabricated Metal	2,906	849	1,377	796	94%	63	7%	83	0.06
Electronics	1,250	420	780	402	96%	27	6%	43	0.06
Automobile Assembly	1,260	507	1,058	431	85%	35	7%	47	0.04
Aerospace	237	119	216	105	88%	8	7%	11	0.05
Shipbuilding and Repair	44	22	51	19	86%	3	14%	4	0.08
Ground Transportation	7,786	1,585	2,499	681	43%	85	5%	103	0.04
Water Transportation	514	84	141	53	63%	10	12%	11	0.08
Air Transportation	444	96	151	69	72%	8	8%	12	0.08
Fossil Fuel Electric Power	3,270	1,318	2,430	804	61%	100	8%	135	0.06
Dry Cleaning	6,063	1,234	1,436	314	25%	12	1%	16	0.01

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Table 17: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	378	1,600	111	39%	19%	52%	52%	8%	12%	1%	17%
Coal Mining	741	3,748	132	57%	64%	38%	28%	4%	8%	1%	1%
Oil and Gas Extraction	**1,902**	**6,071**	**309**	**75%**	**65%**	**16%**	**14%**	**8%**	**18%**	**0%**	**3%**
Non-Metallic Mineral Mining	2,803	12,826	622	83%	81%	14%	13%	3%	4%	0%	3%
Textiles	267	1,465	83	58%	54%	22%	25%	18%	14%	2%	6%
Lumber and Wood	473	2,767	265	49%	47%	6%	6%	44%	31%	1%	16%
Furniture	386	2,379	91	62%	42%	3%	0%	34%	43%	1%	14%
Pulp and Paper	430	4,630	478	51%	59%	32%	28%	15%	10%	2%	4%
Printing	2,092	7,691	428	60%	64%	5%	3%	35%	29%	1%	4%
Inorganic Chemicals	286	3,087	235	38%	44%	27%	21%	34%	30%	1%	5%
Resins and Manmade Fibers	263	2,430	219	35%	43%	23%	28%	38%	23%	4%	6%
Pharmaceuticals	129	1,201	122	35%	49%	15%	25%	45%	20%	5%	5%
Organic Chemicals	355	4,294	468	37%	42%	16%	25%	44%	28%	4%	6%
Agricultural Chemicals	164	1,293	102	43%	39%	24%	20%	28%	30%	5%	11%
Petroleum Refining	148	3,081	763	42%	59%	20%	13%	36%	21%	2%	7%
Rubber and Plastic	981	4,383	276	51%	44%	12%	11%	35%	34%	2%	11%
Stone, Clay, Glass and Concrete	388	3,474	277	56%	57%	13%	9%	31%	30%	1%	4%
Iron and Steel	275	4,476	305	45%	35%	26%	26%	28%	31%	1%	8%
Metal Castings	424	2,535	191	55%	44%	11%	10%	32%	31%	2%	14%
Nonferrous Metals	161	1,640	174	48%	43%	18%	17%	33%	31%	1%	10%
Fabricated Metal	1,858	7,914	600	40%	33%	12%	11%	45%	43%	2%	13%
Electronics	863	4,500	251	38%	32%	13%	11%	47%	50%	2%	7%
Automobile Assembly	927	5,912	413	47%	39%	8%	9%	43%	43%	2%	9%
Aerospace	184	1,206	127	34%	38%	10%	11%	54%	42%	2%	9%
Shipbuilding and Repair	37	243	32	39%	25%	14%	25%	42%	47%	5%	3%
Ground Transportation	3,263	12,904	774	59%	41%	12%	11%	29%	45%	1%	3%
Water Transportation	192	816	70	39%	29%	23%	34%	37%	33%	1%	4%
Air Transportation	231	973	97	25%	32%	27%	20%	48%	48%	0%	0%
Fossil Fuel Electric Power	2,166	14,210	789	57%	59%	32%	26%	11%	10%	1%	5%
Dry Cleaning	2,360	3,813	66	56%	23%	3%	6%	41%	71%	0%	0%

Table 18: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	142	211	10	52%	0%	40%	40%	8%	30%	0%	30%
Coal Mining	362	765	22	56%	82%	40%	14%	4%	5%	0%	0%
Oil and Gas Extraction	**874**	**1,173**	**34**	**82%**	**68%**	**10%**	**9%**	**9%**	**24%**	**0%**	**0%**
Non-Metallic Mineral Mining	1,481	2,451	91	87%	89%	10%	9%	3%	2%	0%	0%
Textiles	172	295	12	66%	75%	17%	17%	17%	8%	0%	0%
Lumber and Wood	279	507	52	51%	30%	6%	5%	44%	25%	0%	40%
Furniture	254	459	11	66%	45%	2%	0%	32%	45%	0%	9%
Pulp and Paper	317	788	74	54%	73%	32%	19%	14%	7%	0%	1%
Printing	892	1,363	53	63%	77%	4%	0%	33%	23%	0%	0%
Inorganic Chemicals	200	548	31	35%	59%	26%	9%	39%	25%	0%	6%
Resins and Manmade Fibers	173	419	36	38%	51%	24%	38%	38%	5%	0%	5%
Pharmaceuticals	80	209	14	43%	71%	11%	14%	45%	14%	0%	0%
Organic Chemicals	259	837	56	40%	54%	13%	13%	47%	34%	0%	0%
Agricultural Chemicals	105	206	11	48%	55%	22%	0%	30%	36%	0%	9%
Petroleum Refining	132	565	132	49%	67%	17%	8%	34%	15%	0%	10%
Rubber and Plastic	466	791	41	55%	64%	10%	13%	35%	23%	0%	0%
Stone, Clay, Glass and Concrete	255	678	27	62%	63%	10%	7%	28%	30%	0%	0%
Iron and Steel	197	866	34	52%	47%	23%	29%	26%	24%	0%	0%
Metal Castings	234	433	26	60%	58%	10%	8%	30%	35%	0%	0%
Nonferrous Metals	108	310	28	44%	43%	15%	20%	41%	30%	0%	7%
Fabricated Metal	849	1,377	83	46%	41%	11%	2%	43%	57%	0%	0%
Electronics	420	780	43	44%	37%	14%	5%	43%	53%	0%	5%
Automobile Assembly	507	1,058	47	53%	47%	7%	6%	41%	47%	0%	0%
Aerospace	119	216	11	37%	36%	7%	0%	54%	55%	1%	9%
Shipbuilding and Repair	22	51	4	54%	0%	11%	50%	35%	50%	0%	0%
Ground Transportation	1,585	2,499	103	64%	46%	11%	10%	26%	44%	0%	1%
Water Transportation	84	141	11	38%	9%	24%	36%	38%	45%	0%	9%
Air Transportation	96	151	12	28%	33%	15%	42%	57%	25%	0%	0%
Fossil Fuel Electric Power	1,318	2,430	135	59%	73%	32%	21%	9%	5%	0%	0%
Dry Cleaning	1,234	1,436	16	69%	56%	1%	6%	30%	38%	0%	0%

VII.C. Review of Major Legal Actions

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs).

VII.C.1. Review of Major Cases

As indicated in EPA's *Enforcement Accomplishments Report* publications for FY 1996, FY 1997, and FY 1998 and a U.S. Department of Justice press release, seven significant enforcement actions have been resolved recently for the oil and gas extraction industry.

Three cases involved violations of the Clean Water Act. Two cases involved violations of National Pollution Discharge Elimination System (NPDES) discharge limits. The Cook Inlet Oil and Gas Platforms (owned by Marathon. Shell, and Unocal) agreed to pay $212,000 for allegedly violating NPDES permits for 18 offshore platforms in Cook Inlet, Alaska. In a separate settlement, BP Exploration, Inc. agreed to pay $59,900 in response to an administrative complaint that the levels of fecal coliform bacteria, BOD, TRC, pH and flow were beyond its NPDES permit levels between January 1992 and October 1995.

The CWA violation settled in U.S. v. Berry Petroleum was part of a multi-agency (federal and state) case relating to a crude oil spill of 2,000 barrels from an oil production facility in a wetland area located adjacent to a California state beach. The spill contaminated the wetlands, adjacent ocean, and nearby beaches. It was determined that the spill occurred, in large part, because the facility failed to implement its EPA-mandated SPCC plan. Berry Petroleum paid $800,000 to EPA for the CWA violation in addition to $1.06 million in penalties to the California Regional Water Quality Control Board, the U.S. Fish and Wildlife Service, and other federal and state agencies. Berry also transferred $1,315,000 to a trust fund administered by the National Fish and Wildlife Foundation that will be used for long term restoration of the site.

A settlement in U.S. (Sac and Fox Nation) v. Tenneco Oil Company was reached over an alleged SDWA violation. Surface and groundwater on land of the Sac and Fox Nation was contaminated near areas of oil leases maintained by Tenneco between 1924 and 1989. Tenneco is required to provide the Sac and Fox Nation with a potable water supply of 207 sustainable gallons per minute and $1.16 million in cash. The overall dollar value of the settlement is over $3.5 million.

An alleged CAA violation was settled with Vastar Resources, Inc. and ARCO, regarding their facility on the Southern Ute Indian Reservation in La Plata County, CO. Vastar (the current owner) and ARCO (the previous owner) failed to install pollution control equipment on gas production engines at the facility. The results were large emissions of carbon monoxide (CO) and savings of $657,412 on the part of Vastar by operating the equipment without the required air emission controls. Vastar complied with EPA self-policing policies, and as a result the company only paid $137,949 plus $247,000 for the pollution control equipment. Although ARCO came forward at the same time as Vastar, it did not report the emissions while it owned the facility, and as a result did not meet EPA's self-disclosure standards. ARCO did not admit to the allegations, but settled for $519,463, which includes money saved from not using the equipment plus a penalty.

In September 1999, the Department of Justice announced that BP Exploration (Alaska) Inc. pleaded guilty to one felony count related to the illegal disposal of hazardous waste on Alaska's North Slope in violation of CERCLA. BP Exploration had contracted with Doyan Drilling Inc. to drill production wells on Endicott Island. Between 1993 and 1995 Doylan employees illegally injected wastes down the outer rim, or annuli, of the oil wells. BP Exploration failed to report the illegal injections as soon as it learned of the conduct. The wastes included paint thinner and toxic solvents containing lead and chemicals such as benzene, toluene, and methyl chloride. BP Exploration was fined $500,000 and agreed to spend a total of $22 million to resolve the criminal case and related civil claims. The civil settlement requires BP Exploration to pay $6.5 million in penalties to resolve allegations that BP illegally disposed of the hazardous waste and violated the Safe Drinking Water Act. Also under the terms of the agreement, BP Exploration will establish an environmental management system at all of BP Amoco's facilities in the U.S. and Gulf of Mexico that are engaged in the exploration, drilling, or production of oil (U.S. Department of Justice, September 23, 1999).

VII.C.2. Supplementary Environmental Projects (SEPs)

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the internet at the SEP National Database, es.epa.gov/oeca/sep/. This information is not comprehensive and provides only a sample of the types of SEPs developed for the oil and gas extraction industry.

One agreement was listed for SIC code 13. George Perry Exploration and Production, in Oceana County, MI, performed a SEP in response to violations of sections 1421 and 1422 of SDWA, in which the company violated the state underground injection control (UIC) program regulations and failed to submit an application for implementation of a UIC program. As a pollution reduction SEP, the company plugged three abandoned production wells to prevent the possible contamination of underground sources of drinking water. The cost of the project was valued at $6,000.

VIII. COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those initiated independently by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

VIII.A.1. Federal Activities

EPA Regional Compliance and Enforcement Activities

Several significant regional activities relating to the oil and gas extraction industry were reported in the 1997 Enforcement and Compliance Assurance Reports. Region VI provided assistance to offshore oil and gas exploration and production facilities with regard to NPDES permits. Region VI sent reporting forms to more than 2,000 facilities for compliance monitoring and reporting of the effluent quality of wastewater discharges from offshore platforms to the Gulf of Mexico. General permitting and reporting questions were explained to increase compliance through approximately 300 telephone conversations with facility operators, consultant, and state and federal agencies. Finally, a presentation on NPDES Offshore General Permit compliance and enforcement was given to approximately 100 permittees in Dallas. Partially as a result of these efforts, the compliance reporting rate is approximately 98 percent.

Region VI also created a work group that addressed the compliance and reporting of over 3,000 injection wells operated by 500 to 600 oil producers in the Osage Mineral Reserve. The group created *Osage Operators' Environmental Handbook* and *Osage Operators' Environmental Manual*, in order to assist small oil producers in complying with Bureau of Indian Affairs (BIA) and EPA requirements.

Region VIII, the U.S. Fish and Wildlife Service (USFWS) and associated states implemented a pilot program regarding problem oil pits (POPs). POPs are open-air pits along with tanks and associated spills at drilling and production sites that lack devices (such as proper netting) to prevent birds from landing on (and becoming stuck in) the layer of oil. This program seeks to address impacts to ground water and surface water as well as impacts to wildlife. The program cooperated with federal and state regulators (Bureau of Land Management, state environmental agencies, and state oil and gas commissions) to perform aerial surveys and ground surveys of oil pits in Colorado, Montana, and Wyoming. The states had the lead whenever possible. It was found that a large number of the pits would be considered POPs and were in noncompliance with applicable federal and state statutes or regulations. To address the high rate of noncompliance, the relevant agencies are mobilizing to offer compliance assistance, informal enforcement, or formal enforcement. All EPA Region VIII states have been completed for this POP effort except Utah, which is planned for completion in 1999 and EPA regions 5 and 7 are pursuing POP programs.

U.S. Department of Energy Oil and Gas Environmental Research and Analysis Program

The Office of Fossil Energy of the Department of Energy (DOE) has initiated several programs that address environmental and regulatory issues in the oil and gas industry. The efforts primarily center around streamlining regulatory procedures that affect the industry and performing research on cost-effective environmental compliance technologies.

The regulatory streamlining efforts attempt three major tasks: coordinating the many federal and state agencies involved with oil and gas regulation, including EPA, the Bureau of Land Management (BLM), and relevant state agencies; incorporating more risk-based decision making into regulatory, enforcement, and compliance decisions; and reducing impediments to technology implementation.

In its efforts to coordinate regulatory agencies, DOE worked with a group including the Interstate Oil and Gas Compact Commission (IOGCC), BLM, industry, and environmental groups to standardize permit applications in different states and on federal lands. The group also identified seven areas of regulatory responsibility that could be transferred from federal to state agencies to reduce overlapping activities within states.

DOE is also attempting to broaden the use of risk-based decision making. In one project, DOE is working with California, Kansas, and Oklahoma to expand exemptions for costly Area of Review (AOR) analyses of surrounding areas prior to the permitting of a disposal or injection well. AOR analyses investigate the potential of aquifer contamination by a proposed disposal well; new DOE methodology would limit the necessity of AOR studies in areas predetermined to have little risk.

The DOE environmental program also works to remove impediments to technology implementation. An example is shown in the case of newly developed synthetic drilling fluids, which show promise in increasing drilling efficiency and safety, particularly in deepwater drilling. Existing EPA regulations, however, limit their use. In 1994, DOE worked with industry and EPA to re-evaluate the regulations that affect these synthetic fluids. Consequently, EPA is in the process of revising regulations to clarify the terms under which industry may be allowed to use the technology. The use of these fluids could save the industry over $50 million annually.

Finally, DOE is assisting in the development of pollution prevention and waste management technologies. DOE's Sandia National Laboratories are developing a laser-equipped camera that can detect methane leaks in pipes. Argonne National Laboratory is undertaking a study to determine whether naturally occurring radioactive material (NORM), which may be found in well fluids, can be disposed of on-site in some locations, in order to reduce disposal costs. DOE also performs or funds research on produced water disposal; this includes further investigation into underground injection systems and development of a treatment for produced water into potable water in arid regions such as California. (Contact: *www.fe.doe.gov/oil_gas/oilgas7.html* or William Hochheiser, Environmental Scientist, at (202) 586-5614 or e-mail william.hochheiser@hq.doe.gov.)

U.S. EPA Voluntary Self-Disclosure Policy

In 1996, EPA adopted its final policy on incentives for self-evaluation and self-disclosure of violations. Through this policy, the Agency aims to protect public health and the environment by reducing civil penalties and not recommending criminal prosecution for regulated entities that voluntarily discover, disclose and correct violations under the environmental laws that EPA administers.

Under the final policy, where violations are found through voluntary environmental audits or efforts that reflect a regulated entity's due diligence (i.e., systematic efforts to prevent, detect and correct violations, as defined in the policy), and all of the policy's conditions are met, EPA will not seek gravity-based penalties and will generally not recommend criminal prosecution against the company if the violation results from the unauthorized criminal conduct of an employee. Where violations are discovered by means other than environmental audits or due diligence efforts, but are promptly disclosed and expeditiously corrected, EPA will reduce gravity-based penalties by 75 percent provided that all of the other conditions of the policy are met. EPA retains its discretion to recover economic benefit gained as a result of noncompliance, so that companies won't be able to obtain an economic advantage over their competitors by delaying their investment in compliance.

In addition to prompt disclosure and correction, the policy requires companies to prevent recurrence of the violation and to remedy any environmental harm. Repeated violations or those which may have presented an imminent and substantial endangerment or resulted in serious harm are excluded from the policy's coverage. Corporations remain criminally liable for violations resulting from conscious disregard of their legal duties, and individuals remain liable for criminal wrongdoing.

Although the final policy restates EPA's practice of not routinely requesting environmental audit reports, it does contain two provisions ensuring public access to information. First, EPA may require as a condition of penalty mitigation that a description of the regulated entity's due diligence efforts be made publicly available. Second, where EPA requires that a regulated entity enter into a written agreement, administrative consent order or judicial consent decree to satisfy the policy's conditions, those agreements will be made publicly available.

VIII.A.2. State Activities

The oil and gas industry is primarily regulated at the state level. Four organizations are discussed in this section that strongly influence state compliance assurance and waste minimization initiatives. Interstate Oil and Gas Compact Commission (IOGCC) coordinates oil and gas issues among oil and gas producing states, including environmental concerns. State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER, Inc.) is a non-profit corporation that develops guidelines for state oil and gas production waste regulatory programs and coordinates state reviews. The Ground Water Protection Council (GWPC) brings together state and federal regulators, industry, and others to address both underground injection control and groundwater protection issues. Finally, the Waste Minimization Program of the Texas Railroad Commission is in many ways a model for other states in disseminating cost-effective waste minimization solutions. While many states have waste minimization programs for underground injection wells, the Texas Railroad Commission has a unique structure among state governments of oil producing states as the regulator of nearly every aspect of the oil and gas extraction industry. The Waste Minimization Program therefore has a wider reach over the industry in the state.

Interstate Oil and Gas Compact Commission (IOGCC)

The IOGCC is an organization of the governors of 30 member states and seven associate states concerned with many aspects of the oil and gas industry. The primary purpose of the compact is to conserve oil and gas by the prevention of physical waste. IOGCC advocates for the rights of the states to govern oil and gas issues within their own borders, and coordinates regulatory efforts among the states to protect oil and gas resources and protect the environment. The organization serves as a forum for government, industry, environmentalists and others to share information and voice opinions on a wide range of topics.

Specifically relating to environmental issues, IOGCC is active in developing state regulatory standards, guidelines, and models for many aspects of the oil and gas industry, including bioremediation, waste disposal, waste minimization, beneficial use of waste, water and air quality, and abandoned sites. One of the most prominent of the IOGCC's efforts with respect to environmental issues has been the development of guidelines and reviews of state extraction and production waste management regulatory programs. Seventeen states representing over 90 percent of the onshore production in the United States have undergone these reviews, and summaries of the reviews are published in individual reports. These reports, in addition to other IOGCC publications, are an excellent source of state-specific regulations and programs. State reviews can be obtained from IOGCC by calling (405) 525-3556, and from the IOGCC Website at: www.iogcc.oklaosf.state.ok.us/. Since mid-1999, the state review program has been managed by STRONGER, Inc., a non-profit organization. Also, the IOGCC, through its annual Environmental Stewardship Awards recognizes major and independent operators that are performing environmentally beneficial projects.

State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER, Inc.)

The state review process described above, established by IOGCC, developed guidelines for state oil and gas exploration and production waste regulatory programs and coordinated reviews of state programs until 1997, when the process was terminated. During 1998, several meetings of interested stakeholders were conducted to determine how the process could be revitalized. In early 1999, the IOGCC proposed to EPA that the program be managed by a separate group of stakeholders equally representing the states, industry, and environmental organizations. Such a group was formed, and in June, 1999, was incorporated as a non-profit corporation, State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER, Inc.). STRONGER, Inc. develops updated and revised guidelines for adoption by IOGCC and coordinates state reviews. Guidelines, documents and state review reports are published and distributed by IOGCC. State participation in STRONGER, Inc. is coordinated through the IOGCC State Review Committee.

Ground Water Protection Council (GWPC)

The Ground Water Protection Council (GWPC) is a nonprofit organization whose members consist of state and federal ground water agencies, industry representatives, environmentalists, and concerned citizens. The council seeks to promote and ensure the use of best management practices and fair but effective laws regarding comprehensive ground water protection. The

GWPC works with the oil and gas industry via its UIC Class II Division. GWPC can be contacted by calling (405) 516-4972 or visiting their website at http://gwpc.site.net/.

Texas Waste Minimization Program

The Waste Minimization Program, run by the Texas Railroad Commission, is a voluntary program intended to provide oil and gas well operators with cost effective waste minimization solutions. The program serves as a technology transfer clearinghouse for information on specific waste streams, such as fugitive VOCs or produced water. The program also performs several forms of outreach:

- A manual outlining general techniques, *Waste Minimization in the Oil Field.*
- One-day workshops.
- A *Waste Minimization Newsletter*, which illustrates case studies of cost-effective programs implemented by operators (the newsletter is published two or three times a year).
- On-site assistance to help operators assess their operations and to develop individualized waste minimization programs.
- WasteMin, an easy-to-use waste minimization planning software package.

The program focuses on discovering and spreading innovative techniques that will add revenue for operators in addition to reducing environmental impacts. (Contact: Jack Ward, (512) 475-4580, or *www.rrc.state.tx.us/divisions/og/key-programs/ogkwast.html*.)

VIII.B. EPA Voluntary Programs

Natural Gas STAR

Natural Gas STAR is a voluntary partnership between EPA and the natural gas industry that was formed to find cost-effective ways of reducing emissions of methane. Methane is a significant concern with regard to the climate change issue; it is second only to carbon dioxide as a component of so-called "greenhouse gases."

Fugitive emissions from the natural gas industry are a substantial source of anthropogenic methane. Natural Gas STAR has two programs: one focusing on production and the other concentrating on distribution and transmission. The program for producers was launched in 1995, and participants represent approximately 35 percent of the U.S. natural gas production. The primary goals of the producers program are to promote technology transfer and implement best management practices (BMPs) that are cost-effective and that reduce methane emissions. Partners perform the following:

- Submit and execute BMP implementation plans
- Assist in the testing of emerging technologies
- Design new facilities to include BMPs when cost effective.

EPA serves to facilitate the transfer of new technology between members, perform outreach to inform and attract non-members, and address regulatory barriers that may threaten BMP implementation.

By mid-1998, partners had prevented the release of roughly 50 billion cubic feet (Bcf) of methane, worth approximately $100 million. The program has achieved this mark and plans to continue improvements by holding workshops for satellite offices of both member and non-member companies and updating members on new developments through newsletters and reports, among other activities. (Contact: www.epa.gov/gasstar or Paul Gunning at (202) 564-9736).

33/50 Program

The 33/50 Program is a groundbreaking program that has focused on reducing pollution from seventeen high-priority chemicals through voluntary partnerships with industry. The program's name stems from its goals: a 33% reduction in toxic releases by 1992, and a 50% reduction by 1995, against a baseline of 1.5 billion pounds of releases and transfers in 1988. The results have been impressive: 1,300 companies joined the 33/50 Program (representing over 6,000 facilities) and reached the national targets a year ahead of schedule. The 33% goal was reached in 1991, and the 50% goal -- a reduction of 745 million pounds of toxic wastes -- was reached in 1994.

Table 19 lists those companies participating in the 33/50 program that reported four-digit SIC codes within 13 to TRI. Some of the companies shown also listed facilities that are not producing oil and gas. The number of facilities within each company that are participating in the 33/50 program and that report oil and gas extraction SIC codes is shown.

Since oil and gas facilities are not currently required to report to TRI under EPCRA section 313 reporting requirements (TRI), only a few oil and gas extraction companies participated in the 33/50 program. Where available and quantifiable against 1988 releases and transfers, each company's 33/50 goals

R0076753

for 1995 and the actual total releases and transfers and percent reduction between 1988 and 1995 are presented. In each case, the participating oil and gas extraction operations of the partner companies performed significantly better than the company-wide goals, and nearly all facilities attained greater than 50 percent reductions in 33/50 chemicals.

Table 19 shows that six companies comprised of 80 facilities reporting SIC 13 participated in the 33/50 program. For those companies shown with more than one oil and gas facility, all facilities may not have participated in 33/50. The 33/50 goals shown for companies with multiple oil and gas facilities, however, are company-wide, potentially aggregating more than one facility and facilities not carrying out oil and gas extraction operations. In addition to company-wide goals, individual facilities within a company may have had their own 33/50 goals or may be specifically listed as not participating in the 33/50 program. Since the actual percent reductions shown in the last column apply to all of the companies' oil and gas facilities and only oil and gas facilities, direct comparisons to those company goals incorporating non-oil and gas facilities may not be possible. For information on specific facilities participating in 33/50, or to review case studies on corporate accomplishments in reducing waste contact David Sarokin, (202) 260-6907, at the 33/50 Program Office.

With the completion of the 33/50 program, several lessons were learned. Industry and the environment benefitted by this program for several reasons. Companies were willing to participate because cost savings and risk reduction were measurable and no additional record keeping and reporting was required. The goals of the program were clear and simple and EPA allowed industry to achieve the goals in whatever manner they could. Therefore, when companies can see the benefits of environmental programs and be an active part of the decision-making process, they are more likely to participate.

Table 19: Oil and Gas Industry Participation in the 33/50 Program

Parent Company (Headquarters Location)	Company-Owned Oil and Gas Facilities Reporting 33/50 Chemicals	Company-Wide % Reduction Goal[1] (1988-1995)	1988 TRI Releases and Transfers of 33/50 Chemicals (pounds)	1995 TRI Releases and Transfers of 33/50 Chemicals (pounds)	Actual % Reduction for Oil and Gas Facilities (1988-1995)
Amerada Hess Corp. New York, NY	4	50%	2,241,601	567,251	75%
Atlantic Richfield Co. Los Angeles, CA	11	23%	835,443	451,818	46%
Dresser Industries, Inc. Dallas, TX	10	47%	230,202	17,578	92%
Exxon Corp. Irving, TX	17	50%	5,155,264	2,159,535	58%
Texaco, Inc. White Plains, NY	14	49%	713,136	251,152	65%
USX Corp. Pittsburgh, PA	24	25%	9,873,833	1,246,246	87%
TOTAL	80	--	19,049,479	4,693,580	75%

Source: U.S. EPA, OPPTS, 33/50 Program 1998
[1] Company-Wide Reduction Goals aggregate all company-owned facilities which may include facilities not involved with oil and gas production.

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by providing participants regulatory flexibility on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific environmental objectives that the regulated entity shall satisfy. EPA will provide regulatory flexibility as an incentive for the participants' superior environmental performance. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including industrial facilities, communities, and government facilities regulated by EPA. Applications will be accepted on a rolling basis. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Fax-on-Demand Hotline (202) 260-8590, Web: www.epa.gov/ProjectXL, or Christopher Knopes in EPA's Office of Reinvention, (202) 260-9298).

Energy Star® Buildings and Green Lights® Partnership

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy-efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings-- a strategy that optimizes whole-building energy-efficiency opportunities.

The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of 110 billion dollars a year. If implemented in every U.S. commercial and industrial building, Energy Star® Buildings' upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to 25 billion dollars annually.

The over 2,500 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. As of January 1, 1998, Energy Star®Buildings and Green Lights® Program participants have reduced their annual energy use by 7 billion kilowatt hours and annually save more than 517 million dollars. By joining, participants agree to upgrade 90 percent of their owned facilities with energy-efficient lighting and 50 percent of their owned facilities with whole-building upgrades, where profitable, over a seven-year period. Energy Star participants first reduce their energy loads with the Green Lights approach to building tune-ups, then focus on "right sizing" their heating and cooling equipment to match their new energy needs. EPA predicts this strategy will prevent more than 5.5 MMTCE of carbon dioxide by the year 2000. EPA's Office of Air and Radiation is responsible for operating the Energy Star Buildings and Green Lights Program. (Contact the Energy Star Hotline number, (888) STAR-YES ((888) 872-7937) or Maria Tikoff Vargas, Co-Director at (202) 564-9178 or visit the website at www.epa.gov/buildings.)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste prevention, recycling collection and the manufacturing and purchase of recycled products. As of 1998, the program had about 700 business, government, and institutional partners. Partners agree to identify and implement actions to reduce their solid wastes setting waste reduction goals and providing EPA with yearly progress reports for a three year period. EPA, in turn, provides partners with technical assistance, publications, networking opportunities, and national and regional recognition. (Contact: WasteWi$e Hotline at (800) 372-9473).

NICE^3

The U.S. Department of Energy sponsors a grant program called *National Industrial Competitiveness through Energy, Environment, and Economics* (NICE^3). The NICE^3 program provides funding to state and industry partnerships (large and small business) for projects demonstrating advances in energy efficiency and clean production technologies. The goal of the NICE^3 program is to demonstrate the performance and economics of innovative technologies in the U.S., leading to the commercialization of improved industrial manufacturing processes. These processes should conserve energy, reduce waste, and improve industrial cost-competitiveness. Industry applicants must submit project proposals through a state energy, pollution prevention, or business development office. The following focus industries, which represent the dominant energy users and waste generators in the U.S. manufacturing sector, are of particular interest to the program: Aluminum, Chemicals, Forest Products, Glass, Metal-casting, and Steel. Awardees receive a one-time, three-year grant of up to $400,000, representing up to 50 percent of a project's total cost. In addition, up to $25,000 is available to support the state applicant's cost share. (Contact: www.oit.doe.gov/Access/nice3, Steve Blazek, DOE, (303) 275-4723 or Eric Hass, DOE, (303) 275-4728)

Design for the Environment (DfE) Program

DfE is working with several industries to identify cost-effective pollution prevention strategies that reduce risks to workers and the environment. DfE helps businesses compare and evaluate the performance, cost, pollution prevention benefits, and human health and environmental risks associated with existing and alternative technologies. The goal of these projects is to encourage businesses to consider and use cleaner products, processes, and technologies. For more information about the DfE Program, call (202) 260-1678. To obtain copies of DfE materials or for general information about DfE, contact EPA's Pollution Prevention Information Clearinghouse at (202) 260-1023 or visit the DfE Website at www.epa.gov/dfe.

Small Business Compliance Assistance Centers

The Office of Compliance, in partnership with industry, academic institutions, environmental groups, and other federal and state agencies, has established national Compliance Assistance Centers for nine specific industry sectors heavily populated with small businesses that face substantial federal regulation. These sectors are printing, metal finishing, automotive services and repair, agriculture, commercial transportation, paint and coating applications, the printed wiring board industry, municipalities and small chemical manufacturers.

The purpose of the Centers is to improve compliance of the customers they serve by increasing their awareness of the pertinent federal regulatory requirements and by providing the information that will enable them to achieve compliance. The Centers accomplish this by offering the following:

- "First-Stop Shopping" - serve as the first place that small businesses and technical assistance providers go to get comprehensive, easy to understand compliance information targeted specifically to industry sectors.

- "Improved Information Transfer" - via the Internet and other means, create linkages between the small business community and providers of technical and regulatory assistance and among the providers themselves to share tools and knowledge and prevent duplication of efforts.

- "Compliance Assistance Tools" - develop and disseminate plain-English guides, consolidated checklists, fact sheets, and other tools where needed by small businesses and their information providers.

- "Links Between Pollution Prevention and Compliance Goals" - provide easy access to information and technical assistance on technologies to help minimize waste generation and maximize environmental performance.

- "Information on Ways to Reduce the Costs of Compliance" - identify technologies and best management practices that reduce pollution while saving money.

For general information regarding EPA's compliance assistance centers, contact Tracy Back at (202) 564-7076.

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Industry Research Programs

American Petroleum Institute- Strategies for Today's Environmental Partnership (STEP)

The STEP (Strategies for Today's Environmental Partnership) program was developed by API member companies to address public environmental concerns by improving the industry's environmental, health, and safety performance; documenting performance improvements; and communicating them to the public. The foundation for STEP is the API Environmental Mission and the API Guiding Environmental Principles. The program also includes a series of environmental strategic plans; a review and revision of existing industry standards; documentation of industry environmental, health, and safety performance; and mechanisms for obtaining public input. In 1992, API endorsed, as part of STEP, adoption of management practices as an API recommended practice. The management practices contain the following elements: pollution prevention, operating and process safety, community awareness, crisis readiness, product stewardship, proactive government interaction, and resource conservation. The management practices are an outline of actions to help companies incorporate environmental health and safety concerns into their planning and decision making. Each company will make its own decisions on how and whether to change its operations. API has developed a compilation of resources that provide recommendations and guidance on various operational areas of the oil industry to assist API members with their implementation of the management practices.

STEP is a program of the American Petroleum Institute (API) that strives to improve and promote the industry's commitment to environmental, health, and safety issues. The program encompasses many projects performed by member companies, plus research performed by API. STEP is involved with environmental issues on two fronts: research, and communications with both member companies and external entities.

STEP sponsors a wide range of research on environmental issues, including studies on releases, exposure assessments, and pollution prevention assessments. In many cases, the data leads toward the setting of API industry standards, which are often cited in EPA regulations.

The program also serves to disseminate information about environmental and health issues to the public. An example is the *Petroleum Industry Environmental Performance Annual Report*, which presents statistics on the progress of the industry in reducing its environmental impacts.

API's Upstream Department undertakes a range of activities focused on environmental issues facing the oil and gas extraction industry. Sponsored research may identify available, cost-effective techniques for control of emissions or remediation of a spill. Workshops are sponsored to assist companies (both members and nonmembers) in complying with new regulations or applying new technologies. As an example, API sponsored research on the remediation of soils affected by salt resulting from decades-old discharges or more recent spills of produced water. From this research has grown a series of workshops to transfer this information to companies and state agencies working to address these sites.

Gas Research Institute (GRI)

The Gas Research Institute is headquartered in Chicago and manages a cooperative research, development, and commercialization program for the mutual benefit of the natural gas industry. GRI works with research organizations, manufacturers and its member companies to develop gas technologies and to transfer new products and information to the marketplace.

GRI has published studies of waste generation and management in the natural gas industry. "Waste Minimization in the Natural Gas Industry: Regulations, Methodology, and Assessment of Alternatives" is of particular interest. The publication provides a thorough overview of waste generation in the industry and methods for minimizing many of the waste streams. (Contact: www.gri.org/ or (773) 399-8100.)

VIII.C.2. Trade Associations

American Petroleum Institute (API) 1220 L Street, NW Washington, DC 20005 Phone: (202) 682-8000 Fax: (202) 962-4797	Members: 500 Staff: 300 Budget: $40,000,000 Contact: Mark Rubin www.api.org/

The American Petroleum Institute (API) is the largest trade group for the oil and gas industry, with the largest membership and budget. API represents major oil companies, and independent oil producers, refiners, marketers, and transporters of crude oil, lubricating oil, gasoline, and natural gas. API conducts and promotes research in the oil and gas industry and collects data and publishes statistical reports on oil production and refining. Numerous manuals, booklets, and other materials are published on oil and gas exploration and production.

Independent Petroleum Association of America (IPAA) 1101 16th St., NW Washington, DC 20036 Phone: (202) 857-4722 Fax: (202) 857-4799	Members: 6,000 Staff: 25 Contact: Gil Thrum www.ipaa.org/

IPAA was founded in 1929 to represent small oil and natural gas producers in legislative and regulatory issues at the federal level. Its members are principally well operators and royalty owners, plus others involved in the industry such as suppliers, and drilling contractors. IPAA collects production, consumption, and economic data on the industry and publishes documents including *The Oil and Natural Gas Producing Industry in Your State.*

Society of Petroleum Engineers (SPE) PO Box 833836 Richardson, TX 75083-3836 Phone: (214) 952-9393 Fax: (214) 952-9435	Members: 53,000 Staff: 92 Budget: $15,000,000 Regional Groups: 13 Local Groups: 137 Contact: Dan K. Adamson www.spe.org/

SPE was founded in 1922 to serve petroleum engineers involved with oil and gas exploration and production. The organization has 53,000 members and a budget of $15 million. SPE publishes several journals and books, including the monthly *Journal of Petroleum Technology,* that report on reservoir characterization and management methods and industry statistics.

Association of Oilwell Servicing Contractors (AOSC) 6060 N. Central Expy., Ste. 428 Dallas, TX 75206 Phone: (214) 692-0771 Fax: (214) 692-0162	Members: 600 Staff: 4 Budget: $500,000 Regional Groups: 16 Contact: M.L. Clark

AOSC was founded in 1956, and represents oil well servicing and workover contractors, equipment manufacturers, and others related to the well servicing industry. The organization publishes the monthly *AOSC Newsletter*, which includes industry news, rig activity information, and legislative updates, and

Well Servicing, a bimonthly journal that includes articles on new technology, equipment and products.

Mid-Continent Oil and Gas Association (MCOGA) 801 Pennsylvania Ave NW, Ste. 840 Washington, DC 20004-2604 Phone: (202) 638-4400 Fax: (202) 638-5967	Members: 7,500 Staff: 6 State Groups: 4 Contact: Albert Modiano

The Mid-Continent Oil and Gas Association was founded in 1917 and represents oil and gas producers, royalty owners, refiners, gasoline manufacturers, transporters, drilling contractors, supply and equipment dealers and wholesalers, bankers, and other individuals interested in oil business.

Western States Petroleum Association (WSPA) 505 N. Brand Blvd., Ste. 1400 Glendale, CA 91203-1925 Phone: (818) 545-4105 Fax: (818) 545-0954	Members: 35 Staff: 32 Regional Groups: 4 Contact: Douglas Henderson www.wspa.org/

The Western States Petroleum Association was founded in 1907 and represents companies involved with petroleum exploration, production, refining, transportation, and wholesale marketing in Arizona, California, Hawaii, Nevada, Oregon, and Washington. WSPA offers advisory services for industry members.

Offshore Operators Committee (OOC) P.O. Box 50751 New Orleans, LA 70150 Phone: (504) 593-7443 Fax: (504) 593-7544	Members: 110 Staff: 1 Contact: Mr. Virgil Harris e-mail: virgil_a_harris@cngp.cng.com

OOC is an industry cooperative representing nearly all of the operators in the Gulf of Mexico. They sponsor research on the effects of oil and gas operations offshore and work with EPA on updates to offshore NPDES permits.

Petroleum Technology Transfer Council (PTTC) 1101 16th Street, NW, Suite 1-C Washington, DC 20036 Phone: (202) 785-2225 or (800)THE-PTTC Fax: (202) 785-2240	Regional Centers: 10 Contact: Deborah Rowell www.pttc.org/

The Petroleum Technology Transfer Council (PTTC) was formed in 1994 by the U.S. oil and natural gas exploration and production industry to identify and transfer upstream technologies to domestic producers. PTTC's technology programs help producers reduce costs, improve operating efficiency, increase ultimate recovery, enhance environmental compliance, and add new oil and gas reserves. Through its 10 regional resource centers located at universities around the country, PTTC offers expert assistance, information resources, inter-disciplinary referrals, and demonstrations of E&P software solutions.

This page left intentionally blank.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the oil and gas extraction industry, a list of contacts and publications are provided below.

Contacts[4]

Name	Organization	Telephone	Subject
Dan Chadwick	EPA/OECA (Office of Enforcement and Compliance Assurance)	(202) 564-7054	Compliance Assurance
Steve Souders	EPA/OSWER (Office of Solid Waste and Emergency Response)	(703) 308-8431	Oil and Gas Wastes
Dan Derkics	EPA/OSWER (Office of Solid Waste and Emergency Response)	(703) 308-8409	Oil and Gas Wastes
Bruce Kobelski	EPA/OW (Office of Water)	(202) 260-7275	Underground Injection
Tom Aalto	EPA/Region VIII	(303) 312-6949	RCRA / Problem Oil Pits
Ron Jordan	EPA/OW (Office of Water)	(202) 260-7115	NPDES Issues
Greg Nizich	EPA/OAQPS (Office of Air Quality Planning and Standards)	(919) 541-3078	Air Issues
Ralph Russell	DOE/EIA (Department of Energy, Energy Information Administration)	(214) 720-6196	Industry Processes
Mike Miller	Louisiana Department of Environmental Quality	(225) 765-0272	Industry Processes, State Waste Minimization Program
Charles Koch	North Dakota Industrial Commission, Oil and Gas Division	(701) 328-8020	Industry Processes
James Erb	Pennsylvania Department of Environmental Protection	(717) 772-2199	Industry Processes
Jack Ward	Texas Railroad Commission, Oil and Gas Division	(512) 475-4580	State Waste Minimization Programs, Pollution Prevention

[4] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

Section II: Introduction to the Oil and Gas Extraction Industry

EIA, *The U.S. Petroleum Industry: Past as Prologue, 1970-1992*, Energy Information Administration, US Department of Energy, 1993.

EIA, *Natural Gas Annual*, Energy Information Administration, U.S. Department of Energy, 1997.

EIA, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1997 Report*, Energy Information Administration, US Department of Energy, 1998.

EIA, *Petroleum: An Energy Profile*, Energy Information Administration, U.S. Department of Energy, 1999. www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/petroleum_profile_1999/profile99v8.pdf

IPAA, *United States Petroleum Statistics: 1998 Data*, Independent Petroleum Association of America, April 1999, www.ipaa.org/departments/information_services/USPS.htm

Sittig, Marshall, *Petroleum Transportation and Production: Oil Spill and Pollution Control*, Park Ridge, NJ: Noyes Data Corporation, 1978.

Smith, Glenda, American Petroleum Institute, written comments to Dan Chadwick, USEPA/OCEA, September 22, 1999.

US DOC, *1992 Census of Mineral Industries*, Bureau of the Census, Economics and Statistics Administration, US Department of Commerce, 1995.

US DOC, *U.S. Industry and Trade Outlook '98*, International Trade Commission, U.S. Department of Commerce, McGraw-Hill, 1998.

US DOE, *A Strategy for Methane Hydrates Research and Development*, Office of Fossil Energy, U.S. Department of Energy, August 1998.

US DOI, "Press Release: Babbitt Signs Decision for Alaska Petroleum Reserve that Balances Protection for Wildlife Habitat With Oil and Gas Development," Office of the Secretary, U.S. Department of the Interior, October 7, 1998, www.doi.gov/news/981007.html

US EPA, Office of Solid Waste, *Background for NEPA Reviewers: Crude Oil and Natural Gas Exploration, Development, and Production*, U.S. Environmental Protection Agency, 1992.

Section III: Industrial Process Description

API, *Oil and Gas Waste Management – Preliminary Results from API Survey*, American Petroleum Institute, 1997.

API, *1997 Joint Association Survey on Drilling Costs*, American Petroleum Institute, 1998a.

API, *Petroleum Industry Environmental Performance Sixth Annual Report*, American Petroleum Institute, 1998b.

Berger, Bill D. and Kenneth E. Anderson, *Modern Petroleum -- A Basic Primer of the Industry, Third Edition*, Tulsa, OK: PennWell Publishing Company, 1992.

Buckner, Edwin, EPA Region VII, e-mail to Dan Chadwick, EPA/OECA, December 15,1998.

Buist, Ian, "Window of Opportunity for In Situ Burning," in *In Situ Burning of Oil Spills Workshop Proceedings, New Orleans, Louisiana, November 2-4, 1998*, William D. Walton and Nora H. Jason, eds., Gaithersburg, MD: Building and Fire Research Laboratory, National Institute of Standards and Technology, February 1999.

Deepstar, Proprietary information on platform/pipeline infrastructure and capacities in deepwater. This information is part of a series of reports on future deep-water technologies and hypothetic scenarios generated by a consortium of industry, academia, and the regulatory participants, 1994.

Deuel, Lloyd E. and George H. Holliday, *Soil Remediation for the Petroleum Extraction Industry, Second Edition*, Tulsa, OK: PennWell Publishing Company, 1997.

EIA, *Petroleum: An Energy Profile*, Energy Information Administration, U.S. Department of Energy, 1991.

Federal Register, vol. 61, no. 242, December 16, 1996, "Oil and Gas Extraction Point Source Category; Final Effluent Limitations Guidelines and Standards for the Coastal Subcategory; Final Rule."

Fields, Stephen and Max Martin, "The Plugging Process: Securing Old Gas & Oil Wells for the Protection of the Environment," in *Proceedings: Public Workshop, Decommissioning and Removal of Oil and Gas Facilities Offshore California*, F. Manago and B. Williamson, eds., Santa Barbara, CA: Marine Science Institute, University of California, Santa Barbara, May 1998.

Fingas, M.L., "In Situ Burning of Oil Spills: A Historical Perspective," in *In Situ Burning of Oil Spills Workshop Proceedings, New Orleans, Louisiana, November 2-4, 1998*, William D. Walton and Nora H. Jason, eds., Gaithersburg, MD: Building and Fire Research Laboratory, National Institute of Standards and Technology, February 1999.

IOGCC and US DOE, *A Study of Idle Oil and Gas Wells in the United States*, Interstate Oil and Gas Compact Commission, 1992.

IOGCC, *IOGCC Environmental Guidelines for State Oil & Gas Regulatory Programs*. Interstate Oil and Gas Compact Commission, May 1994.

IOGCC, *Produce or Plug: The Dilemma over the Nation's Idle Oil and Gas Wells*, Interstate Oil and Gas Compact Commission, December 1996.

Jordan, Ronald, EPA/OW, written comments to Dan Chadwick, EPA/OECA, 1999.

Kennedy, John L., *Fundamentals of Drilling*, Tulsa, OK: PennWell Publishing Company, 1983.

Lake, Larry W., *Enhanced Oil Recovery*, Englewood Cliffs, NJ: Prentice-Hall, Inc., 1989.

MMS, *Federal Offshore Statistics*, Minerals Management Service, U.S. Department of the Interior. 1995.

MMS, Gulf of Mexico OCS Oil and Gas Lease Sales 171, 174, 177, and 180 (Western Planning Area) - Final Environmental Impact Statement, 1998.

MMS, *Decommissioning Structures*, Minerals Management Service, U.S. Department of the Interior. *www.mms.gov/tarp/es2a.htm*, 1999.

National Research Council, *An Assessment of Techniques for Removing Offshore Structures*. Washington, DC: Marine Board, Commission on Engineering and Technical Systems, National Research Council, 1996.

Neff, Jerry M. and Theodor C. Sauer, Jr., "An Ecological Risk Assessment for Polycyclic Aromatic Hydrocarbons in Produced Water Discharges to the Western Gulf of Mexico," in *Produced Water 2: Environmental Issues and Mitigation Technologies*, International Produced Water Symposium. Mark Reed and Stale Johnsen, eds., New York: Plenum Press, 1996.

Rabalais, N.N., B.A. McKee, D.J. Reed, and J.C. Means, "Fate and Effects of Produced Water Discharges in Coastal Louisiana, Gulf of Mexico, USA," in *Produced Water: Technological/ Environmental Issues and Solutions*, International Produced Water Symposium, James P. Ray and F. Rainer Engelhardt, eds., New York: Plenum Press, 1992.

Shell Oil Company, Specific comments for draft EIS 152 and 155 (Section V). Data derived by Shell Oil Company from discharge monitoring reports submitted to USEPA, Region 6 for 1992, 1994.

Sittig, Marshall, *Petroleum Transportation and Production: Oil Spill and Pollution Control*, Park Ridge, NJ: Noyes Data Corporation, 1978.

Souders, Stephen, USEPA/OSW, written comments to Dan Chadwick, USEPA/OECA, December 30, 1998.

Stephenson, M.T., "A Survey of Produced Water Studies," in *Produced Water: Technological/ Environmental Issues and Solutions*, International Produced Water Symposium, James P. Ray and F. Rainer Engelhardt, eds., New York: Plenum Press, 1992.

Texas Railroad Commission, written comments to Dan Chadwick, EPA/OECA, January 9, 1999.

US DOE and IOGCC, *Oil and Gas Exploration and Production Waste Management: A 17-State Study*, Office of Fossil Energy, U.S. Department of Energy, and Interstate Oil and Gas Compact Commission, June, 1993.

US EPA, Office of Solid Waste, *Management of Wastes From Oil and Gas Exploration, Development, and Production, Report to Congress*, U.S. Environmental Protection Agency, 1987.

US EPA, Office of Solid Waste, *Background for NEPA Reviewers: Crude Oil and Natural Gas Exploration, Development, and Production*, U.S. Environmental Protection Agency, 1992.

US EPA, Office of Solid Waste and Emergency Response, *Understanding Oil Spills and Oil Spill Response*, U.S. Environmental Protection Agency, July 1993a.

U.S. EPA Office of Solid Waste and Emergency Response, *SPCC Requirements and Pollution Prevention Practices for Oil Production, Drilling and Workover Facilities*, *www.epa.gov/oilspill/spcc/index.htm*.

US EPA, Office of Water, Supplemental information for effluent limitation guidelines and new source performance standards for the offshore subcategory of the oil and gas extraction point source category (40 CFR 435), 1993b .

US EPA, Office of Water, *Development Document For Effluent Limitations Guidelines And Standards For The Coastal Subcategory Of The Oil And Gas Extraction Point Source Category*, US Environmental Protection Agency, 1996.

US EPA, Office of Water, written comments to Dan Chadwick, EPA/OECA, September, 1999.

Wakim, Paul, *API 1985 Production Waste Survey*, American Petroleum Institute, 1987.

Wiedeman, Allison, "Regulation of Produced Water by the U.S. Environmental Protection Agency," in *Produced Water 2: Environmental Issues and Mitigation Technologies,* International Produced Water Symposium, Mark Reed and Stale Johnsen, eds., New York: Plenum Press, 1996.

Williams, Howard R. and Charles J. Meyers, *Manual of Oil and Gas Terms – Tenth Edition*, rev. by Patrick Martin and Bruce Kramer, New York: Matthew Bender & Company, 1997.

Zengel, Scott A. et al., Environmental Effects of In Situ Burning of Oil Spills in Inland and Upland Habitats," in *In Situ Burning of Oil Spills Workshop Proceedings, New Orleans, Louisiana, November 2-4, 1998*, William D. Walton and Nora H. Jason, eds., Gaithersburg, MD: Building and Fire Research Laboratory, National Institute of Standards and Technology, February 1999.

Section IV: Chemical Release and Transfer Profile

API, *Oil and Gas Waste Management – Preliminary Results from API Survey*, American Petroleum Institute, 1997.

Pennsylvania DEP, *Characterization and Disposal Options for Oilfield Wastes in Pennsylvania*, Bureau of Oil and Gas Management, Pennsylvania Department of Environmental Protection, June 1994.

Pennsylvania DEP, *Oil Brine Characteristics Report, Working Draft*, Bureau of Oil and Gas Management, Pennsylvania Department of Environmental Protection, July 31, 1999.

US EPA, Office of Water, *Development Document for Final Effluent Limitations Guidelines and Standards for the Coastal Subcategory of the Oil and Gas Extraction Point Source Category*, US Environmental Protection Agency, 1996.

Section V: Pollution Prevention Opportunities

API, *Developing Area-Specific Waste Management Plans for E&P Operations, 1st ed.*, American Petroleum Institute, Washington, DC, 1991.

County Sanitation Districts of Los Angeles County, *Oil and Gas Extraction: Pollution Prevention Opportunities Checklist*, Industrial Waste Section, County Sanitation Districts of Los Angeles County, 1990.

Michelet, J.F. "Down Hole Separation Technology," in *Produced Water 2: Environmental Issues and Mitigation Technologies,* International Produced Water Symposium, Mark Reed and Stale Johnsen, eds., New York: Plenum Press, 1996.

NETA, *Keepin' It All Clean in the Oil Patch – Field Guide*, Phoenix: National Environmental Training Association, 1995.

Petroleum Technology Transfer Council, *New Technology Summaries*, www.pttc.org/.

Souders, Stephen, USEPA/OSW, written comments to Dan Chadwick, USEPA/OECA, December 30, 1998.

Texas Railroad Commission, Oil and Gas Division, *Waste Minimization in the Oil Field*, Revised April 1999.

Texas Railroad Commission, Oil and Gas Division, *Waste Minimization Case Histories-Drilling Operations*, www.rrc.state.tx.us/divisions/og/key-programs/.

U.S. DOE - Fossil Energy: Oil and Natural Gas Program, www.fe.doe.gov/programs/oil_gas.html.

U.S. EPA EnviroSenSe website, http://es.epa.gov/.

U.S. EPA Natural Gas STAR Program, *Lessons Learned*, www.epa.gov/gasstar/.

Section VI: Summary of Federal Statutes and Regulations

Arbuckle, J. Gordon, et al. *Environmental Law Handbook*, 12th ed., Rockville, MD: Government Institutes, Inc., 1993.

Environmental Law Institute, *Sustainable Environmental Law*, Celia Campbell-Mohn, ed., St. Paul, MN: West Publishing Co., 1993.

IOGCC, *Produce or Plug: The Dilemma over the Nation's Idle Oil and Gas Wells*, Interstate Oil and Gas Compact Commission, December 1996.

MMS, "Outer Continental Shelf Lands Act," Minerals Management Service, U.S. Department of the Interior, www.mms.gov/ocslands.htm, 1999.

National Research Council, *An Assessment of Techniques for Removing Offshore Structures*, Washington, DC: Marine Board, Commission on Engineering and Technical Systems, National Research Council, 1996.

Rittenhouse, Bryan, USEPA/OW, written comments to Dan Chadwick, USEPA/OECA, September 21, 1999.

US EPA, Office of Solid Waste, *Background for NEPA Reviewers: Crude Oil and Natural Gas Exploration, Development, and Production*, U.S. Environmental Protection Agency, 1992.

US EPA, Office of Solid Waste and Emergency Response, "FAQ: What Substances are Covered? Petroleum Exclusion," U.S. Environmental Protection Agency, 1998, www.epa.gov/oerrpage/superfund/programs/er/triggers/haztrigs/whatsub3.htm.

US EPA, Office of Water, "Clean Water Act Section 403: A Framework for Ecological Risk Assessment," U.S. Environmental Protection Agency, 1999, www.epa.gov/OWOW/oceans/discharges/403.html.

Williams, Howard R. and Charles J. Meyers, *Manual of Oil and Gas Terms – Tenth Edition*, rev. by Patrick Martin and Bruce Kramer, New York: Matthew Bender & Company, 1997.

Section VIII: Compliance Activities and Initiatives

Interstate Oil and Gas Compact Commission, www.iogcc.oklaosf.state.ok.us/.

Sandra Jaszczak, ed., *Gale Encyclopedia of Associations, 31st ed.*, International Thomson Publishing Co., 1996.

U.S. DOE, Office of Fossil Energy, *Oil and Gas Environmental Research and Analysis Program*. www.fe.doe.gov/oil_gas/oilgas7.html.

This page left intentionally blank

GPO Access — Keeping America Informed

Charge your order, It's easy! VISA MasterCard

Fax your orders (202) 512-2250
Phone your orders (202) 512-1800
Order online at http://bookstore.gpo.gov

Order Processing Code: 3212

Qty	GPO Stock #	Title	Price (each)	Total
		Published in 1995		
	005-000-00512-5	Profile of the Dry Cleaning Industry, 104 pages	$6.50	
	055-000-00513-3	Profile of the Electronics and Computer Industry, 160 pages	$11.00	
	055-000-00518-4	Profile of the Fabricated Metal Products Industry, 164 pages	$11.00	
	055-000-00515-0	Profile of the Inorganic Chemical Industry, 136 pages	$9.00	
	005-000-00516-8	Profile of the Iron and Steel Industry, 128 pages	$8.00	
	055-000-00517-6	Profile of the Lumber and Wood Products Industry, 136 pages	$9.00	
	055-000-00519-2	Profile of the Metal Mining Industry, 148 pages	$10.00	
	055-000-00520-6	Profile of the Motor Vehicle Assembly Industry, 156 pages	$11.00	
	055-000-00521-4	Profile of the Nonferrous Metals Industry, 140 pages	$9.00	
	055-000-00522-2	Profile of the Non-Fuel, Non-Metal Mining Industry, 108 pages	$6.00	
	055-000-00523-1	Profile of the Organic Chemical Industry, 152 pages	$11.00	
	055-000-00524-9	Profile of the Petroleum Refining Industry, 124 pages	$11.00	
	005-000-00525-7	Profile of the Printing Industry, 124 pages	$7.50	
	055-000-00526-5	Profile of the Pulp and Paper Industry, 156 pages	$11.00	
	055-000-00527-3	Profile of the Rubber and Plastic Industry, 152 pages	$11.00	
	055-000-00528-1	Profile of the Stone, Clay, Glass and Concrete Industry, 124 pages	$7.50	
	055-000-00529-0	Profile of the Transportation Equipment Cleaning Industry, 84 pages	$5.50	
	055-000-00514-1	Profile of the Wood Furniture and Fixtures Industry, 132 pages	$8.00	
		Published in 1997		
	055-000-00570-2	Profile of the Air Transportation Industry, 90 pages	$7.50	
	055-000-00576-1	Profile of the Fossil Fuel Electric Power Generation Ind., 160 pages	$14.00	
	055-000-00571-1	Profile of the Ground Transportation Industry, 130 pages	$10.00	
	055-000-00573-7	Profile of the Metal Casting Industry, 150 pages	$13.00	
	055-000-00574-5	Profile of the Pharmaceutical Manufacturing Industry, 147 pages	$13.00	
	055-000-00575-3	Profile of the Plastic Resin & Man-made Fiber Industry, 180 pages	$15.00	
	055-000-00577-0	Profile of the Shipbuilding and Repair Industry, 120 pages	$9.50	
	055-000-00578-8	Profile of the Textile Industry, 130 pages	$10.00	
	055-000-00572-9	Profile of the Water Transportation Industry, 90 pages	$7.50	
		Published in 1998		
	055-000-00579-6	Sector Notebook Data Refresh-1997, 210 pages	$17.00	
	055-000-00619-9	Profile of the Aerospace Industry, 130 pages	$10.00	
		Published in 1999		
	055-000-00620-2	Profile of Local Government Operations, 310 pages	$25.00	
		Published in 2000		
	055-000-00635-1	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry, 200 pp.	$18.00	
	055-000-00636-9	Profile of the Agricultural Crop Production Industry, 178 pages	$16.00	
	055-000-00633-4	Profile of the Agricultural Livestock Production Industry, 159 pages	$15.00	
	055-000-00634-2	Profile of the Oil and Gas Extraction Industry,	$16.00	

The total cost of my order is $_________. Price includes regular shipping and handling and is subject to change. International orders add 25 percent.

Company or personal name (please type or print)

Additional address/attention line

Street Address

City, State, Zip Code

Daytime phone including area code

Check method of payment:

☐ Check payable to Superintendent of Documents
☐ GPO Deposit Account ________
VISA ☐ MasterCard Discover/NOVUS ☐
☐ Credit Card # ________
Expiration date ______ *Thank you for your order!*

Authorizing signature

Mail to: Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954

**Important: Please include completed order form with payment

R0076773

EPA
United States
Environmental Protection Agency
(2221A)
Washington, DC 20460-0001

Official Business
Penalty for Private Use $300

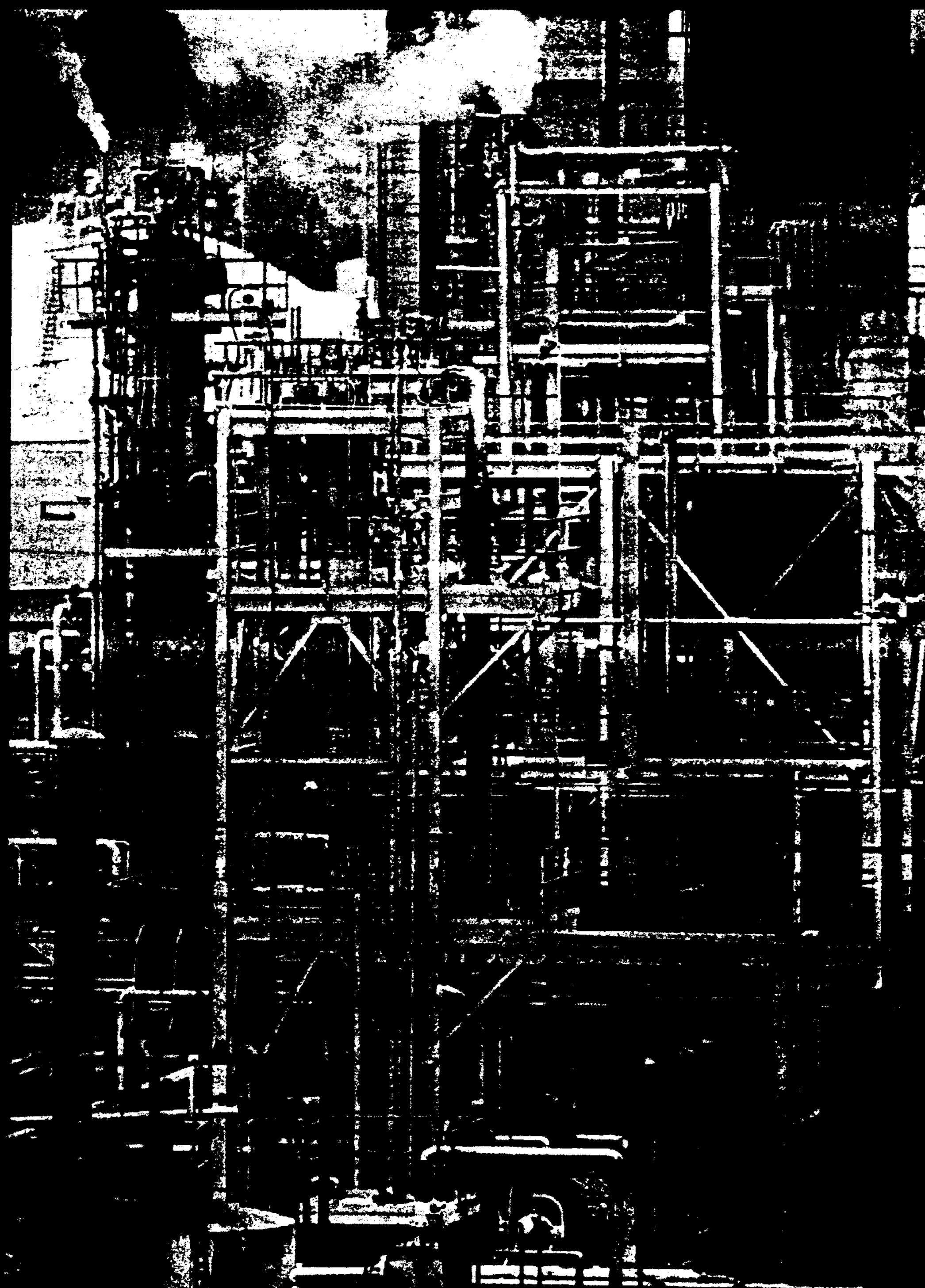
United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2221A)

EPA 310-R-95-012
September 1995

EPA

Profile Of The Organic Chemicals Industry



SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Message from the Administrator

Over the past 25 years, our nation has made tremendous progress in protecting public health and our environment while promoting economic prosperity. Businesses as large as iron and steel plants and businesses as small as the dry cleaner on the corner have worked with EPA to find ways to operate cleaner, cheaper, and smarter. As a result, we no longer have rivers catching on fire. Our skies are clearer. American environmental technology and expertise are in demand throughout the world.

The Clinton Administration recognizes that to continue this progress, we must move beyond the pollutant-by-pollutant approaches of the past to comprehensive, facility-wide approaches for the future. Industry by industry and community by community, we must build a new generation of environmental protection.

Within the past two years, the Environmental Protection Agency undertook its Sector Notebook Project to compile, for a number of key industries, information about environmental problems and solutions, case studies and tips about complying with regulations. We called on industry leaders, state regulators, and EPA staff with many years of experience in these industries and with their unique environmental issues. Together with notebooks for 17 other industries, the notebook you hold in your hand is the result.

These notebooks will help business managers to better understand their regulatory requirements, learn more about how others in their industry have undertaken regulatory compliance and the innovative methods some have found to prevent pollution in the first instance. These notebooks will give useful information to state regulatory agencies moving toward industry-based programs. Across EPA we will use this manual to better integrate our programs and improve our compliance assistance efforts.

I encourage you to use this notebook to evaluate and improve the way that together we achieve our important environmental protection goals. I am confident that these notebooks will help us to move forward in ensuring that -- in industry after industry, community after community -- environmental protection and economic prosperity go hand in hand.

Carol M. Browner

Recycled/Recyclable • Printed with Vegetable Based Inks on Recycled Paper (20% Postconsumer)

EPA/310-R-95-012

EPA Office of Compliance Sector Notebook Project

Profile of the Organic Chemical Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
Washington, DC 20460

For sale by the U.S. Government Printing Office
Superintendent of Documents. Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048279-8

This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included at the end of this document.

All telephone orders should be directed to:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800
FAX (202) 512-2250
9:00 a.m. to 4:30 p.m., Eastern Time, M-F

Using the form provided at the end of this document, all mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary volumes are available to certain groups or subscribers, such as public and academic libraries, Federal, State, local, and foreign governments, and the media. For further information, and for answers to questions pertaining to these documents, please refer to the contact names and numbers provided within this volume.

Electronic versions of all Sector Notebooks are available on the EPA Enviroene Bulletin Board and via the Internet on the Enviroene World Wide Web. Downloading procedures are described in Appendix A of this document.

Cover photograph by Steve Delaney, EPA. Photograph courtesy of Vista Chemicals, Baltimore, Maryland. Special thanks to Dave Mahler.

Sector Notebook Contacts

The Sector Notebooks were developed by the EPA's Office of Compliance. Particular questions regarding the Sector Notebook Project in general can be directed to:

Seth Heminway, Sector Notebook Project Coordinator
US EPA, Office of Compliance
401 M St., SW (2223-A)
Washington, DC 20460
(202) 564-7017 fax (202) 564-0050
E-mail: heminway.seth@epamail.epa.gov

Questions and comments regarding the individual documents can be directed to the appropriate specialists listed below.

Document Number	Industry	Contact	Phone (202)
EPA/310-R-95-001.	Dry Cleaning Industry	Joyce Chandler	564-7073
EPA/310-R-95-002.	Electronics and Computer Industry	Steve Hoover	564-7007
EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Suzanne Childress	564-7018
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Keith Brown	564-7124
EPA/310-R-95-012.	Organic Chemical Industry	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
EPA/310-R-95-015.	Pulp and Paper Industry	Maria Eisemann	564-7016
EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	*Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	*Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceutical Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	*Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	*Shipbuilding and Repair Industry	Suzanne Childress	564-7018
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	*Sector Notebook Data Refresh, 1997	Seth Heminway	564-7017
EPA/310-B-96-003.	Federal Facilities	Jim Edwards	564-2461

*Currently in DRAFT anticipated publication in September 1997

This page updated during June 1997 reprinting

Industry Sector Notebook Contents: Organic Chemicals

Exhibits Index

List of Acronyms

AFS - AIRS Facility Subsystem (CAA database)
AIRS - Aerometric Information Retrieval System (CAA database)
BIFs - Boilers and Industrial Furnaces (RCRA)
BOD - Biochemical Oxygen Demand
CAA - Clean Air Act
CAAA - Clean Air Act Amendments of 1990
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS - CERCLA Information System
CFCs - Chlorofluorocarbons
CO - Carbon Monoxide
COD - Chemical Oxygen Demand
CSI - Common Sense Initiative
CWA - Clean Water Act
D&B - Dun and Bradstreet Marketing Index
ELP - Environmental Leadership Program
EPA - United States Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
FINDS - Facility Indexing System
HAPs - Hazardous Air Pollutants (CAA)
HSDB - Hazardous Substances Data Bank
IDEA - Integrated Data for Enforcement Analysis
LDR - Land Disposal Restrictions (RCRA)
LEPCs - Local Emergency Planning Committees
MACT - Maximum Achievable Control Technology (CAA)
MCLGs - Maximum Contaminant Level Goals
MCLs - Maximum Contaminant Levels
MEK - Methyl Ethyl Ketone
MSDSs - Material Safety Data Sheets
NAAQS - National Ambient Air Quality Standards (CAA)
NAFTA - North American Free Trade Agreement
NCDB - National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NEIC - National Enforcement Investigation Center
NESHAP - National Emission Standards for Hazardous Air Pollutants
NO_2 - Nitrogen Dioxide
NOV - Notice of Violation
NO_x - Nitrogen Oxides
NPDES - National Pollution Discharge Elimination System (CWA)
NPL - National Priorities List
NRC - National Response Center

NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SO_x -	Sulfur Oxides
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector based" approach within the EPA Office of Compliance led to the creation of this document. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references if more in-depth information is available. The contents of each profile were researched from a variety of sources, and were usually condensed from more detailed sources. This approach allowed for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process which enabled us to develop more complete, accurate and up-to-date summaries.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project. 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.
If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE ORGANIC CHEMICALS INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the organic chemical industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The industrial organic chemical sector produces organic chemicals (those containing carbon) used as either chemical intermediates or end-products. This categorization corresponds to Standard Industrial Classification (SIC) code 286 established by the Bureau of Census to track the flow of goods and services within the economy. The 286 category includes gum and wood chemicals (SIC 2861), cyclic organic crudes and intermediates, organic dyes and pigments (SIC 2865), and industrial organic chemicals not elsewhere classified (SIC 2869). By this definition, the industry does not include plastics, drugs, soaps and detergents, agricultural chemicals or paints, and allied products which are typical end-products manufactured from industrial organic chemicals. In 1993, there were 987 establishments in SIC 286 of which the largest 53 firms (by employment) accounted for more than 50 percent of the industry's value of shipments. The SIC 286 may include a small number of integrated firms that are also engaged in petroleum refining and manufacturing of other types of chemicals at the same site although firms primarily engaged in manufacturing coal tar crudes or petroleum refining are classified elsewhere.[a]

The industrial organic chemical market has two broadly defined categories, commodity and specialty. Commodity chemical manufacturers compete on price and produce large volumes of small sets of chemicals using dedicated equipment with continuous and efficient processing. Specialty chemical manufacturers cater to custom markets, manufacture a diverse set of chemicals, use two or three different reaction steps to produce a product, tend to use batch processes, compete on technological expertise and have a greater value added to their products. Commodity chemical manufacturers have lower labor requirements per volume and require less professional labor per volume.

[a] Variations in facility counts occur across data sources due to many factors including reporting and definitional differences. This notebook does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

The *1992 Census of Manufactures for Industrial Organic Chemicals* reports employment of 124,800 and a 1992 value of shipments of $64.6 billion. This value of shipments does not include organic chemicals manufactured for captive use within a facility or the value of other non-industrial organic chemical products manufactured by the same facility. It does, however, include intra-company transfers which are significant in this industry. By comparison, the 1992 value of shipments for inorganic chemicals totaled $27.3 billion with employment of 103,400 people. The 1992 value of shipments for the entire chemical industry (SIC 28) was $292.3 billion and employment totaled 850,000. According to *Chemical and Engineering News*, the production of industrial organic chemicals has increased by three percent per year between 1983 and 1993 while employment has fallen by one percent per year over the same period indicating an overall increase in productivity for the sector. The same source reports the industry employed 153,000 people in 1993 while shipping products valued at $60.9 billion.

The Department of Commerce reported that output in the industrial organic chemical market grew five percent between 1992 and 1993 and is expected to continue to grow at the same rate partially on the strength of increased demand and production of methyl tert-butyl ether, a fuel oxygenate.

II.B. Characterization of the Organic Chemicals Industry

II.B.1. Industry size and geographic distribution

Industrial organic chemical facilities have an unusual distribution when compared to downstream manufacturing facilities. Most significantly, a small number of very large facilities account for the majority of the industry's value of shipments. The *1992 Census of Manufactures* (Exhibit 1) showed that only 113 of the 986 industrial organic chemical facilities (11 percent) had more than 250 employees. However, these facilities accounted for almost 70 percent of the value of shipments for the industry; the largest 16 plants (greater than 1,000 employees) accounted for about 25 percent of the total value of shipments.

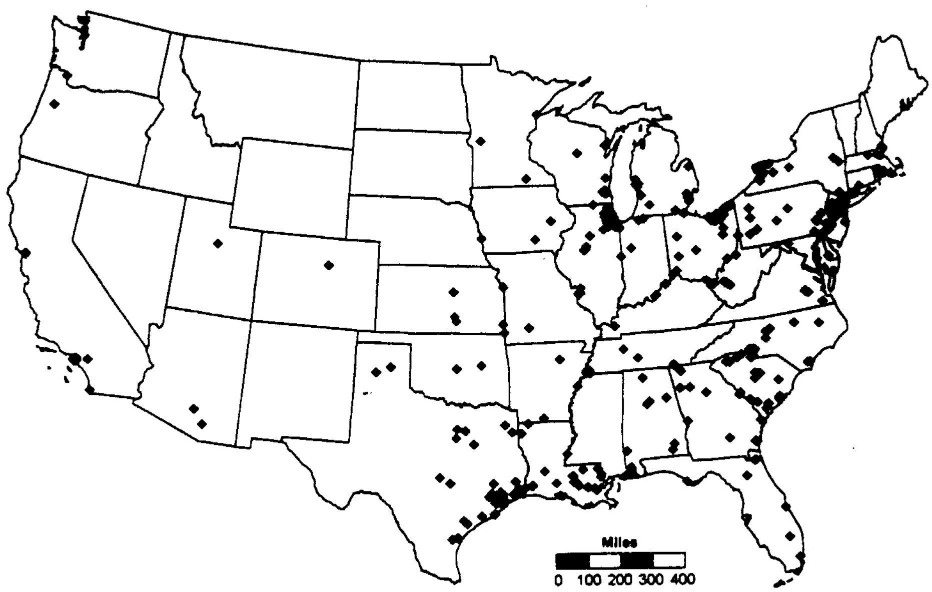
Exhibit 1: Small Number of Large Facilities Account for Majority of Shipments

Number of Employees	Number of Facilities	Percent of Facilities	Percent of Shipment Value
fewer than 10	259	26%	1%
10 to 49	301	30%	5%
50 to 249	313	32%	27%
250 to 499	60	6%	16%
500 to 999	37	4%	26%
1,000 or more	16	2%	25%
Total	986	100%	100%

Source: *1992 Census of Manufactures*

The industrial organic chemical sector is geographically diverse (Exhibit 2). Gum and wood chemical manufacture (SIC 2861) is concentrated in Missouri, Florida and Virginia. Cyclic crudes and intermediates (SIC 2865) and unclassified industrial organic chemicals (SIC 2869) are concentrated in Texas, Louisiana, New Jersey, Ohio, Illinois and West Virginia. Facility sites are typically chosen for their access to raw materials (petroleum and coal products for SICs 2865 and 2869 and wood for SIC 2861) and to transportation routes. In addition, because much of the market for industrial organic chemicals is the chemical industry, facilities tend to cluster near such end-users.

Exhibit 2: Organic Chemical Manufacturing Facilities (SIC 286)



(Source: U.S. EPA, Toxics Release Inventory Database, 1993)

Ward's Business Directory of U.S. Private and Public Companies, produced by Gale Research Inc., compiles financial data on U.S. companies including those operating within the organic chemical industry. Ward's ranks U.S. companies, whether they are a parent company, subsidiary or division, by sales volume within their assigned 4-digit SIC code. Readers should note that: (1) companies are assigned a 4-digit SIC that most closely resembles their principal industry; and (2) sales figures include total company sales, including subsidiaries and operations (not related to organic chemicals). Additional sources of company specific financial information include Standard & Poor's *Stock Report Services*, Dun & Bradstreet's *Million Dollar Directory*, Moody's Manuals, and annual reports.

Exhibit 3: Top U.S. Companies with Organic Chemical Operations

Rank[a]	Company[b]	1993 Sales (millions of dollars)
1	Exxon Corp., Exxon Chemical Co. - S. Darien, CT	9,591
2	Dow Chemical USA - Midland, MI	9,000
3	Miles, Inc. - Pittsburgh, PA	5,130
4	Union Carbide Corp. - Danbury, CT	4,877
5	Amoco Chemical Co. - Chicago, IL	4,031
6	Chevron Chemical Co. - San Ramon, CA	3,354
7	Quantum Chemical Corp. - New York, NY	2,532
8	Witco Corp. - New York, NY	1,631
9	Ethyl Corp. - Baton Rouge, LA	1,600
10	Texaco Chemical Co. - Houston, TX	1,600

Note: [a] When Ward's Business Directory lists both a parent and subsidiary in the top ten, only the parent company is presented above to avoid double counting. Not all sales can be attributed to the companies' organic chemical operations.
[b] Companies shown listed SIC 286 as primary activity.

Source: Ward's Business Directory of U.S. Private and Public Companies - 1993.

II.B.2. Product Characterization

The two-digit SIC code 28, Chemicals and Allied Products, includes facilities classified as industrial organic chemical manufacturers under the three-digit SIC code 286. This includes gum and wood chemicals, cyclic crudes and intermediates and industrial organic chemical not elsewhere classified. The last category is by far the largest and most diverse of the three; however, its size distribution and industry structure are similar to those of the cyclic crudes and intermediates because both use primarily petroleum and coal derived feedstocks. In addition to industrial organic chemicals, seven separate types of product establishments are identified under Chemicals and Allied Products (SIC 28). Many of the other industry sectors within the two-digit SIC code 28, such as plastics materials and synthetics (SIC 282), are downstream users of the products manufactured by the industrial organic chemical industry. Others, such as the inorganic chemical sector, utilize unrelated feedstocks.

The following list includes industrial organic chemicals (italicized) as well as other chemicals and allied product SIC codes included within SIC code 28.

SIC	Industry Sector	SIC	Industry Sector
281	Inorganic Chemicals	*2861*	*Gum and Wood Chemicals*
282	Plastics Materials and Synthetics	*2865*	*Cyclic Organic Chemicals*
283	Drugs	*2869*	*Industrial Organic Chemicals, n.e.c.*
284	Soaps, Cleaners, and Toilet Goods	287	Agricultural Chemicals
285	Paints and Allied Products	289	Miscellaneous Chemical Products

The industrial organic chemical industry uses feedstocks derived from petroleum and natural gas (about 90 percent) and from recovered coal tar condensates generated by coke production (about 10 percent). The chemical industry produces raw materials and intermediates, as well as a wide variety of finished products for industry, business and individual consumers. The important classes of products within SIC code 2861 are hardwood and softwood distillation products, wood and gum naval stores, charcoal, natural dyestuffs, and natural tanning materials.

The important classes of products within SIC code 2865 are: (1) derivatives of benzene, toluene, naphthalene, anthracene, pyridene, carbazole, and other cyclic chemical products, (2) synthetic organic dyes, (3) synthetic organic pigments, (4) cyclic (coal tar) crudes, such as light oils and light oil products; coal tar acids; and products of medium and heavy oil such as creosote oil, naphthalene, anthracene and their high homologues.

Important classes of chemicals produced by organic chemical industry facilities within SIC code 2869 include: (1) non-cyclic organic chemicals such as acetic, chloroacetic, adipic, formic, oxalic acids and their metallic salts, chloral, formaldehyde, and methylamine; (2) solvents such as amyl, butyl and ethyl alcohols; methanol; amyl, butyl, and ethyl acetates; ethyl ether, ethylene glycol ether and diethylene glycol ether; acetone, carbon disulfide, and chlorinated solvents such as carbon tetrachloride, tetrachloroethene, and trichloroethene; (3) polyhydric alcohols such as ethylene glycol, sorbitol, pentaerythritol, and synthetic glycerin; (4) synthetic perfumes and flavoring materials such as coumarin, methyl salicylate, saccharin, citral, citronellal, synthetic geraniol, ionone, terpineol, and synthetic vanillin; (5) rubber processing chemicals such as accelerators and antioxidants, both cyclic and acyclic; (6) plasticizers, both cyclic and acyclic, such as esters of phosphoric acid, phthalic anhydride, adipic acid, lauric acid, oleic acid, sebacic acid, and stearic acid; (7) synthetic tanning agents such as sulfonic acid condensates; and (8) esters and amines of polyhydric alcohols and fatty and other acids.

II.B.3. Economic trends

With organic chemicals as the single largest segment of chemical exports (accounting for nearly one-half of total chemical shipments to foreign markets), the industrial organic sector faces a market similar to the petrochemical industry. While the U.S. production is expected to continue to grow at two to four percent annually, there is increasing competition in the export market despite growing demand. World petrochemical demand is projected to increase from 320 million metric tons in 1992 to 575 million metric tons in 2010. The share accounted for by the United States, Western Europe and Japan is expected to drop from 71 to 63 percent. Products from the Gulf Cooperation Council and Pacific Rim countries, including China and Korea, will begin to compete with U.S. products in current export markets as new facilities are brought on-line. The U.S. is expected to maintain a positive trade balance in organic chemicals. Chemical imports of organic chemicals (some representing intra-company transfers) have been steady over the last five years. The reduced trade barriers due to the North American Free Trade Agreement (NAFTA) and the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) have increased competition. Firms are adapting to the increased competition by emphasizing specialty chemicals and higher value-added products.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the organic chemical industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the by-products produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Organic Chemicals Industry

Industrial Organic Chemicals - Overview

The industrial organic chemical sector includes thousands of chemicals and hundreds of processes. In general, a set of building blocks (feedstocks) is combined in a series of reaction steps to produce both intermediates and end-products. The chart and flow diagram below (Exhibits 4 and 5) show the primary organic chemical building blocks (generated principally from petroleum refining), a key subset of the large volume secondary building blocks and a set of large volume tertiary building blocks. The subsequent chart (Exhibit 6) shows the reaction types used to manufacture a sample of organic chemicals, and illustrates the large variety of processes used by the industry.

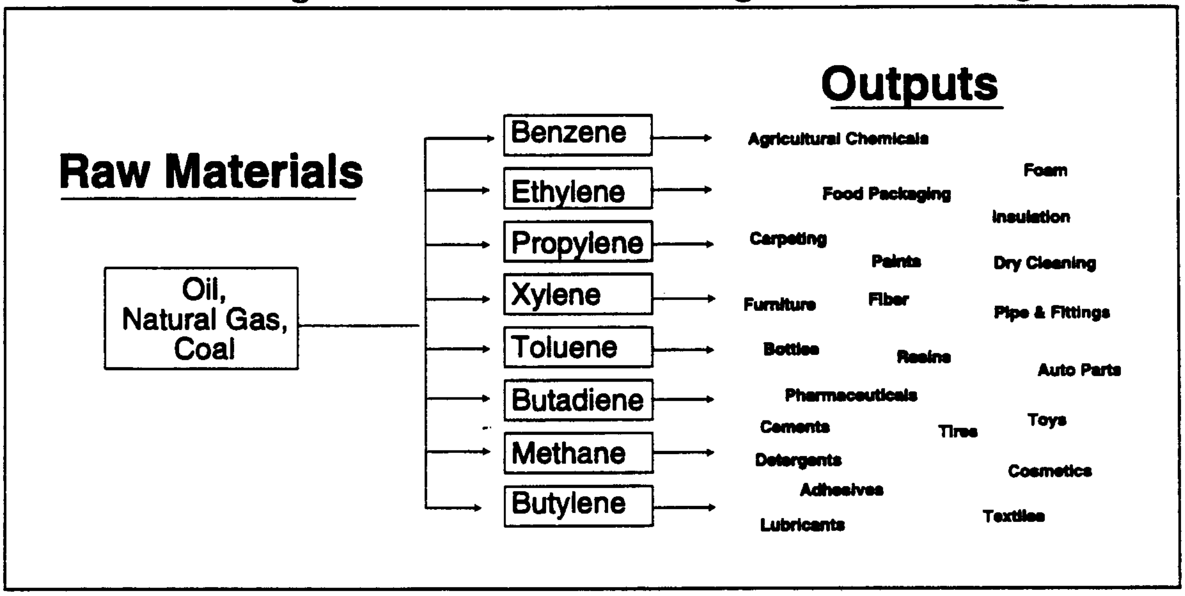
Exhibit 4: High Volume Organic Chemical Building Blocks

Primary Building Block	Secondary Building Block	Tertiary Building Block
Ethylene	Ethylene dichloride Ethylene oxide Ethylbenzene	Vinyl chloride Ethylene glycol Vinyl acetate
Propylene	Propylene oxide Acrylonitrile Isopropyl alcohol	 Acetone
Benzene	Ethylbenzene Cumene Cyclohexane	Styrene Phenol Acetone Adipic acid
Methanol	Acetic acid Formaldehyde Methyl t-butyl ether	Vinyl acetate
Toluene		
Xylenes p-isomer	 Terephthalic acid	
Butadiene		
Butylene		

Source: Szmant, *Organic Building Blocks of the Chemical Industry*

R0076795

Exhibit 5: Organic Chemicals and Building Blocks Flow Diagram



The typical chemical synthesis process involves combining multiple feedstocks in a series of unit operations. The first unit operation is a chemical reaction. Commodity chemicals tend to be synthesized in a continuous reactor while specialty chemicals usually are produced in batches. Most reactions take place at high temperatures, involve metal catalysts, and include one or two additional reaction components. The yield of the reaction will partially determine the kind and quantity of by-products and releases. Many specialty chemicals require a series of two or three reaction steps. Once the reaction is complete, the desired product must be separated from the by-products by a second unit operation. A number of separation techniques such as settling, distillation or refrigeration may be used. The final product may be further processed, by spray drying or pelletizing for example, to produce the saleable item. Frequently by-products are also sold and their value may alter the process economics.

Exhibit 6: Reaction/Process Types by Chemical Category for a Sampling of Organic Chemicals

Generic Process	Ethers		Halocarbons			Hydrocarbons					Ke-tones	Ni-trile
	Bis-1,2-Chloroisopropyl Ether	Ethylene Glycol Monomethyl Ether	Epichlorohydrin	Methyl Bromide	1,1,1-Trichloroethane	Butadiene	Hexane	Isoamylene	Styrene	Xylenes	Acetone	Acetonitrile
Alkoxylation		●										
Condensation	●											
Halogenation			●		●							
Oxidation												
Polymerization												
Hydrolysis												
Hydrogenation												
Esterification												
Pyrolysis								●		●	●	
Alkylation									●			
Dehydrogenation						●			●			
Amination (Ammonolysis)												
Nitration												
Sulfonation												
Ammoxidation												●
Carbonylation												
Hydrohalogenation				●								
Dehydration												
Dehydrohalogenation			●									
Oxyhalogenation					●							
Catalytic Cracking							●					
Hydrodealkylation										●		
Phosgenation												
Extraction						●		●				
Distillation						●		●				
Other											●	
Hydration												

R0076797

Exhibit 6 (cont.): Reaction/Process Types by Chemical Category for a Sampling of Organic Chemicals

Generic Process	Nitro-Carbon	Phenol	Salt	Misc.		Acid	Alcohols		Alde-hyde	Amine	Amide	Anhy-drides	Ester
	Nitrobenzene	p-Aminophenol	Sodium Benzoate	Dichlorodiphenyl Sulfone	Methylene Diphenyl Diisocyanate	Sulfonic Acid	n-Butanol	1,6-Hexanediol	Benzaldehyde	Hydroxylamine	Formamide	Tetrachloroprophthalic Anhydride	Dimethyl Terephthalate
Alkoxylation													
Condensation					●								
Halogenation												●	
Oxidation			●					●	●			●	●
Polymerization													
Hydrolysis										●			
Hydrogenation		●					●	●					
Esterification								●					●
Pyrolysis													
Alkylation													
Dehydrogenation													
Amination (Ammonolysis)											●		
Nitration	●												
Sulfonation				●									
Ammoxidation													
Carbonylation						●			●				
Hydrohalogenation													
Dehydration												●	
Dehydrohalogenation													
Oxyhalogenation													
Catalytic Cracking													
Hydrodealkylation													
Phosgenation					●								
Extraction													
Distillation													
Other			●	●									
Hydration							●						

Source: U.S. Development Document for Effluent Limitations, Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Point Source Category

R0076798

The separation technology employed depends on many factors including the phases of the substances being separated, the number of components in the mixture, and whether recovery of by-products is important. Numerous techniques such as distillation, extraction, filtration, and settling can be used singly or in combination to accomplish separations and are summarized in publications such as *Perry's Chemical Engineers' Handbook* or basic texts on chemical plant design.

Relatively few organic chemical manufacturing facilities are single product/process plants. Additionally, many process units are designed so that production levels of related products can be varied over wide ranges. This flexibility is required to accommodate variations in feedstock and product prices which can change the production rate and processes used, even on a short-term (less than a year) basis. A 1983 survey showed that 59 percent of industrial organic plants had more than one product or process and that seven percent had more than 20 (USEPA Development Document for Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Point Source Category).

The type of reaction process used to manufacture chemicals depends on the intended product; however, several types of reactions are common: polymerization, oxidation, and addition. Polymerization is a chemical reaction usually carried out with a catalyst, heat or light (often under high pressure) in which a large number of relatively simple molecules combine to form a chain-like macromolecule. Oxidation, in the strict sense, means combining oxygen chemically with another substance although this name is also applied to reactions where electrons are transferred. Addition covers a wide range of reactions where a double or triple bond is broken and a component added to the structure. Alkylation can be considered an addition, as can some oxidation reactions. The following charts list the reactions used to produce a subset of organic chemical products.

Four Specific Industrial Organic Chemicals

This profile examines the reactions of four high-volume chemicals (ethylene, propylene, benzene and vinyl chloride) chosen to illustrate the use of typical chemical feedstocks based on several factors, including the quantity of chemical produced, and the health and environmental impacts of the chemical. Ethylene, propylene, and benzene are all primary building blocks and their reaction products are used to produce still other chemicals. Vinyl chloride is an important tertiary building block.

The four chemicals described below illustrate several key points. First, primary building blocks are typically used in more reactions than the building blocks further down the chain. Second, most feedstocks can participate in more than one reaction and third, there is typically more than one reaction route to an end-product. The end-products of all of these chemicals can be used in numerous commercial applications; *Riegel's Handbook of Industrial Chemistry*, listed in the reference section, describes many uses.

Ethylene

The major uses for ethylene are in the synthesis of polymers (polyethylene) and in ethylene dichloride, a precursor to vinyl chloride. Other important products are ethylene oxide (a precursor to ethylene glycol) and ethylbenzene (a precursor to styrene). While ethylene itself is not generally considered a health threat, several of its derivatives, such as ethylene oxide and vinyl chloride, have been shown to cause cancer. The distribution of uses is shown below.

The manufacturing processes that use ethylene as a feedstock are summarized in the table below along with reaction conditions and components. In 1993, 18.8 million metric tons of ethylene were produced in the United States making ethylene the fourth largest production volume organic chemical in the United States. Ethylene dichloride, ethylbenzene, and ethylene oxide (products of ethylene reactions) are all among the top 50 high production volume organic chemicals in the United States (*Chemical and Engineering News*).

Exhibit 7: Distribution of Uses for Ethylene

Product	Percent of Ethylene Use
Polyethylene	54
Ethylene dichloride	16
Ethylbenzene-styrene	7
Ethylene oxide-glycol	13
Ethanol	1
Linear olefins-alcohol	3
Vinyl acetate	2
Other	4

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*

Exhibit 8: Manufacturing Processes Using Ethylene

		Process Conditions				
Process	**Target Product**	**Pressure (MPa)**	**Temperature (°C)**	**Catalyst**	**Reaction Components**	**Other Characteristics**
Polymerization	Low Density Polyethylene (LDPE)	60 - 350	350		Oxygen or Peroxide	
	High Density Polyethylene	0.1 - 20	50 - 300	Molybdenum Chromium oxide		
	Polyethylene	Low		Aluminum alkyls Titanium oxide		
Oxidation	Ethylene Oxide	1 - 2	250 - 300	Silver	1,2-Dichloro-ethane, Oxygen	60% is converted to ethylene glycol using an acid catalyst
	Acetaldehyde	0.3	120 - 130	Copper chloride/ palladium chloride	Oxygen	Vapor phase
	Vinyl acetate	0.4 - 1	170 - 200	Palladium	Acetic acid	
<u>Addition</u> Halogenation\ hydrohalogenation	Ethylene dichloride		60	Iron, aluminum, copper, or antimony chlorides	Chlorine	Feedstock for vinyl chloride and trichloroethylene and tetrachloroethylene
	Ethyl chloride	0.3 - 0.5		Aluminum or iron chlorides	HCl	Precursor of styrene
Alkylation	Ethylbenzene			Aluminum, iron, and boron chlorides	Benzene	
Hydroformation	Propionaldehyde	4 - 35	60 - 200	Cobalt	Synthesis gas (carbon monoxide and hydrogen)	

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*

Propylene

Over half of the U.S. propylene supplies (10.2 million metric tons produced in 1993) are used in the production of chemicals. The primary products are polypropylene, acrylonitrile, propylene oxide, and isopropyl alcohol. Of these, propylene, acrylonitrile and propylene oxide are among the top fifty high-volume chemicals produced in the United States. Acrylonitrile and propylene oxide have both been shown to cause cancer, while propylene itself is not generally considered a health threat. The table below shows the use distribution of propylene.

Exhibit 9: Distribution of Propylene Use

Product	Percent of Propylene Use
Polypropylene	36
Acrylonitrile	16
Propylene oxide	11
Cumene	9
Butyraldehydes	7
Oligomers	6
Isopropyl alcohol	6
Other	9

Source: Szmant, *Organic Building Blocks of the Chemical Industry*

The important propylene reactions are shown below. The products of the reactions are the feedstocks for numerous additional products.

R0076802

Exhibit 10: Manufacturing Processes Using Propylene

Process	Target Product	Process Conditions			Reaction Components	Other Characteristics
		Pressure (MPa)	Temperature	Catalyst		
Polymerization	Polypropylene			Aluminum alkyls/Titanium oxide		
Oxidation	Acrylonitrile		400	Phosphomolybdate	Ammonia Oxygen	Commercially valuable by-products are acetonitrile and hydrogen cyanide
	Propylene oxide				Oxygen Ethylbenzene	Commercially valuable by-product is *tert*-butyl alcohol
Addition Chlorohydrination	Propylene oxide	25	37	Tungsten	Hypochlorous acid	
Hydrolysis	Isopropyl alcohol		267		Water	

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*

Benzene

Benzene is an important intermediate in the manufacture of industrial chemicals and over 5.5 million metric tons were produced in the U.S. in 1993 (*Chemical and Engineering News*). Over 95 percent of U.S. consumption of benzene is for the preparation of ethylbenzene, cumene, cyclohexane, nitrobenzene, and various chlorobenzenes as shown in the table below.

Exhibit 11: Distribution of Benzene Use

Product	Percent of Benzene Use
Ethylbenzene	52
Cumene	22
Cyclohexane	14
Nitrobenzene	5
Chlorobenzenes	2
Linear detergent alkylate	2
Other	3

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*

The following table summarizes the primary benzene reactions. The products are frequently feedstocks in the synthesis of additional chemicals. Benzene is considered a human carcinogen by the Agency.

Exhibit 12: Manufacturing Processes Using Benzene

Process	Target product	Process Conditions			Reaction components	Other characteristics
		Pressure (MPa)	Temperature (°C)	Catalyst		
Oxidation	Phenol	0.6	90-100		Cumene, Oxygen	Most important phenol synthesis
	Maleic anhydride	0.1-0.2	350-400	Vanadium oxide	Butane Oxygen	
	Styrene	0.1	580-590	Iron oxide	Ethylene benzene	
Addition Alkylation	Ethylbenzene	0.2-0.4	125-140	Aluminum chloride	Benzene, Ethylene	Precursor to styrene
	Ethylbenzene	2.0	420-430	Zeolite	Benzene, Ethylene	Precursor to styrene
	Cumene	0.3-1.0	250-350	Phosphoric acid/silicate	Benzene, Propylene	
	2,6-Xylenol	0.1-0.2	300-400	Aluminum oxide	Phenol, Methanol	
Hydrogenation	Cyclohexanone	0.1	140-170	Palladium	Phenol, Hydrogen	
	Cyclohexanol	1.0-2.0	120-200	Nickel/silicon oxide and aluminum oxide	Phenol Hydrogen	
	Cyclohexane	2.0-5.0	150-200	Nickel	Benzene, Hydrogen	
	Aniline	.18	270	Copper	Nitrobenzene, Hydrogen	
Nitration	Nitrobenzene	0.1	60		Benzene, sulfuric acid, nitric acid	
Sulfonation	Surfactants	0.1	40-50		Alkylbenezenes/ Sulfur trioxide	
Chlorination	Chlorobenzene	0.1	30-40	Aluminum chloride/ Iron chloride	Benzene, Chlorine	
Condensation	Biphenol A	0.1	50-90	HCl	Phenol, Acetone	

Source: *Franck and Stadelhofer, "Industrial Aromatic Chemistry"*

Vinyl Chloride

Vinyl chloride is one of the largest commodity chemicals in the U.S. with over 6.25 million metric tons produced in 1993. It is also considered a human carcinogen by the EPA. Vinyl chloride polymers are the primary end use but various vinyl ethers, esters, and halogen products can also be made as shown in the table below.

Exhibit 13: Manufacturing Processes Using Vinyl Chloride

Process	Target Product	Process Conditions			Reaction components	Other characteristics
		Pressure (MPa)	Temperature (°C)	Catalyst		
Polymerization	Polyvinylchloride		50	Peroxides		
Substitution at the Carbon-Chlorine Bond	Vinyl acetates, alcholates, vinyl esters and vinyl ethers			Palladium	Alkyl halides	
Addition	Various halogen addition products					

Source: *Kirk-Othmer Encyclopedia of Chemical Technology*

III.B. Raw Material Inputs and Pollution Outputs

Industrial organic chemical manufacturers use and generate both large numbers and quantities of chemicals. The industry emits chemicals to all media including air (through both fugitive and direct emissions), water (direct discharge and runoff) and land. The types of pollutants a single facility will release depend on the feedstocks, processes, equipment in use and maintenance practices. These can vary from hour to hour and can also vary with the part of the process that is underway. For example, for batch reactions in a closed vessel, the chemicals are more likely to be emitted at the beginning and end of a reaction step (associated with vessel loading and product transfer operations), than during the reaction. The potential sources of pollutant outputs by media are shown below.

Exhibit 14: Potential Releases During Organic Chemical Manufacturing

Media	Potential Sources of Emissions
Air	Point source emissions: stack, vent (e.g. laboratory hood, distillation unit, reactor, storage tank vent), material loading/unloading operations (including rail cars, tank trucks, and marine vessels) Fugitive emissions: pumps, valves, flanges, sample collection, mechanical seals, relief devices, tanks Secondary emissions: waste and wastewater treatment units, cooling tower, process sewer, sump, spill/leak areas
Liquid wastes (Organic or Aqueous)	Equipment wash solvent/water, lab samples, surplus chemicals, product washes/purifications, seal flushes, scrubber blowdown, cooling water, steam jets, vacuum pumps, leaks, spills, spent/used solvents, housekeeping (pad washdown), waste oils/lubricants from maintenance
Solid Wastes	Spent catalysts, spent filters, sludges, wastewater treatment biological sludge, contaminated soil, old equipment/insulation, packaging material, reaction by-products, spent carbon/resins, drying aids
Ground Water Contamination	Unlined ditches, process trenches, sumps, pumps/valves/fittings, wastewater treatment ponds, product storage areas, tanks and tank farms, aboveground and underground piping, loading/unloading areas/racks, manufacturing maintenance facilities

Source: *Designing Pollution Prevention into the Process- Research, Development and Engineering*

III.C. Management of Chemicals in the Production Process

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992 through 1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has remained reasonably constant between 1992 and 1995 (projected). While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The PPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 15 shows that the organic chemical industry managed about 6.3 trillion pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, seven percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 90 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns E, F and G, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns H, I and J, respectively. The remaining portion of the production related wastes (three percent), shown in column D, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

Exhibit 15: Source Reduction and Recycling Activity for the Organic Chemical Industry (SIC 286) as Reported within TRI

A	B	C	D	On-Site			Off-Site		
				E	F	G	H	I	J
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Released and Transferred[b]	% Released and Disposed[c] Off-site	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated
1992	6,313	7%	3%	71%	7%	15%	2%	1%	2%
1993	6,325	7%	3%	71%	7%	15%	2%	1%	1%
1994	6,712	---	2%	71%	8%	15%	2%	1%	1%
1995	6,645	---	2%	72%	7%	15%	2%	1%	<1%

[a] Within this industry sector, non-production related waste < 1% of production related wastes for 1993.
[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes.
[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20 through 39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries. TRI data provide the type, amount and media receptor of each chemical released or transferred.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 43 percent between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotlines at 800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, this notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by the organic chemical industry.

Definitions Associated with Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20 through 39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are waste waters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or land filled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Organic Chemicals Industry

According to the Toxics Release Inventory (TRI) data, 417 organic chemical facilities released (to the air, water or land) and transferred (shipped off-site or discharged to sewers) a total of 438 million pounds of toxic chemicals during calendar year 1993. That represents approximately 18 percent of the 2.5 billion pounds of releases and transfers from the chemical industry as a whole (SIC 28) and about six percent of the releases and transfers for all manufacturers reporting to TRI that year. By comparison, the inorganic chemical industry's releases and transfers in 1993 totaled 249.7 million pounds, or sixty percent of the releases and transfers of the industrial organic chemical sector.

The chemical industry's <u>releases</u> have been declining in recent years. Between 1988 and 1992 TRI emissions from chemical companies (all those categorized within SIC 28, not just organic chemical manufacturers) to air, land, and water were reduced 44 percent, which is average for all manufacturing sectors reporting to TRI.

Because the chemical industry (SIC 28) has historically released more TRI chemicals than any other industry, the EPA has worked to improve environmental performance within this sector. This has been done through a combination of enforcement actions, regulatory requirements, pollution prevention projects, and voluntary programs (e.g. EPA's 33/50 program). In addition, the chemical industry has focused on reducing pollutant releases. For example, the Chemical Manufacturer's Association's (CMA's) Responsible Care® initiative is intended to reduce or eliminate chemical manufacturers' wastes. All 185 members of the CMA, firms that account for the majority of U.S. chemical industry sales and earnings, are required to participate in the program as a condition of CMA membership. Participation involves demonstrating a commitment to the program's mandate of continuous improvement of the environment, health, and safety. In June of 1994, the CMA approved the use of a third-party verification of management plans to meet these objectives. State-level toxics use reduction requirements, public disclosure of release and transfer information contained in TRI, and voluntary programs such as EPA's 33/50 Program have also been given as reasons for release reductions.

Exhibit 16 presents the number and volumes of chemicals released by organic chemical facilities. The quantity of the basic feedstocks released reflects their volume of usage. The inorganic chemicals among the top ten released (ammonia, nitric acid, ammonium sulfate, and sulfuric acid) are also large volume reaction feedstocks. Inorganic chemicals contained in wastes injected underground on-site account for 58 percent of the industry's releases; ammonia makes up the vast majority of TRI chemicals disposed of via underground injection. Air releases account for 40 percent (61 million pounds), and the remaining approximately 1.5 percent (2.4 million pounds) is discharged directly to water or land disposed.

Exhibit 17 presents the number and volumes of chemicals transferred by organic chemical facilities. Off-site transfers account for the largest amount, 65 percent, of the organic chemical industry's total releases and transfers as reported in TRI. Three chemicals (sulfuric acid, methanol and *tert*-butyl alcohol) account for over one-half of the 287 million pounds transferred off-site. The 49 million pounds of POTW discharges (primarily methanol and ammonia) account for 17 percent of releases and transfers.

The frequency with which chemicals are reported by facilities within a sector is one indication of the diversity of operations and processes. Many chemicals are released or transferred by a small number of facilities, which indicates a wide diversity of production processes, particularly for specialty organic chemicals -- over one half of the 204 chemicals reported are released by fewer than 10 facilities. However, the organic chemical industry is also characterized by one of the largest numbers of chemicals reported by any manufacturing sector. Of the over 300 chemicals currently listed on TRI, 204 are reported as released or transferred by at least one organic chemical facility.

Exhibit 16: 1993 Releases for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASE PER FACILITY
SULFURIC ACID	216	38,135	84,847	50	5,590,786	6,367	5,720,185	26,482
METHANOL	194	3,872,663	5,125,135	60,131	5,944,874	6,212	15,009,015	77,366
HYDROCHLORIC ACID	144	389,413	1,153,510	29,028	82,677	974	1,655,602	11,497
AMMONIA	116	1,111,918	2,572,704	726,248	28,145,563	235,994	32,792,427	282,693
TOLUENE	109	851,359	957,684	154	194,937	1,019	2,005,153	18,396
XYLENE (MIXED ISOMERS)	89	730,696	207,630	334	161,156	313	1,100,129	12,361
ETHYLENE GLYCOL	86	204,427	3,272,040	28,445	5,867,002	63,735	9,435,649	109,717
CHLORINE	85	130,761	157,695	2,236	780	0	291,472	3,429
ACETONE	84	5,159,656	1,348,278	4,040	1,264,031	7,195	7,783,200	92,657
FORMALDEHYDE	78	280,006	382,300	4,610	75,086	1,205	743,207	9,528
BENZENE	72	850,106	803,898	494	231,093	308	1,885,899	26,193
GLYCOL ETHERS	67	136,339	22,304	23,684	88	8,197	190,612	2,845
PHOSPHORIC ACID	67	11,835	1,378	15	0	5	13,233	198
PHENOL	62	434,770	268,529	3,620	2,011,015	1,134	2,719,068	43,856
N-BUTYL ALCOHOL	56	256,456	236,442	15,550	1,363,944	1,303	1,873,695	33,459
STYRENE	47	210,666	277,926	283	132,575	851	622,301	13,240
ZINC COMPOUNDS	46	9,364	15,103	8,011	9,254	36,160	77,892	1,693
COPPER COMPOUNDS	44	1,274	1,363	6,454	147,134	33,141	189,366	4,304
NAPHTHALENE	44	305,328	337,758	45	63,265	12,131	718,527	16,330
ETHYLBENZENE	42	230,216	138,969	60	333,489	102	702,836	16,734
ETHYLENE	38	2,649,664	4,027,122	0	0	0	6,676,786	175,705
MALEIC ANHYDRIDE	38	17,956	20,838	15	0	0	38,809	1,021
DICHLOROMETHANE	36	65,419	191,239	600	0	0	257,258	7,146
PROPYLENE	35	2,353,950	602,285	0	0	0	2,956,235	84,464
ACRYLIC ACID	31	269,020	108,887	14	160,000	0	537,921	17,352
BIPHENYL	28	51,616	10,857	10	44,266	6,138	112,887	4,032
CYCLOHEXANE	28	232,868	812,798	17,370	258,817	169	1,322,022	47,215
DIETHANOLAMINE	28	33,271	1,035	22,766	0	53,663	110,735	3,955
BARIUM COMPOUNDS	27	6,838	4,156	6,900	1,600	22	19,516	723
METHYL ETHYL KETONE	27	166,230	215,714	290	246,072	0	628,306	23,271
NITRIC ACID	27	3,949	26,784	2,000	16,097,146	2,490	16,132,369	597,495
PHTHALIC ANHYDRIDE	27	33,350	13,593	0	0	0	46,943	1,739
ANILINE	26	73,410	54,142	2,073	430,763	20	560,408	21,554
CHLOROMETHANE	25	263,303	719,728	570	0	0	983,601	39,344
CUMENE	25	299,630	436,635	40	17,000	200	753,505	30,140
CHROMIUM COMPOUNDS	24	725	1,239	1,365	3,269	6,184	12,782	533
ETHYLENE OXIDE	24	130,124	70,116	2,359	28,000	895	231,494	9,646
PROPYLENE OXIDE	23	175,006	129,503	5,472	5,151	6,125	321,257	13,968
1,3-BUTADIENE	23	496,952	196,341	1,321	0	284	694,898	30,213
1,2,4-TRIMETHYLBENZENE	22	12,418	6,232	286	304	25	19,265	876
ACETALDEHYDE	20	150,111	1,131,895	1,436	1,346,120	16	2,629,578	131,479
METHYL ISOBUTYL KETONE	19	1,632,377	298,258	6,119	0	5	1,936,759	101,935
NICKEL COMPOUNDS	19	758	2,294	2,251	100,816	4,113	110,232	5,802
ACRYLONITRILE	18	27,146	38,612	17	629,590	10	695,375	38,632
CHLOROETHANE	18	32,455	54,124	2,179	0	0	88,758	4,931
ANTHRACENE	17	6,817	9,620	10	0	5,119	21,566	1,269
CHLOROBENZENE	16	47,007	23,124	272	51,000	293	121,696	7,606
1,1,1-TRICHLOROETHANE	16	26,046	12,350	0	0	0	38,396	2,400
CRESOL (MIXED ISOMERS)	15	72,079	17,910	35	793,402	120	883,546	58,903
DICHLORODIFLUOROMETHANE	15	389,258	73,271	10	1	100	462,640	30,843
TERT-BUTYL ALCOHOL	15	1,068,315	234,114	158,120	302,943	180	1,763,672	117,578
AMMONIUM SULFATE	14	10	6,810	122	5,746,409	420,001	6,173,352	440,954

R0076816

Exhibit 16 (cont.): 1993 Releases for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting
(Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
DIMETHYL SULFATE	14	1,310	644	0	0	5	1,959	140
TETRACHLOROETHYLENE	14	29,594	17,654	29	0	0	47,277	3,377
CREOSOTE	13	55,110	74,595	5	0	585	130,295	10,023
BUTYL ACRYLATE	12	81,815	45,684	306	0	0	127,805	10,650
CARBON DISULFIDE	12	43,576	10,221	251	0	0	54,048	4,504
EPICHLOROHYDRIN	12	17,289	2,296	292	0	0	19,877	1,656
O-XYLENE	12	102,254	160,275	141	0	0	262,670	21,889
1,2-DICHLOROETHANE	12	220,032	968,026	70	0	0	1,188,128	99,011
BENZOYL CHLORIDE	11	6,087	1,819	0	0	5	7,911	719
BUTYRALDEHYDE	11	34,477	31,689	7	189,447	0	255,620	23,238
CHLOROFORM	11	12,764	62,055	693	74	200	75,786	6,890
COBALT COMPOUNDS	11	0	4,592	80,304	0	18,696	103,592	9,417
DIBENZOFURAN	11	10,880	10,059	10	0	910	21,859	1,987
DIETHYL SULFATE	11	616	17	0	0	5	638	58
ETHYL ACRYLATE	11	46,571	35,631	410	2,400	0	85,012	7,728
HYDROQUINONE	11	188	5	30	190,000	117	190,340	17,304
MANGANESE COMPOUNDS	11	1,760	28,017	131,505	0	61,000	222,282	20,207
METHYL ACRYLATE	11	51,940	49,500	5	0	0	101,445	9,222
METHYL METHACRYLATE	11	76,114	119,538	750	0	250	196,652	17,877
METHYL TERT-BUTYL ETHER	11	143,917	70,795	85	8,772	0	223,569	20,324
TRICHLOROETHYLENE	11	42,619	936	5	0	0	43,560	3,960
VINYL ACETATE	11	166,157	744,939	0	892,698	0	1,803,794	163,981
BENZYL CHLORIDE	10	2,297	432	0	0	58	2,787	279
HYDROGEN CYANIDE	10	10,539	298,141	0	651,815	12	960,507	96,051
M-CRESOL	10	20,937	2,442	406	520,000	0	543,785	54,379
QUINOLINE	10	3,327	17,900	40	63,000	190	84,457	8,446
SEC-BUTYL ALCOHOL	10	15,241	8,310	2,440	0	5	25,996	2,600
ACETONITRILE	9	79,850	64,366	217	3,969,793	13	4,114,239	457,138
ACRYLAMIDE	9	16,503	1,597	0	930,000	160	948,260	105,362
CARBON TETRACHLORIDE	9	55,191	55,130	234	63	0	110,618	12,291
FREON 113	9	23,242	84,780	44	4	406	108,476	12,053
HYDRAZINE	9	7,195	1,551	0	0	0	8,746	972
TRICHLOROFLUOROMETHAN	9	103,857	74,459	50	11	750	179,127	19,903
ALLYL ALCOHOL	8	36,773	6,928	5,100	192,966	0	241,767	30,221
CHLOROACETIC ACID	8	3,786	413	5	0	0	4,204	526
COPPER	8	0	170	1,329	0	4,880	6,379	797
CUMENE HYDROPEROXIDE	8	11,380	5,404	190	380,000	3	396,977	49,622
CYANIDE COMPOUNDS	8	26,142	1,543	7,391	426,890	2,846	464,812	58,102
ISOBUTYRALDEHYDE	8	37,012	16,187	255	34,783	0	88,237	11,030
O-TOLUIDINE	8	8,370	155	5	9,600	7	18,137	2,267
P-CRESOL	8	13,522	2,197	273	260,000	0	275,992	34,499
PROPIONALDEHYDE	8	20,845	13,991	5	31,995	0	66,836	8,355
2-METHOXYETHANOL	8	27,431	3,436	430	0	0	31,297	3,912
4,4'-	8	67,835	8,979	337	43,000	250	120,401	15,050
DI(2-ETHYLHEXYL)	7	270	255	0	0	0	525	75
DIBUTYL PHTHALATE	7	271	505	23	0	0	799	114
DIMETHYL PHTHALATE	7	5,424	1,461	12	1,300	5	8,202	1,172
HYDROGEN FLUORIDE	7	3,894	4,627	0	1	0	8,522	1,217
NICKEL	7	6	250	5	0	113	374	53
PHOSGENE	7	265	293	0	0	0	558	80
PYRIDINE	7	11,229	2,339	0	220,000	0	233,568	33,367
ACROLEIN	6	5,170	10,129	0	82	0	15,381	2,564

Exhibit 16 (cont.): 1993 Releases for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
ANTIMONY COMPOUNDS	6	20	257	125	759	10	1,171	195
BIS(2-ETHYLHEXYL) ADIPATE	6	23	257	0	0	0	280	47
LEAD COMPOUNDS	6	304	256	1	0	0	561	94
M-XYLENE	6	90,153	51,519	0	0	0	141,672	23,612
N,N-DIMETHYLANILINE	6	906	2,745	250	0	0	3,901	650
P-XYLENE	6	240,522	2,362,739	1	0	1	2,603,263	433,877
1,2,4-TRICHLOROBENZENE	6	2,536	38,272	10	0	0	40,818	6,803
AMMONIUM NITRATE (SOLUTION)	5	0	750	8,500	0	0	9,250	1,850
CADMIUM COMPOUNDS	5	1,895	1,005	0	0	0	2,900	580
DIETHYL PHTHALATE	5	510	10	0	0	250	770	154
MOLYBDENUM TRIOXIDE	5	0	7,100	0	55,000	99	62,199	12,440
O-ANISIDINE	5	405	11	81	0	116	613	123
P-CRESIDINE	5	285	125	5	0	85	500	100
VINYL CHLORIDE	5	31,082	3,504	0	0	0	34,586	6,917
ALLYL CHLORIDE	4	2,702	294	0	0	0	2,996	749
BENZOYL PEROXIDE	4	250	977	0	0	0	1,227	307
BUTYL BENZYL PHTHALATE	4	18	0	0	83	7	108	27
CHROMIUM	4	0	0	250	0	1	251	63
METHYLENEBIS (PHENYLISOCYANATE)	4	3,053	256	0	0	5	3,314	829
O-CRESOL	4	8,804	1,087	95	560,000	0	569,986	142,497
1,1,2-TRICHLOROETHANE	4	2,672	90	3	0	0	2,765	691
1,2-DICHLOROETHYLENE	4	224	50	0	0	0	274	69
1,4-DIOXANE	4	15,613	2,414	21,715	0	2,100	41,842	10,461
2-ETHOXYETHANOL	4	26,298	10,122	1,932	0	0	38,352	9,588
3,3'-DICHLOROBENZIDINE	4	0	0	0	0	0	0	0
4,6-DINITRO-O-CRESOL	4	6	37	10	0	0	53	13
ASBESTOS (FRIABLE)	3	0	0	0	0	0	0	0
DIAMINOTOLUENE (MIXED	3	1,205	19	500	0	10	1,734	578
DICHLOROTETRAFLUOROETHANE	3	7,967	23,440	0	0	0	31,407	10,469
ISOPROPYL ALCOHOL	3	157	34	0	0	0	191	64
NITROBENZENE	3	11,255	1,030	0	0	0	12,285	4,095
PICRIC ACID	3	2	2	1	38,294	1	38,300	12,767
SILVER	3	0	9	62	210	0	281	94
SILVER COMPOUNDS	3	3,743	0	0	0	0	3,743	1,248
STYRENE OXIDE	3	298	38	0	0	0	336	112
VINYLIDENE CHLORIDE	3	162	158	0	0	0	320	107
1,1,2,2-TETRACHLOROETHANE	3	141	10	0	0	0	151	50
1,2-DICHLOROBENZENE	3	7,605	8,412	1	0	0	16,018	5,339
2-NITROPHENOL	3	5	10	5	0	0	20	7
2,4-DIAMINOTOLUENE	3	13	0	0	0	0	13	4
ANTIMONY	2	260	33	0	0	0	293	147
BROMOMETHANE	2	2,300	618,500	0	0	0	620,800	310,400
C.I. BASIC GREEN 4	2	0	0	0	0	0	0	0
C.I. FOOD RED 15	2	0	1	0	0	0	1	1
CHLOROPRENE	2	6	13	0	0	0	19	10
DICHLOROBENZENE (MIXED	2	219	13	0	1	0	233	117
HEXACHLORO-1,3-BUTADIENE	2	1	0	0	0	0	1	1
HEXACHLOROBENZENE	2	0	0	0	0	0	0	0

R0076818

Exhibit 16 (cont.): 1993 Releases for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASES PER FACILITY
TOLUENEDIISOCYANATE	2	5	5	0	0	250	260	13,059
(MIXED ISOMERS)	0			0	0	0		
1,2-BUTYLENE OXIDE	2	289	0	0	0	0	289	145
2,4-DIMETHYLPHENOL	0	3,400	160	80	0	0	58,640	29,320
2,3-DINITROPHENOL	2	1	2	110	0	0	117	59
3,3'-DIMETHOXYBENZIDINE	0	0	0	4	0	0	4	2
4,4'-METHYLENEDIANILINE	(1)	2,404	5	0	150	0	2,559	1,280
ACETAMIDE	0	2	8	0	89,000	0	89,010	89,010
ALPHA-NAPHTHYLAMINE	0	0	0	0	0	0	0	0
ALUMINUM (FUME OR DUST)	1	115	0	219	0	0	334	334
BENZIOIC TRICHLORIDE	1	1,318	5	0	0	0	1,323	1,323
BIS(2-CHLOROETHYL) ETHER	1	22	0	0	0	0	22	22
BROMOCHLORODIFLUOROMETHANE	1	0	0	0	0	0	0	0
C.I. BASIC RED 1	1	0	0	0	0	0	0	0
C.I. DISPERSE YELLOW 3	1	399	0	28	0	9,199	9,626	9,626
C.I. SOLVENT YELLOW 3	1	0	0	0	0	0	0	0
CADMIUM	1	0	0	0	0	0	0	0
CHLORDANE	1	51	0	15	0	0	66	66
COBALT	1	0	1,800	460	0	1,600	3,860	3,860
CUPFERRON	1	2	23	0	0	0	25	25
ETHYL CHLOROFORMATE	1	250	5	0	0	0	255	255
ETHYLENE THIOUREA	1	5	5	0	0	0	10	10
ETHYLENEIMINE	1	0	0	0	0	0	0	0
HEPTACHLOR	1	31	0	2	0	0	33	33
HEXACHLOROCYCLOPENTADIENE	1	1,342	861	0	0	0	2,203	2,203
HEXACHLOROETHANE	1	1	0	0	0	0	1	1
HYDRAZINE SULFATE	1	0	0	0	0	0	0	0
LEAD	1	5	5	0	0	0	10	10
M-DINITROBENZINE	1	49	7	0	0	0	56	56
METHYL IODIDE	1	6,800	92	0	0	0	6,892	6,892
METHYL ISOCYANATE	1	0	0	0	0	0	0	0
METHYLENE BROMIDE	1	3	13	0	0	0	16	16
O-DINITROBENZENE	1	1	1	0	0	0	2	2
OXY-ALKYLATED ALCOHOL	1	250	5	0	0	0	255	255
P-PHENYLENEDIAMINE	1	1	1	0	0	0	4	4
PHENYL MIXTURE	1	2,600	200	0	0	0	2,800	2,800
PHOSPHORUS (YELLOW OR WHITE)	1	0	0	0	0	0	0	0
SACCHARIN (MANUFACTURING)	1	50	1	0	0	0	51	51
TITANIUM TETRACHLORIDE	1	0	0	0	0	0	0	0
ZINC (FUME OR DUST)	1	0	290	0	0	0	290	290
1,3-DICHLOROBENZENE	1	0	0	0	0	0	0	0
1,3-DICHLOROPROPYLENE	1	3	22	0	0	0	25	25
1,4-DICHLOROBENZENE	1	32	95	0	0	0	127	127
2-NITROPROPANE	1	0	0	0	0	0	0	0
2,4-DIAMINOANISOLE	1	0	13	0	0	0	13	13
2,4-DINITROTOLUENE	1	1	2	0	0	0	3	3
2,6-SYLIDINE	1	53	2	0	0	0	55	55
4-NITROPHENOL	1	290	21	0	0	0	311	311
5-NITRO-O-ANISIDINE	1	5	5	0	0	0	10	10
TOTAL	417	28,256,560	33,222,806	1,415,674	87,698,609	1,027,734	151,621,383	363,600

R0076819

Exhibit 17: 1993 Transfers for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting
(Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFERS PER FACILITY
SULFURIC ACID	216	60,857	1,460,275	84,722,700	3,530,520	0	86,596,884	400,912
METHANOL	194	210,007,643	298,453	5,596,077	4,597,065	11,815,643	43,307,981	223,237
HYDROCHLORIC ACID	144	742,576	770,703	7,415	2,680,884	182	4,202,346	29,183
AMMONIA	116	8,351,095	1,263,566	162,738	83,271	930	9,861,610	85,014
TOLUENE	109	13,790	267,107	7,155,414	999,051	9,256,100	17,691,462	162,307
XYLENE (MIXED ISOMERS)	89	19,513	248,470	303,172	205,720	4,912,122	5,688,997	63,921
ETHYLENE GLYCOL	86	2,630,290	291,143	122,260	2,504,914	4,915,874	10,464,481	121,680
CHLORINE	85	30,671	22	0	115,400	2,687	148,780	1,750
ACETONE	84	2,452,706	27,530	182,320	859,366	3,893,746	7,415,668	88,282
FORMALDEHYDE	78	264,163	403	173	102,654	1,055	368,448	4,724
BENZENE	72	596	31,498	705,846	225,803	174,445	1,138,188	158,808
GLYCOL ETHERS	67	2,469,069	82,646	10,170	173,874	254,182	2,989,941	44,626
PHOSPHORIC ACID	67	36,422	11,680	0	2,166	15	50,283	750
PHENOL	62	559,856	96,193	3,300	247,644	466,822	1,373,815	22,158
N-BUTYL ALCOHOL	56	235,678	193,040	210	335,171	2,024,030	2,788,129	49,788
STYRENE	47	9,772	12,738	9,935	714,896	250,703	998,044	21,235
ZINC COMPOUNDS	46	53,120	1,078,844	173,261	62,751	16,914	1,384,890	30,106
COPPER COMPOUNDS	44	46,957	242,892	1,458,665	187,352	0	193,866	43,997
NAPHTHALENE	44	3,853	156,104	56,080	218,493	220,473	655,003	14,886
ETHYLBENZENE	42	331	28,706	4,765	12,484	448,357	494,643	11,777
ETHYLENE	38	0	68	0	0	0	68	2
MALEIC ANHYDRIDE	38	155	7,797	0	2,563	0	10,515	277
DICHLOROMETHANE	36	533	814	539,664	278,008	420,139	1,239,158	34,421
PROPYLENE	35	0	0	0	380,000	0	380,000	10,857
ACRYLIC ACID	31	29,470	26,822	0	73,140	7,855,500	7,984,932	257,578
BIPHENYL	28	265,741	9,922	14,409	92,951	75,951	458,974	16,392
CYCLOHEXANE	28	3,083	1,420	1,034,820	196,873	406,927	1,643,123	58,683
DIETHANOLAMINE	28	123,941	46,624	0	1,428	6,839	178,832	6,387
BARIUM COMPOUNDS	27	80,991	251,349	1,039	22,895	32,435	388,709	14,397
METHYL ETHYL KETONE	27	88,200	14,967	7,402	34,173	1,703,103	1,847,845	68,439
NITRIC ACID	27	355	232,000	0	7,160	0	239,515	8,871
PHTHALIC ANHYDRIDE	27	3,956	46,965	0	34,579	1,774,375	1,859,875	68,884
ANILINE	26	1,309,605	390,621	0	28,201	166,308	1,894,735	72,874
CHLOROMETHANE	25	788	6	0	91,521	47,285	139,600	5,584
CUMENE	25	20,017	5,761	4,511	8,372	68,031	106,692	4,268
CHROMIUM COMPOUNDS	24	4,982	44,909	561,231	110,976	190	722,288	30,095
ETHYLENE OXIDE	24	18,441	1,989	0	0	1	20,431	851
PROPYLENE OXIDE	23	9,409	9,564	0	7	2,660	21,640	941
1,3-BUTADIENE	23	250	550	0	21	81	902	39
1,2,4-TRIMETHYLBENZENE	22	49,994	5,068	4,511	451	60,471	120,495	5,477
ACETALDEHYDE	20	80,071	0	0	264	0	80,335	4,019
METHYL ISOBUTYL KETONE	19	50,988	642	25	856	289,105	341,616	17,980
NICKEL COMPOUNDS	19	5,504	43,454	747,998	211,744	0	1,008,700	53,089
ACRYLONITRILE	18	35,489	0	0	349,878	585,483	970,850	53,936
CHLOROETHANE	18	5	0	151,000	388,895	0	539,900	29,994
ANTHRACENE	17	256	28,683	8,909	2,600	53,834	94,282	5,546
CHLOROBENZENE	16	1,076	915	157	17,904	15,591	35,643	2,228
1,1,1-TRICHLOROETHANE	16	12	0	16,461	620,387	1,591	638,451	39,903
CRESOL (MIXED ISOMERS)	15	250	4,113	6,500	26,725	447	38,035	2,536
DICHLORODIFLUOROMETHANE	15	8	8	0	0	0	16	1
TERT-BUTYL ALCOHOL	15	862,730	255,223	5,324	328,262	29,383,821	30,835,362	2,055,691
AMMONIUM SULFATE	14	5,178,324	250	0	211,000	0	5,389,574	384,970

Exhibit 17(cont.): 1993 Transfers for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFERS PER FACILITY
DIMETHYL SULFATE	14	255	0	39,542	0	0	39,797	2,843
TETRACHLOROETHYLENE	14	447	79	1,126	282,805	11,855	296,312	21,165
CREOSOTE	13	0	700,472	273,000	300	29,220	1,002,992	77,153
BUTYL ACRYLATE	12	279	725	0	7,541	0	8,545	712
CARBON DISULFIDE	12	7,289	279	4,413	7,925	125,206	145,112	12,093
EPICHLOROHYDRIN	12	255	0	0	185	0	440	37
O-XYLENE	12	28	28,557	5,414	10,341	861,637	905,977	75,498
1,2-DICHLOROETHANE	12	731	54,402	1,700,000	402,888	406	2,158,427	179,869
BENZOYL CHLORIDE	11	0	250	0	0	0	250	23
BUTYRALDEHYDE	11	0	1,700	450	0	1,700	3,850	350
CHLOROFORM	11	264	0	3,100	131,685	19,297	154,346	14,031
COBALT COMPOUNDS	11	14	184,500	148,400	7	0	332,921	30,266
DIBENZOFURAN	11	250	25,701	3,609	0	19,988	49,548	4,504
DIETHYL SULFATE	11	10	0	5,370,000	0	0	53,701,010	488,183
ETHYL ACRYLATE	11	500	6,950	0	187,311	1,378,573	1,573,334	143,030
HYDROQUINONE	11	1,210	32,261	0	338	0	33,809	3,074
MANGANESE COMPOUNDS	11	5,019	819,758	11,600	0	0	836,377	76,034
METHYL ACRYLATE	11	2,110	250	0	5,765	10,508	18,633	1,694
METHYL METHACRYLATE	11	563	750	71,000	226,520	10,410	309,243	28,113
METHYL TERT-BUTYL ETHER	11	31	133,320	0	0	237,779	371,130	33,739
TRICHLOROETHYLENE	11	7	0	1,143	310,803	0	311,953	28,359
VINYL ACETATE	11	95,453	390	0	9,341	561,083	666,267	60,570
BENZYL CHLORIDE	10	250	0	0	14	30,980	31,244	3,124
HYDROGEN CYANIDE	10	250	2,053	0	74	250	2,627	263
M-CRESOL	10	9,649	13,336	270,000	51,118	2,923	347,026	34,703
QUINOLINE	10	250	5,482	3,609	2	5,354	14,397	1,470
SEC-BUTYL ALCOHOL	10	2,046	145,000	0	1,682	4,082,657	4,231,385	423,139
ACETONITRILE	9	255	1,601	0	410	263,316	265,582	29,509
ACRYLAMIDE	9	79,559	500	0	20,470	44,330	154,859	17,207
CARBON TETRACHLORIDE	9	1,604	1,366	1,750	136,570	0	141,290	15,699
FREON 113	9	0	12	13,215	64,636	0	77,863	8,651
HYDRAZINE	9	1,400	3,617	0	0	0	5,017	557
TRICHLOROFLUOROMETHANE	9	349	0	750	2,433	0	3,532	392
ALLYL ALCOHOL	8	27,663	4,271	0	28,172	139,592	199,698	24,962
CHLOROACETIC ACID	8	0	250	0	1,026	150	1,426	178
COPPER	8	0	30,937	35,708	21,000	0	86,756	10,845
CUMENE HYDROPEROXIDE	8	0	415	0	3,566	0	3,981	498
CYANIDE COMPOUNDS	8	3,005	3,231	0	3,292	0	9,528	1,191
ISOBUTYRALDEHYDE	8	0	0	200	32,000	655,579	687,779	85,972
O-TOLUIDINE	8	5,819	42	0	0	220	6,081	760
P-CRESOL	8	866,495	7,086	160,000	10,886	41,466	1,085,933	135,742
PROPIONALDEHYDE	8	0	3,167	0	0	0	3,167	396
2-METHOXYETHANOL	8	46,000	16,300	70	0	91,736	154,106	19,263
4,4'-ISOPROPYLIDENEDIPHENOL	8	255	30,767	0	1,231	5,447	37,700	4,713
DI(2-ETHYLHEXYL)	7	10	250	0	250	1,424	1,934	276
DIBUTYL PHTHALATE	7	256	296	0	658	5,659	6,869	981
DIMETHYL PHTHALATE	7	119,565	825	0	3,967	618	124,975	17,854
HYDROGEN FLUORIDE	7	0	1	0	3,603	0	3,604	515
NICKEL	7	748	3,413	192,295	0	0	196,456	28,065
PHOSGENE	7	0	0	0	0	0	0	0
PYRIDINE	7	24,344	606	3,609	12,457	0	41,016	5,859
ACROLEIN	6	0	0	0	8	5,873	5,881	980

Exhibit 17(cont.): 1993 Transfers for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
ANTIMONY COMPOUNDS	6	124	2,152	0	2,450	22,055	27,031	4,505
BIS(2-ETHYLHEXYL) ADIPATE	6	250	746	0	5	308	1,309	218
LEAD COMPOUNDS	6	2	53,692	0	213	0	53,907	8,985
M-XYLENE	6	0	237	17,143	794	884	19,058	3,176
N,N-DIMETHYLANILINE	6	52,126	0	0	1,500	120,000	173,626	28,938
P-XYLENE	6	0	1,058	0	5,260	1,402	7,720	1,287
1,2,4-TRICHLOROBENZENE	6	503	3,255	520	5,428	4,400	14,106	2,351
AMMONIUM NITRATE (SOLUTION)	5	28,800	2,530,000	0	0	0	2,558,800	511,760
CADMIUM COMPOUNDS	5	29	21,776	0	3,738	1,128	26,671	5,334
DIETHYL PHTHALATE	5	255	94	0	500	250	1,099	220
MOLYBDENUM TRIOXIDE	5	0	1,897	17,000	19,000	0	37,897	7,579
O-ANISIDINE	5	0	0	0	0	0	0	0
P-CRESIDINE	5	28,223	0	0	1,400	0	29,623	5,925
VINYL CHLORIDE	5	0	1	53,000	1,329	0	54,330	10,866
ALLYL CHLORIDE	4	0	0	0	0	0	0	0
BENZOYL PEROXIDE	4	9,980	0	0	4,620	0	14,600	3,650
BUTYL BENZYL PHTHALATE	4	158	43	0	12,943	0	13,144	3,286
CHROMIUM	4	0	0	0	21,505	0	21,505	5,376
METHYLENEBIS (PHENYLISOCYANATE)	4	0	0	0	13,270	0	13,270	3,318
O-CRESOL	4	40,541	6,110	0	11,109	1,301	59,061	14,765
1,1,2-TRICHLOROETHANE	4	0	70	57,000	236,101	0	293,171	73,298
1,2-DICHLOROETHYLENE	4	0	0	2,100	10	0	21,110	528
1,4-DIOXANE	4	0	0	8	0	0	8	2
2-ETHOXYETHANOL	4	390,022	0	328,374	11,783	150,875	881,054	220,264
3,3'-DICHLOROBENZIDINE	4	10	5	0	250	0	265	66
4,6-DINITRO-O-CRESOL	4	0	6,630	0	4,422	1,376	12,428	3,107
ASBESTOS (FRIABLE)	3	0	28,894	0	0	0	28,894	9,631
DIAMINOTOLUENE (MIXED ISOMERS)	3	550	0	0	172	1,100	1,822	607
DICHLOROTETRAFLUOROETHANE	3	0	15	0	51	0	66	22
ISOPROPYL ALCOHOL	3	0	0	50	81,000	72,700	153,750	51,250
NITROBENZENE	3	108	420	0	8,620	5,440	14,588	4,863
PICRIC ACID	3	0	0	0	0	0	0	0
SILVER	3	0	590	35,000	0	0	35,590	11,863
SILVER COMPOUNDS	3	0	0	48,230	0	0	48,230	16,077
STYRENE OXIDE	3	0	0	0	0	0	0	0
VINYLIDENE CHLORIDE	3	169	0	0	10,519	0	40,688	13,563
1,1,2,2-TETRACHLOROETHANE	3	0	17	1	10	0	28	9
1,2-DICHLOROBENZENE	3	0	0	860	1,477	12,830	15,167	5,056
2-NITROPHENOL	3	0	0	0	4,216	4,592	8,808	2,936
2,4-DIAMINOTOLUENE	3	0	0	0	882	0	882	294
ANTIMONY	2	8,355	7,657	58,716	0	0	74,728	37,364
BROMOMETHANE	2	0	0	0	0	0	0	0
C.I. BASIC GREEN 4	2	83	0	0	0	0	83	42
C.I. FOOD RED 15	2	1,100	0	0	0	0	1,100	550
CHLOROPRENE	2	0	0	134,800	570	0	135,370	67,685
DICHLOROBENZENE (MIXED ISOMERS)	2	0	0	0	0	128	128	64
HEXACHLORO-1,3-BUTADIENE	2	0	0	0	13,750	0	13,750	6,875
HEXACHLOROBENZENE	2	0	0	1	2,503	0	2,504	1,252
MONOCHLOROPENTAFLUOROETHANE	2	0	0	0	0	0	0	0
P-ANISIDINE	2	2	0	0	0	0	2	1
PERACETIC ACID	2	0	0	0	0	0	0	0

R0076822

Exhibit 17(cont.): 1993 Transfers for Organic Chemical Manufacturing Facilities in TRI, by Number of Facilities Reporting (Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
TOLUENEDIISOCYANATE (MIXED ISOMERS)	2	0	0	0	9,050	2,700	11,750	5,875
1,2-BUTYLENE OXIDE	2	0	0	0	0	373,200	373,200	186,600
2,4-DIMETHYLPHENOL	2	0	0	0	13,000	0	17,244	8,622
2,3-DINITROPHENOL	2	0	0	0	9,000	0	9,020	4,510
3,3'-DIMETHOXYBENZIDINE	2	0	635	3,609	0	0	0	0
4,4'-METHYLENEDIANILINE	2	960	20	0	0	2,530	3,490	1,745
ACETAMIDE	1	0	0	0	98	0	98	98
ALPHA-NAPHTHYLAMINE	1	0	0	0	0	0	0	0
ALUMINUM (FUME OR DUST)	1	0	0	0	0	0	0	0
BENZOIC TRICHLORIDE	1	0	0	0	0	0	0	0
BIS(2-CHLOROETHYL) ETHER	1	0	0	0	0	0	0	0
BROMOCHLORODIFLUOROMETHANE	1	0	0	0	0	0	0	0
C.I. BASIC RED 1	1	24	0	0	0	0	24	24
C.I. DISPERSE YELLOW 3	1	0	1,658	0	0	0	1,658	1,658
C.I. SOLVENT YELLOW 3	1	0	0	0	0	0	0	0
CADMIUM	1	0	0	0	0	0	0	0
CHLORDANE	1	51	0	0	11	0	62	62
COBALT	1	0	21	0	0	0	21	21
CUPFERRON	1	0	0	0	2,300	0	2,300	2,300
ETHYL CHLOROFORMATE	1	0	0	0	0	0	0	0
ETHYLENE THIOUREA	1	0	250	0	0	0	250	250
ETHYLENEIMINE	1	0	0	0	0	0	0	0
HEPTACHLOR	1	42	0	0	77,287	0	77,329	77,329
HEXACHLOROCYCLOPENTADIENE	1	636	0	0	4,810	0	5,446	5,446
HEXACHLOROETHANE	1	0	0	0	0	0	0	0
HYDRAZINE SULFATE	1	0	0	0	0	0	0	0
LEAD	1	0	0	0	0	0	0	0
M-DINITROBENZINE	1	0	0	0	0	0	0	0
METHYL IODIDE	1	0	27	0	230	350	607	607
METHYL ISOCYANATE	1	0	0	0	0	0	0	0
METHYLENE BROMIDE	1	0	0	0	0	0	0	0
O-DINITROBENZENE	1	0	0	0	0	0	0	0
OXY-ALKYLATED ALCOHOL	1	5	0	0	0	0	5	5
P-PHENYLENEDIAMINE	1	0	0	0	0	0	0	0
PHENYL MIXTURE	1	0	0	0	0	11,525	11,525	11,525
PHOSPHORUS (YELLOW OR WHITE)	1	0	0	0	0	0	0	0
SACCHARIN (MANUFACTURING)	1	7	840	0	0	0	847	847
TITANIUM TETRACHLORIDE	1	0	0	0	0	0	0	0
ZINC (FUME OR DUST)	1	0	0	0	0	0	0	0
1,3-DICHLOROBENZENE	1	0	0	860	570	0	1,430	1,430
1,3-DICHLOROPROPYLENE	1	0	0	0	0	0	0	0
1,4-DICHLOROBENZENE	1	0	0	0	4	0	4	4
2-NITROPROPANE	1	0	0	0	12,180	0	12,180	12,180
2,4-DIAMINOANISOLE	1	0	0	0	0	0	0	0
2,4-DINITROTOLUENE	1	0	0	0	0	300	300	300
2,6-SYLIDINE	1	0	0	0	0	0	0	0
4-NITROPHENOL	1	0	0	0	1	0	5	5
5-NITRO-O-ANISIDINE	1	5	0	0	0	0	5	5
TOTAL	417	49,074,289	12,926,499	112,849,737	20,826,187	91,051,060	286,728,608	687,599

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below (Exhibit 18). Facilities that have reported only the SIC codes covered under this notebook appear on the first list. Exhibit 19 contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations -- some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 18: Top 10 TRI Releasing Organic Chemical Manufacturing Facilities[b]

Rank	Facility	Total TRI Releases in Pounds
1	Du Pont Victoria Plant - Victoria, TX	22,471,672
2	BP Chemicals Inc. Green Lake - Port Lavaca, TX	20,650,979
3	Zeneca Specialties Mount Pleasant Plant - Mt. Pleasant, TN	13,429,259
4	Hoechst-Celanese Chemical Group Inc. Clear Lake Plant - Pasadena, TX	10,354,443
5	Du Pont Sabine River Works - Orange, TX	9,731,302
6	Merichem Co. - Houston, TX	3,832,980
7	Hoechst-Celanese Chemical Group Inc. - Bay City, TX	3,454,971
8	Union Carbide C & P CO. Institute WV Plant Ops. - Institute, WV	3,082,932
9	Aqualon - Hopewell, VA	3,007,010
10	Aristech Chemical Corp. - Haverhill, OH	2,858,009

Source: U.S. EPA, Toxics Release Inventory Database, 1993

[b] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0076824

Exhibit 19: Top 10 TRI Releasing Facilities Reporting Organic Chemical Manufacturing SIC Codes to TRI[c]

Rank	SIC Codes Reported in TRI	Facility	Total TRI Releases in Pounds
1	2819, 2869	Cytec Inc. Inc. Fortier Plant - Westwego, LA	120,149,724
2	2869, 2819, 2841, 2879	Monsanto Co. - Alvin, TX	40,517,095
3	2822, 2865, 2869, 2873	Du Pont Beaumont Plant - Beaumont, TX	36,817,348
4	2823, 2821, 2869, 2824	Tennessee Eastman Division - Kingsport, TN	29,339,677
5	2869, 2865, 2819	Sterling Chemicals Inc. - Texas City, TX	24,709,135
6	2869	Du Pont Victoria Plant - Victoria, TX	22,471,672
7	2869	BP Chemicals Inc. Green Lake - Port Lavaca, TX	20,650,979
8	2821, 2869, 2873	BP Chemicals - Lima, OH	20,620,680
9	2812, 2869, 2813	Vulcan Chemicals - Cheyenne, WY	17,406,218
10	2813, 2819, 2869, 2873	Coastal Chemicals Inc. - Cheyenne, WY	15,334,423

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

[c] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

R0076825

IV.B. Summary of Selected Chemicals Released

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET.[d]

Ammonia[e] (CAS: 7664-41-7)

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

[d] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

[e] The reporting standards for ammonia were changed in 1995. Ammonium sulfate is deleted from the list and threshold and release determinations for aqueous ammonia are limited to 10 percent of the total ammonia present in solution. This change will reduce the amount of ammonia reported to TRI. Complete details of the revisions can be found in 40 CFR Part 372.

Nitric Acid (CAS: 7697-37-2)

Toxicity. The toxicity of nitric acid is related to its potent corrosivity as an acid, with ulceration of all membranes and tissues with which it comes in contact. Concentrated nitric acid causes immediate opacification and blindness of the cornea when it comes in contact with the eye. Inhalation of concentrated nitric acid causes severe, sometimes fatal, corrosion of the respiratory tract. Ingestion of nitric acid leads to gastric hemorrhaging, nausea, and vomiting. Circulatory shock is often the immediate cause of death due to nitric acid exposure. Damage to the respiratory system may be delayed for months, and even years. Populations at increased risk from nitric acid exposure include people with pre-existing skin, eye, or cardiopulmonary disorders.

Ecologically, gaseous nitric acid is a component of acid rain. Acid rain causes serious and cumulative damage to surface waters and aquatic and terrestrial organisms by decreasing water and soil pH levels. Nitric acid in rainwater acts as a topical source of nitrogen, preventing "hardening off" of evergreen foliage and increasing frost damage to perennial plants in temperate regions. Nitric acid also acts as an available nitrogen source in surface water, stimulating plankton and aquatic weed growth.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Nitric acid is mainly transported in the atmosphere as nitric acid vapors and in water as dissociated nitrate and hydrogen ions. In soil, nitric acid reacts with minerals such as calcium and magnesium, becoming neutralized, and at the same time decreasing soil "buffering capacity" against changes in pH levels.

Nitric acid leaches readily to groundwater, where it decreases the pH of the affected groundwater. In the winter, gaseous nitric acid is incorporated into snow, causing surges of acid during spring snow melt. Forested areas are strong sinks for nitric acid, incorporating the nitrate ions into plant tissues.

Methanol (CAS: 67-56-1)

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed one mg methanol per liter water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microörganisms in soils and surface waters.

Physical Properties. Methanol is highly flammable

Ethylene Glycol (CAS: 74-85-1)

Sources. Ethylene glycol is used as an antifreeze, heat transfer agent and solvent in industrial organic chemical facilities. The large quantity of ethylene glycol released is due to its ubiquitous use as an antifreeze and because in 1993 it had the 29th largest chemical production volume in the United States (*Chemical and Engineering News*). While the largest volume is released through underground injection, a substantial release also occurs from air point sources.

Toxicity. Long-term inhalation exposure to low levels of ethylene glycol may cause throat irritation, mild headache and backache. Exposure to higher concentrations may lead to unconsciousness. Liquid ethylene glycol is irritating to the eyes and skin.

Toxic effects from ingestion of ethylene glycol include damage to the central nervous system and kidneys, intoxication, conjunctivitis, nausea and vomiting, abdominal pain, weakness, low blood oxygen, tremors, convulsions, respiratory failure, and coma. Renal failure due to ethylene glycol poisoning can lead to death.

Environmental Fate. Ethylene glycol readily biodegrades in water. No data are available that report its fate in soils; however, biodegradation is probably the dominant removal mechanism. Should ethylene glycol leach into the groundwater, biodegradation may occur.

Ethylene glycol in water is not expected to bioconcentrate in aquatic organisms, adsorb to sediments or volatilize. Atmospheric ethylene glycol degrades rapidly in the presence of hydroxyl radicals.

Acetone (CAS: 67-64-1)

Toxicity. Acetone is irritating to the eyes, nose, and throat. Symptoms of exposure to large quantities of acetone may include headache, unsteadiness, confusion, lassitude, drowsiness, vomiting, and respiratory depression.

Reactions of acetone (see environmental fate) in the lower atmosphere contribute to the formation of ground-level ozone. Ozone (a major component of urban smog) can affect the respiratory system, especially in sensitive individuals such as asthmatics or allergy sufferers.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. If released into water, acetone will be degraded by microorganisms or will evaporate into the atmosphere. Degradation by microorganisms will be the primary removal mechanism.

Acetone is highly volatile, and once it reaches the troposphere (lower atmosphere), it will react with other gases, contributing to the formation of ground-level ozone and other air pollutants. EPA is reevaluating acetone's reactivity in the lower atmosphere to determine whether this contribution is significant.

Physical Properties. Acetone is a volatile and flammable organic chemical.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures the vast majority of facilities in the organic chemicals industry. It also allows for a comparison across years and industry sectors. Reported chemicals are limited however to the 316 reported chemicals. Most of the hydrocarbon emissions from organic chemical facilities are not captured by TRI.[1] The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SO_x, NO_x, CO, particulates, etc.) from many chemical manufacturing sources.[2]

The EPA Office of Air's Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 20 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulate (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 20: Pollutant Releases (short tons/year)

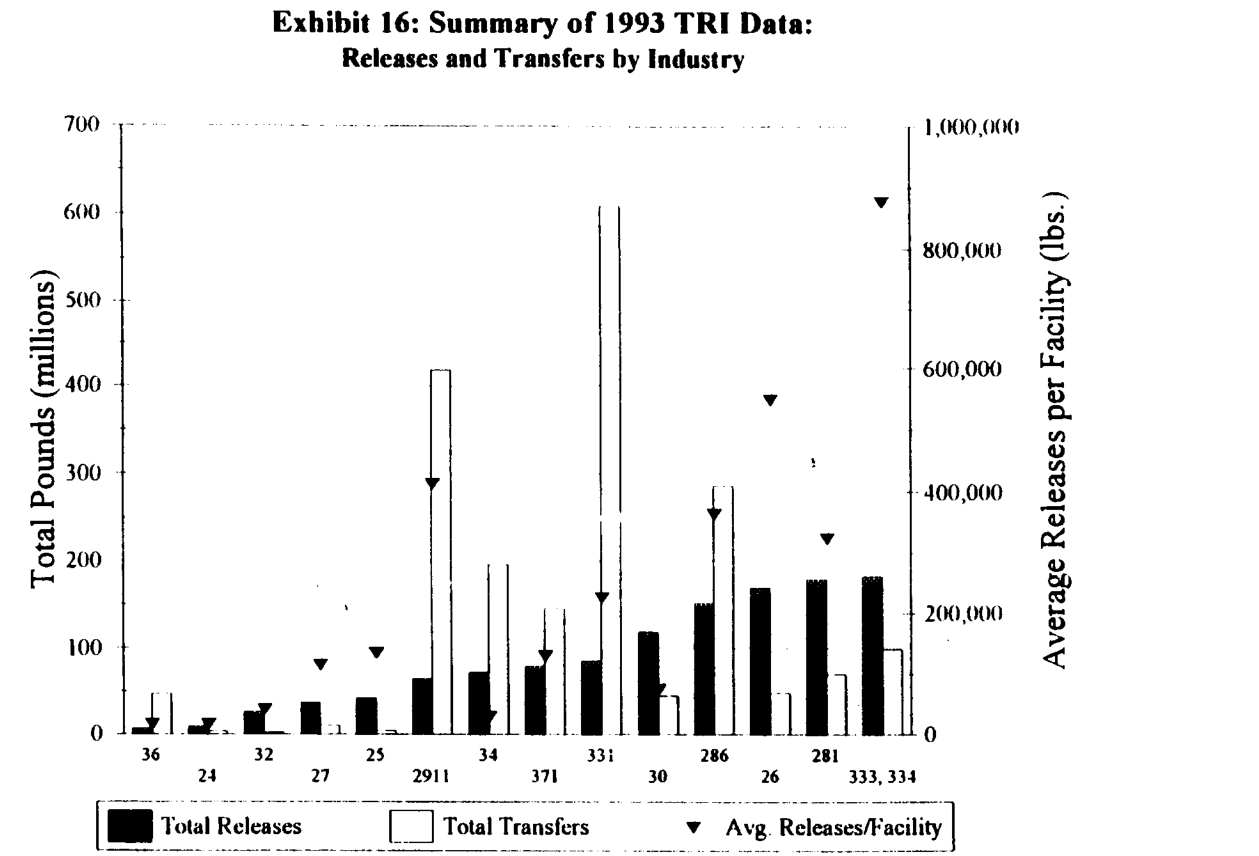
Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Production	123,756	42,658	14,135	63,761	9,419	41,423
Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	541,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	103,575	4,107	39,062	182,189	52,091
Organic Chemicals	**146,947**	**236,826**	**26,493**	**44,860**	**132,459**	**201,888**
Petroleum Refining	419,311	380,641	18,787	36,877	648,155	369,058
Rubber and Misc. Plastics	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 21 is a graphical representation of a summary of the 1993 TRI data for the organic chemical industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 22 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the organic chemical industry, the 1993 TRI data presented here covers 417 facilities. Only those facilities listing SIC Codes falling within SIC 286 were used.



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333, 334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

R0076832

Exhibit 22: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	1993 TRI Releases: Total Releases (million lbs.)	1993 TRI Releases: Average Releases per Facility (pounds)	1993 TRI Transfers: Total Transfers (million lbs.)	1993 TRI Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	42,000	2.2	4,000	28.8	46,000
Lumber and Wood Products	24	491	8.4	17,000	3.5	7,000	11.9	24,000
Furniture and Fixtures	25	313	42.2	135,000	4.2	13,000	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	32,000	46.7	147,000
Electronic Equip. and Components	36	406	6.7	17,000	47.1	116,000	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	75,000	45	29,000	163.4	104,000
Motor Vehicles, Bodies, Parts, and Accessories	371	609	79.3	130,000	145.5	239,000	224.8	369,000
Pulp and Paper	2611-2631	309	169.7	549,000	48.4	157,000	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72	30,000	195.7	83,000	267.7	123,000
Iron and Steel	331	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	333, 334	208	182.5	877,000	98.2	472,000	280.7	1,349,000
Organic Chemical Mfg.	**2861-2869**	**417**	**151.6**	**364,000**	**286.7**	**688,000**	**438.4**	**1,052,000**
Metal Mining	10	Industry sector not subject to TRI reporting.						
Nonmetal Mining	14	Industry sector not subject to TRI reporting.						
Dry Cleaning	7216	Industry sector not subject to TRI reporting.						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and substituting benign chemicals for toxic ones. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the organic chemical industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

The leaders in the organic chemical industry, similar to those in the chemical industry as a whole, have been promoting pollution prevention through various means. The most visible of these efforts is the Responsible Care® initiative of the Chemical Manufacturer's Association (CMA). Responsible Care is mandatory for CMA members who must commit to act as stewards for products through use and ultimate reuse or disposal. One of the guiding principles of this initiative is the inclusion of waste and release prevention objectives in research and in design of new or modified facilities, processes and products. The Synthetic Organic Chemical Manufactures Association (SOCMA) also requires its members to implement the Responsible Care® Guiding Principles as a condition of membership. SOCMA is instituting the Responsible Care® management practice codes on a phased-in basis to assist its approximately 110-non CMA members, which are primarily small and batch chemical manufacturers, in successfully implementing their programs.

Using pollution prevention techniques which prevent the release or generation of pollution in the first place have several advantages over end-of-pipe waste treatment technologies. The table below lists the direct and indirect benefits that could result.

Exhibit 23: Pollution Prevention Activities Can Reduce Costs

Direct Benefits

- Reduced waste treatment costs
  - Reduced capital and operating costs for waste treatment facilities
  - Reduced off-site treatment and disposal costs
- Reduced manufacturing costs due to improved yields
- Income or savings from sale or reuse of wastes
- Reduced environmental compliance costs (e.g., fines, shutdowns)
- Reduced or eliminated inventories or spills
- Reduced secondary emissions from waste treatment facilities
- Retained sales (production threatened by poor environmental performance or sales)

Indirect Benefits

- Reduced likelihood of future costs from:
  - Remediation
  - Legal liabilities
  - Complying with future regulations
- Use of emission offsets (internal and external)
- Improved community relations
- Increase environmental awareness by plant personnel and management
- Reduced societal costs
- Improved public health

Source: Chemical Manufacturer's Association *Designing Pollution Prevention into the Process*

These incentives may encourage organic chemical manufacturers to undertake pollution prevention activities voluntarily, but a number of barriers still exist in achieving widespread adoption of pollution prevention. The U.S. Office of Technology Assessment has identified and characterized a number of these barriers in its report titled *Industry, Technology, and the Environment*.

Pollution prevention can be carried out at any stage of the development of a process. In general, changes made at the research and development stage will have the greatest impact; however, changes in the process design and operating practices can also yield significant results.

In the research and development stage, all possible reaction pathways for producing the desired product can be examined. These can then be evaluated in light of yield, undesirable by-products, and their health and environmental impacts. The area of "green synthesis" is the focus of considerable research funded jointly by the Agency and by the National Science Foundation. Several alternative syntheses have already been developed that could reduce wastes. For example, Joseph M. Desimone of the University of North

Carolina, Chapel Hill, has used supercritical carbon dioxide as a medium for carrying out dispersion polymerizations. He uses a specially engineered free-radical initiator to start the reaction and a polymeric stabilizer to affect the polymerization of methyl methacrylate. Because the carbon dioxide can easily be separated from the reaction mixture, this reaction offers the possibility of reduced hazardous waste generation, particularly of aqueous streams contaminated with residual monomer and initiator.

Because of the large investment in current technology, and the lifetime of capital equipment, pollution prevention at the earliest stages is unlikely unless a company undertakes the design of a new production line or facility. There are, however, more numerous pollution prevention opportunities that can be realized by modifying current processes and equipment.

Exhibit 24: Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
By-products **Co-products**		
Quantity and Quality	▪ Process inefficiencies result in the generation of undesired by-products and co-products. Inefficiencies will require larger volumes of raw materials and result in additional secondary products. Inefficiencies can also increase fugitive emissions and wastes generated through material handling.	▪ Increase product yield to reduce by-product and co-product generation and raw material requirements.
Uses and Outlets	▪ By-products and co-products are not fully utilized, generating material or waste that must be managed.	▪ Identify uses and develop a sales outlet. Collect information necessary to firm up a purchase commitment such as minimum quality criteria, maximum impurity levels that can be tolerated, and performance criteria.
Catalysts		
Composition	▪ The presence of heavy metals in catalysts can result in contaminated process wastewater from catalyst handling and separation. These wastes may require special treatment and disposal procedures or facilities. Heavy metals can be inhibitory or toxic to biological wastewater treatment units. Sludge from wastewater treatment units may be classified as hazardous due to heavy metals content. Heavy metals generally exhibit low toxicity thresholds in aquatic environments and may bioaccumulate.	▪ Catalysts comprised of noble metals, because of their cost, are generally recycled by both onsite and offsite reclaimers.
Preparation and Handling	▪ Emissions or effluents are generated with catalyst activation or regeneration.	▪ Obtain catalyst in the active form. ▪ Provide insitu activation with appropriate processing/activation facilities.
	▪ Catalyst attrition and carryover into product requires de-ashing facilities which are a likely source of wastewater and solid waste.	▪ Develop a more robust catalyst or support.

R0076837

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
Catalysts (cont.)		
Preparation and Handling (cont.)	▪ Catalyst is spent and needs to be replaced.	▪ In situ regeneration eliminates unloading/loading emissions and effluents versus offsite regeneration or disposal.
	▪ Pyrophoric catalyst needs to be kept wet, resulting in liquid contaminated with metals.	▪ Use a nonpryrophoric catalyst. Minimize amount of water required to handle and store safely.
	▪ Short catalyst life.	▪ Study and identify catalyst deactivitation mechanisms. Avoid conditions which promote thermal or chemical deactivation. By extending catalyst life, emissions and effluents associated with catalyst handling and regeneration can be reduced.
Effectiveness	▪ Catalyzed reaction has by-product formation, incomplete conversion and less-than-perfect yield.	▪ Reduce catalyst consumption with a more active form. A higher concentration of active ingredient or increased surface area can reduce catalyst loadings.
		▪ Use a more selective catalyst which will reduce the yield of undesired by-products.
		▪ Improve reactor mixing/contacting to increase catalyst effectiveness.
	▪ Catalyzed reaction has by-product formation, incomplete conversion and less-than perfect yield.	▪ Develop a thorough understanding of reaction to allow optimization of reactor design. Include in the optimization, catalyst consumption and by-product yield.
Intermediate Products		
Quantity and Quality	▪ Intermediate reaction products or chemical species, including trace levels of toxic constituents, may contribute to process waste under both normal and upset conditions.	▪ Modify reaction sequence to reduce amount or change composition of intermediates.
	▪ Intermediates may contain toxic constituents or have characteristics that are harmful to the environment.	▪ Modify reaction sequence to change intermediate properties.
		▪ Use equipment design and process control to reduce releases.

R0076838

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
Process Conditions/ Configuration		
Temperature	▪ High heat exchange tube temperatures cause thermal cracking/decomposition of many chemicals. These lower molecular weight by-products are a source of "light ends" and fugitive emissions. High localized temperature gives rise to polymerization of reactive monomers, resulting in "heavies" or "tars." such materials can foul heat exchange equipment or plug fixed-bed reactors, thereby requiring costly equipment cleaning and production outage.	▪ Select operating temperatures at or near ambient temperature whenever possible. ▪ Use lower pressure steam to lower temperatures. ▪ Use intermediate exchangers to avoid contact with furnace tubes and walls. ▪ Use staged heating to minimize product degradation and unwanted side reactions. ▪ Use superheat of high-pressure steam in place of furnace. ▪ Monitor exchanger fouling to correlate process conditions which increase fouling, avoid conditions which rapidly foul exchangers. ▪ Use online tube cleaning technologies to keep tube surfaces clean to increase heat transfer. ▪ Use scraped wall exchangers in viscous service. ▪ Use falling film reboiler, pumped recirculation reboiler or high-flux tubes.
	▪ Higher operating temperatures imply "heat input" usually via combustion which generates emissions. ▪ Heat sources such as furnaces and boilers are a source of combustion emissions. ▪ Vapor pressure increases with increasing temperature. Loading/ unloading, tankage and fugitive emissions generally increase with increasing vapor pressure.	▪ Explore heat integration opportunities (e.g., use waste heat to preheat materials and reduce the amount of combustion required.) ▪ Use thermocompressor to upgrade low-pressure steam to avoid the need for additional boilers and furnaces. ▪ If possible, cool materials before sending to storage. ▪ Use hot process streams to reheat feeds.

R0076839

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities		
Area	**Potential Problem**	**Possible Approach**
Process Conditions/ Configuration (cont.)		
Temperature (cont.)		▪ Add vent condensers to recover vapors in storage tanks or process.
		▪ Add closed dome loading with vapor recovery condensers.
	▪ Water solubility of most chemicals increases with increasing temperature.	▪ Use lower temperature (vacuum processing).
Pressure	▪ Fugitive emissions from equipment.	▪ Equipment operating in vacuum service is not a source of fugitives; however, leaks into the process require control when system is degassed.
	▪ Seal leakage potential due to pressure differential.	▪ Minimize operating pressure.
	▪ Gas solubility increases with higher pressures.	▪ Determine whether gases can be recovered, compressed, and reused or require controls.
Corrosive Environment	▪ Material contamination occurs from corrosion products. Equipment failures result in spills, leaks and increased maintenance costs.	▪ Improve metallurgy or provide coating or lining.
		▪ Neutralize corrosivity of materials contacting equipment.
		▪ Use corrosion inhibitors.
	▪ Increased waste generation due to addition of corrosion inhibitors or neutralization.	▪ Improve metallurgy or provide coating or lining or operate in a less corrosive environment.
Batch vs. Continuous Operations	▪ Vent gas lost during batch fill.	▪Equalize reactor and storage tank vent lines.
		▪Recover vapors through condenser, adsorber, etc.
	▪ Waste generated by cleaning/purging of process equipment between production batches.	▪ Use materials with low viscosity. Minimize equipment roughness.

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities		
Area	**Potential Problem**	**Possible Approach**
Process Conditions/ Configuration (cont.) *Batch vs. Continuous Operations (cont.)*		▪ Optimize product manufacturing sequence to minimize washing operations and cross-contamination of subsequent batches.
	▪ Process inefficiencies lower yield and increase emissions.	▪ Sequence addition of reactants and reagents to optimize yields and lower emissions.
	▪ Continuous process fugitive emissions and waste increase over time due to equipment failure through a lack of maintenance between turnarounds.	▪Design facility to readily allow maintenance so as to avoid unexpected equipment failure and resultant release.
Process Operation/Design	▪ Numerous processing steps create wastes and opportunities for errors.	▪ Keep it simple. Make sure all operations are necessary. More operations and complexity only tend to increase potential emission and waste sources.
	▪ Nonreactant materials (solvents, absorbants, etc.) create wastes. Each chemical (including water) employed within the process introduces additional potential waste sources; the composition of generated wastes also tends to become more complex.	▪ Evaluate unit operation or technologies (e.g., separation) that do not require the addition of solvents or other nonreactant chemicals.
	▪ High conversion with low yield results in wastes.	▪ Recycle operations generally improve overall use of raw materials and chemicals, thereby both increasing the yield of desired products while at the same time reducing the generation of wastes. A case-in-point is to operate at a lower conversion per reaction cycle by reducing catalyst consumption, temperature, or residence time. Many times, this can result in a higher selectivity to desired products. The net effect upon recycle of unreacted reagents is an increase in product yield, while at the same time reducing the quantities of spent catalyst and less desirable by-products.

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities		
Area	**Potential Problem**	**Possible Approach**
Process Conditions/ Configuration (cont.)		
Process Operation/Design	■ Non-regenerative treatment systems result in increased waste versus regenerative systems.	■ Regenerative fixed bed treating or desiccant operation (e.g., aluminum oxide, silica, activated carbon, molecular sieves, etc.) will generate less quantities of solid or liquid waste than nonregenerative units (e.g., calcium chloride or activated clay). With regenerative units though, emissions during bed activation and regeneration can be significant. Further, side reactions during activation/regeneration can give rise to problematic pollutants.
Product		
Process Chemistry	■ Insufficient R&D into alternative reaction pathways may miss pollution opportunities such as waste reduction or eliminating a hazardous constituent.	■ R&D during process conception and laboratory studies should thoroughly investigate alternatives in process chemistry that affect pollution prevention.
Product Formulation	■ Product based on end-use performance may have undesirable environmental impacts or use raw materials or components that generate excessive or hazardous wastes.	■ Reformulate products by substituting different material or using a mixture of individual chemicals that meet end-use performance specifications.
Raw Materials		
Purity	■ Impurities may produce unwanted by-products and waste. Toxic impurities, even in trace amounts, can make a waste hazardous and therefore subject to strict and costly regulation.	■ Use higher purity materials. ■ Purify materials before use and reuse if practical. ■ Use inhibitors to prevent side reactions.
	■ Excessive impurities may require more processing and equipment to meet product specifications, increasing costs and potential for fugitive emissions, leaks, and spills.	■ Achieve balance between feed purity, processing steps, product quality and waste generation.
	■ Specifying a purity greater than needed by the process increases costs and can result in more waste generation by the supplier.	■ Specify a purity no greater than what the process needs.

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities		
Area	**Potential Problem**	**Possible Approach**
Raw Materials (cont.)		
Purity (cont.)	▪ Impurities in clean air can increase inert purges.	▪Use pure oxygen.
	▪ Impurities may poison catalyst prematurely resulting in increased wastes due to yield loss and more frequent catalyst replacement.	▪Install guard beds to protect catalysts.
Vapor Pressure	▪ Higher vapor pressures increase fugitive emissions in material handling and storage.	▪ Use material with lower vapor pressure.
	▪ High vapor pressure with low odor threshold materials can cause nuisance odors.	▪ Use materials with lower vapor pressure and higher odor threshold.
Water Solubility	▪ Toxic or nonbiodegradable materials that are water soluble may affect wastewater treatment operation, efficiency, and cost.	▪ Use less toxic or more biodegradable materials.
	▪ Higher solubility may increase potential for surface and groundwater contamination and may require more careful spill prevention, containment, and cleanup (SPCC) plans.	▪ Use less soluble materials.
	▪ Higher solubility may increase potential for storm water contamination in open areas.	▪ Use less soluble materials. ▪ Prevent direct contact with storm water by diking or covering areas.
	▪ Process wastewater associated with water washing or hydrocarbon/water phase separation will be impacted by containment solubility in water. Appropriate wastewater treatment will be impacted.	▪ Minimize water usage. ▪ Reuse wash water. ▪ Determine optimum process conditions for phase separation. ▪ Evaluate alternative separation technologies (coalescers, membranes, distillation, etc.)

R0076843

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
Raw Materials (cont.)		
Toxicity	▪ Community and worker safety and health concerns result from routine and nonroutine emissions. Emissions sources include vents, equipment leaks, wastewater emissions, emergency pressure relief, etc.	▪ Use less toxic materials. ▪ Reduce exposure through equipment design and process control. Use systems which are passive for emergency containment of toxic releases.
	▪ Surges or higher than normal continuous levels of toxic materials can shock or miss wastewater biological treatment systems resulting in possible fines and possible toxicity in the receiving water.	▪ Use less toxic material. ▪ Reduce spills, leaks, and upset conditions through equipment and process control. ▪ Consider effect of chemicals on biological treatment; provide unit pretreatment or diversion capacity to remove toxicity. ▪ Install surge capacity for flow and concentration equalization.
Regulatory	▪ Hazardous or toxic materials are stringently regulated. They may require enhanced control and monitoring; increased compliance issues and paperwork for permits and record keeping; stricter control for handling, shipping, and disposal; higher sampling and analytical costs; and increased health and safety costs.	▪ Use materials which are less toxic or hazardous. ▪ Use better equipment and process design to minimize or control releases; in some cases, meeting certain regulatory criteria will exempt a system from permitting or other regulatory requirements.
Form of Supply	▪ Small containers increase shipping frequency which increases chances of material releases and waste residues from shipping containers (including wash waters).	▪ Use bulk supply, ship by pipeline, or use "jumbo" drums or sacks. ▪ In some cases, product may be shipped out in the same containers the material supply was shipped in without washing.
	▪ Nonreturnable containers may increase waste.	▪ Use returnable shipping containers or drums.
Handling and Storage	▪ Physical state (solid, liquid, gaseous) may raise unique environmental, safety, and health issues with unloading operations and transfer to process equipment.	▪ Use equipment and controls appropriate to the type of materials to control releases.

Exhibit 24 (cont.): Process/Product Modifications Create Pollution Prevention Opportunities

Area	Potential Problem	Possible Approach
Raw Materials (cont.)		
Handling and Storage (cont.)	▪ Large inventories can lead to spills, inherent safety issues and material expiration.	▪ Minimize inventory by utilizing just-in-time delivery.
Waste Streams		
Quantity and Quality	▪ Characteristics and sources of waste streams are unknown.	▪ Document sources and quantities of waste streams prior to pollution prevention assessment.
	▪ Wastes are generated as part of the process.	▪ Determine what changes in process conditions would lower waste generation of toxicity.
		▪ Determine if wastes can be recycled back into the process.
Composition	▪ Hazardous or toxic constituents are found in waste streams. Examples are: sulfides, heavy metals, halogenated hydrocarbons, and polynuclear aromatics.	▪ Evaluate whether different process conditions, routes, or reagent chemicals (e.g., solvent catalysts) can be substituted or changed to reduce or eliminate hazardous or toxic compounds.
Properties	▪ Environmental fate and waste properties are not known or understood.	▪ Evaluate waste characteristics using the following type properties: corrosivity, ignitability, reactivity, BTU content (energy recovery), biodegradability, aquatic toxicity, and bioaccumulation potential of the waste and of its degradable products, and whether it is a solid, liquid, or gas.
Disposal	▪ Ability to treat and manage hazardous and toxic waste unknown or limited.	▪ Consider and evaluate all onsite and offsite recycle, reuse, treatment, and disposal options available. Determine availability of facilities to treat or manage wastes generated.

Source: Chemical Manufacturer's Association. *Designing Pollution Prevention into the Process, Research, Development and Engineering.*

Exhibit 25: Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Compressors, blowers, fans	▪ Shaft seal leaks, piston rod seal leaks, and vent streams	▪ Seal-less designs (diaphragmatic, hermetic or magnetic) ▪ Design for low emissions (internal balancing, double inlet, gland eductors) ▪ Shaft seal designs (carbon rings, double mechanical seals, buffered seals) ▪ Double seal with barrier fluid vented to control device	▪ Preventive maintenance program
Concrete pads, floors, sumps	▪ Leaks to groundwater	▪ Water stops ▪ Embedded metal plates ▪ Epoxy sealing ▪ Other impervious sealing	▪ Reduce unnecessary purges, transfers, and sampling ▪ Use drip pans where necessary
Controls	▪ Shutdowns and start-ups generate waste and releases	▪ Improve on-line controls ▪ On-line instrumentation ▪ Automatic start-up and shutdown ▪ On-line vibration analysis ▪ Use "consensus" systems (e.g., shutdown trip requires 2 out of 3 affirmative responses)	▪ Continuous versus batch ▪ Optimize on-line run time ▪ Optimize shutdown interlock inspection frequency ▪ Identify safety and environment critical instruments and equipment
Distillation	▪ Impurities remain in process streams	▪ Increase reflux ratio ▪ Add section to column ▪ Column intervals ▪ Change feed tray	▪ Change column operating conditions - reflux ratio - feed tray - temperature - pressure - etc.

Exhibit 25 (cont.): Modifications to Equipment Can Also Prevent Pollution			
		Possible Approach	
Equipment	Potential Environment Problem	Design Related	Operational Related
Distillation (cont.)	▪ Impurities remain in process streams (cont.)	▪ Insulate to prevent heat loss ▪ Preheat column feed ▪ Increase vapor line size to lower pressure drop	▪ Clean column to reduce fouling
	▪ Large amounts of contaminated water condensate from stream stripping	▪ Use reboilers or inert gas stripping agents	▪ Use higher temperature steam
General manufacturing equipment areas	▪ Contaminated rainwater	▪ Provide roof over process facilities ▪ Segregate process sewer from storm sewer (diking) ▪ Hard-pipe process streams to process sewer	▪ Return samples to process ▪ Monitor stormwater discharge
	▪ Contaminated sprinkler and fire water	▪ Seal floors ▪ Drain to sump ▪ Route to waste treatment	
	▪ Leaks and emissions during cleaning	▪ Design for cleaning ▪ Design for minimum rinsing ▪ Design for minimum sludge ▪ Provide vapor enclosure ▪ Drain to process	▪ Use drip pans for maintenance activities ▪ Rinse to sump ▪ Reuse cleaning solutions
Heat exchangers	▪ Increased waste due to high localized temperatures	▪ Use intermediate exchangers to avoid contact with furnace tubes and walls ▪ Use staged heating to minimize product degradation and unwanted side reactions. (waste heat >>low pressure steam >>high pressure steam)	▪ Select operating temperatures at or near ambient temperature when-ever possible. These are generally most desirable from a pollution prevention standpoint ▪ Use lower pressure steam to lower temperatures

Exhibit 25 (cont.): Modifications to Equipment Can Also Prevent Pollution			
		Possible Approach	
Equipment	**Potential Environment Problem**	**Design Related**	**Operational Related**
Heat exchangers (cont.)	▪ Increased waste due to high localized temperatures (cont.)	▪ Use scraped wall exchangers in viscous service ▪ Using falling film reboiler, piped recirculation reboiler or high-flux tubes ▪ Use lowest pressure steam possible	▪ Monitor exchanger fouling to correlate process conditions which increase fouling, avoid conditions which rapidly foul exchangers ▪ Use on-line tube cleaning techniques to keep tube surfaces clean
	▪ Contaminated materials due to tubes leaking at tube sheets	▪ Use welded tubes or double tube sheets with inert purge. Mount vertically	▪ Monitor for leaks
	▪ Furnace emissions	▪ Use superheat of high-pressure steam in place of a furnace	
Piping	▪ Leaks to groundwater; fugitive emissions	▪ Design equipment layout so as to minimize pipe run length ▪ Eliminate underground piping or design for cathodic protection if necessary to install piping underground ▪ Welded fittings ▪ Reduce number of flanges and valves ▪ All welded pipe ▪ Secondary containment ▪ Spiral-wound gaskets ▪ Use plugs and double valves for open end lines ▪ Change metallurgy ▪ Use lined pipe	▪ Monitor for corrosion and erosion ▪ Paint to prevent external corrosion

Exhibit 25 (cont.): Modifications to Equipment Can Also Prevent Pollution			
		Possible Approach	
Equipment	Potential Environment Problem	Design Related	Operational Related
Piping (cont.)	▪ Releases when cleaning or purging lines	▪ Use "pigs" for cleaning ▪ Slope to low point drain ▪ Use heat tracing and insulation to prevent freezing ▪ Install equalizer lines	▪ Flush to product storage tank
Pumps	▪ Fugitive emissions from shaft seal leaks	▪ Mechanical seal in lieu of packing ▪ Double mechanical seal with inert barrier fluid ▪ Double machined seal with barrier fluid vented to control device ▪ Seal-less pump (canned motor magnetic drive) ▪ Vertical pump	▪ Seal installation practices ▪ Monitor for leaks
	▪ Fugitive emissions from shaft seal leaks	▪ Use pressure transfer to eliminate pump	
	▪ Residual "heel" of liquid during pump maintenance	▪ Low point drain on pump casing	▪ Flush casing to process sewer for treatment ▪ Increase the mean time between pump failures by: - selecting proper seal material; - good alignment; - reduce pipe-induced stress - Maintaining seal lubrication
	▪ Injection of seal flush fluid into process stream	▪ Use double mechanical seal with inert barrier fluid where practical	
Reactors	▪ Poor conversion or performance due to inadequate mixing	▪ Static mixing ▪ Add baffles ▪ Change impellers	▪ Add ingredients with optimum sequence

R0076849

Exhibit 25 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach: Design Related	Possible Approach: Operational Related
Reactors (cont.)	■ Poor conversion (cont.)	■ Add horsepower ■ Add distributor	■ Allow proper head space in reactor to enhance vortex effect
	■ Waste by-product formation	■ Provide separate reactor for converting recycle streams to usable products	■ Optimize reaction conditions (temperature, pressure, etc.)
Relief Valve	■ Leaks	■ Provide upstream rupture disc	
	■ Fugitive emissions	■ Vent to control or recovery device	■ Monitor for leaks and for control efficiency
	■ Discharge to environment from over pressure	■ Pump discharges to suction of pump ■ Thermal relief to tanks ■ Avoid discharge to roof areas to prevent contamination of rainwater	■ Monitor for leaks
	■ Frequent relief	■ Use pilot operated relief valve ■ Increase margin between design and operating pressure	■ Reduce operating pressure ■ Review system performance
Sampling	■ Waste generation due to sampling (disposal, containers, leaks, fugitives, etc.)	■ In-line insitu analyzers ■ System for return to process ■ Closed loop ■ Drain to sump	■ Reduce number and size of samples required ■ Sample at the lowest possible temperature ■ Cool before sampling
Tanks	■ Tank breathing and working losses	■ Cool materials before storage ■ Insulate tanks ■ Vent to control device (flare, condenser, etc.) ■ Vapor balancing ■ Floating roof	■ Optimize storage conditions to reduce losses

Exhibit 25 (cont.): Modifications to Equipment Can Also Prevent Pollution

Equipment	Potential Environment Problem	Possible Approach	
		Design Related	Operational Related
Tanks (cont.)	■ Tank breathing and working losses (cont.)	■ Floating roof ■ Higher design pressure	
	■ Leak to groundwater	■ All aboveground (situated so bottom can routinely be checked for leaks) ■ Secondary containment ■ Improve corrosion resistance	■ Monitor for leaks and corrosion
	■ Large waste heel	■ Design for 100% de-inventory	■ Recycle to process if practical
Vacuum Systems	■ Waste discharge from jets	■ Substitute mechanical vacuum pump ■ Evaluate using process fluid for powering jet	■ Monitor for air leaks ■ Recycle condensate to process
Valves	■ Fugitive emissions from leaks	■ Bellow seals ■ Reduce number where practical ■ Special packing sets	■ Stringent adherence to packing procedures
Vents	■ Release to environment	■ Route to control or recovery device	■ Monitor performance

Source: Chemical Manufacturer's Association. *Designing Pollution Prevention into the Process, Research, Development and Engineering*.

It is critical to emphasize that pollution prevention in the chemical industry is process specific and oftentimes constrained by site-specific considerations. As such, it is difficult to generalize about the relative merits of different pollution prevention strategies. The age, size, and purpose of the plant will influence the choice of the most effective pollution prevention strategy. Commodity chemical manufacturers redesign their processes infrequently so that redesign of the reaction process or equipment is unlikely in the short term. Here operational changes are the most feasible response. Specialty chemical manufacturers are making a greater variety of chemicals and have more process and design flexibility. Incorporating changes at the earlier research and development phases may be possible for them.

Changes in operational practices may yield the most immediate gains with the least investment. For example, the majority of the waste generated by the chemical processing industry is contaminated water: Borden Chemical Company has collected and isolated its waste water in a trench coming from the phenol rail car unloading area and reused the water in resin batches. This eliminated the entire waste stream with a capital investment of $3,000 and annual savings of $1,500 a year in treatment costs. Rhone-Poulenc, in New Brunswick, New Jersey, is now sending all quality control and raw material samples back to be reused in the production process saving $20,000 per year and reducing waste volume by 3,000 pounds.

Another area that can yield significant benefits is improved process control so that less off-specification product is produced (that must be discarded) and the process is run more optimally (fewer by-products). Exxon Chemical Americas of Linden, New Jersey, used continuous process optimization to reduce the generation of acid coke, a process residue, thus saving $340,000 annually in treatment costs. New in-line process controls are under development (a fertile area of research being pursued by the Center for Process Analytic Chemistry at the University of Washington) that may allow better process optimization through tighter process control.

Chemical substitution, particularly of water for non-aqueous solvents, can also prevent pollution. For example, Du Pont at the Chamber Works in New Jersey is using a high-pressure water-jet system to clean polymer reaction vessels. This replaces organic solvent cleaning that annually produced 40,000 pounds of solvent waste. Installing the new cleaning system cost $125,000 but it will save $270,000 annually.

Improved separations design also offers a pollution prevention opportunity since separations account for about 20 percent of energy use in the chemical process industry. In one case, a solvent was replaced by an excess of a reaction component, thus eliminating the need to separate the solvent from the waste stream while reducing separation costs.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A contains a general overview of major statutes
- Section VI.B contains a list of regulations specific to this industry
- Section VI.C contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation And Recovery Act (RCRA)

RCRA of 1976, which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for

R0076853

conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil** storage and disposal regulations (40 CFR Part 279) do not define **Used Oil Management Standards** impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act (CERCLA)

CERCLA, a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the

National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act (EPCRA)

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created EPCRA, also known as SARA Title III, a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act (CWA)

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the CWA, is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants and various toxic pollutants: "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants which are pollutants not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized approximately forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines, which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw material storage areas at an industrial plant (40 CFR 122.26 (b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act (SDWA)

The SDWA mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control** (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily state-enforced, since EPA has authorized all but a few states to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act (TSCA)

TSCA granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act (CAA)

The CAA and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date, EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology (MACT)." The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Requirements

The organic chemical industry is affected by nearly all federal environmental statutes. In addition, the industry is subject to numerous laws and regulations from state and local governments designed to protect and improve the nation's health, safety, and environment. A summary of the major federal regulations affecting the chemical industry follows. The Synthetic Organic Chemical Manufacturer's Association is undertaking a year-long study to identify the environmental regulations that apply to their members. The study should be available in early 1996.

Federal Statutes

Toxic Substances Control Act (TSCA)

TSCA gives the Environmental Protection Agency comprehensive authority to regulate any chemical substance whose manufacture, processing, distribution in commerce, use or disposal may present an unreasonable risk of injury to health or the environment. Three sections are of primary importance to the organic chemical industry. TSCA §5 mandates that chemical companies submit pre-manufacture notices that provide information on health and environmental effects for each new product and test existing products for these effects (40 CFR Part 720). TSCA §4 authorizes the EPA to require testing of certain substances (40 CFR Part 790). TSCA §6 gives the EPA authority to prohibit, limit or ban the manufacture, process and use of chemicals (40 CFR Part 750). To date over 20,000 premanufacturing notices have been filed.

Clean Air Act

The original CAA authorized EPA to set limits on chemical plant emissions. Many of these new source performance standards (NSPS) apply to organic chemical manufacturers including those for flares (40 CFR Part 60 Subpart A), storage vessels (40 CFR Part 60 Subpart K), synthetic organic chemical manufacturers equipment leaks (40 CFR Part 60 Subpart VV), synthetic organic chemicals manufacturers using air oxidation processes (40 CFR Part 60 Subpart III), distillation operations (40 CFR Part 60 Subpart NNN), reactor processes (40 CFR Part 60 Subpart RRR), and wastewater (40 CFR Part 60 Subpart YYY).

The Clean Air Act Amendments of 1990 set control standards by industrial sources for 41 pollutants to be met by 1995 and for 148 other pollutants to be reached by 2003. Several provisions affect the organic chemical industry. Under the air toxics provisions of the CAAA, more sources are covered including small businesses. In April 1994, the EPA proposed regulations to reduce air toxics emissions at chemical plants. The Hazardous Organic National Emissions Standard for Hazardous Air Pollutants, also known as HON, covers hundreds of chemical plants and thousands of chemical process units (40 CFR Part 63 Subparts F, G, H, I, J, K). The HON also includes innovative provisions such as emissions trading, that offer industry flexibility in complying with the rule's emissions goals. Subsets of the industry are regulated under other National Emission Standards for Hazardous Air Pollutants (NESHAP). These include vinyl chloride manufacturers (40 CFR Part 61 Subpart F), benzene emission from ethylbenzene/styrene manufacturers (40 CFR Part 61 Subpart I), benzene equipment leaks (40 CFR Part 61 Subpart J), emissions from storage tanks (40 CFR Part 61 Subpart K), benzene emissions from benzene transfer operations (40 CFR Part 61 Subpart BB), and benzene waste operations (40 CFR Part 61 Subpart FF). Another NESHAP that may affect organic chemical manufacturers is that for treatment, storage, and disposal facilities (TSDF) (40 Part CFR 63 Subpart AA). CAAA provisions on oxygenated additives for reformulated gasoline have also affected the chemical industry by encouraging production of the oxygenates methyl *tert*-butyl ether and ethyl *tert*-butyl ether.

Title V of the CAA introduces a new permit system that will require all major sources to obtain operating permits to cover all applicable control requirements. States were required to develop and implement the program in 1993 and the first permits were to be issued in 1995.

Clean Water Act

The Clean Water Act, first passed in 1972 and amended in 1977 and 1987, gives EPA the authority to regulate effluents from sewage treatment works, chemical plants, and other industrial sources into waters. The act sets "best available" technology standards for treatment of wastes for both direct and indirect (to a Publicly Owned Treatment Works) discharges. In 1987, EPA proposed final effluent guidelines for the organic, polymer and synthetic fiber industry. The majority of this rule was upheld by the federal courts. A final proposal for the remaining portions of the rule was issued in August 1993. The implementation of the guidelines is left to the states who issue National Pollutant Discharge Elimination System (NPDES) permits for each facility.

The Storm Water Rule (40 CFR §122.26(b)(14) Subparts (i, ii)) requires the capture and treatment of stormwater at facilities producing chemicals and allied products, including industrial organic chemical manufacture. Required treatment will remove from stormwater flows a large fraction of both conventional pollutants, such as suspended solids and biological oxygen demand (BOD), as well as toxic pollutants, such as certain metals and organic compounds.

Superfund

The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) provide the basic legal framework for the federal "Superfund" program to clean up abandoned hazardous waste sites (40 CFR Part 305). The 1986 SARA legislation extended those taxes for five years and adopted a new broad-based corporate environmental tax. In 1990, Congress passed a simple reauthorization that did not substantially change the law but extended the program authority until 1994 and the taxing authority until 1995. The chemical industry (all SIC codes) pays about $300 million a year in Superfund chemical feedstock taxes. A comprehensive reauthorization was considered in 1994. The industry believes several serious concerns need to be addressed including the liability standard which threatens Potentially Responsible Parties (PRPs) with the entire cost of clean-up at sites even though they may be responsible for only a tiny fraction of the waste; clean-up requirements, which are often unaffordable, unattainable, and unjustified by the risks presented by the sites; and the punitive, adversarial nature of the enforcement program.

Title III of the 1986 SARA amendments (also known as Emergency Response and Community Right-to-Know Act, EPCRA) requires all manufacturing facilities, including chemical facilities, to report annual information to the public about stored toxic substances as well as release of these substances into the environment (42 U.S.C. 9601). This is known as the Toxic Release Inventory (TRI). Between 1988 and 1993 TRI emissions by chemical companies to air, land, and water were reduced 44 percent. EPCRA also establishes requirements for federal, state, and local governments regarding emergency planning. In 1994, over 300 more chemicals were added to the list of chemicals for which reporting is required.

VI.C. Pending and Proposed Regulatory Requirements

Chemical Inventory Update Rule

Every four years chemical manufacturers must report to EPA on their manufacture, importation, and, in 1994, use of chemicals on the Toxic Substances Control Act inventory.

VII. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general makeup.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the five calendar years August 10, 1990 to August 9, 1995, and the other for the most recent twelve-month period, August 10, 1994 to August 9, 1995. The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[f] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund),

[f] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time. expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (a facility with three enforcement actions counts as one). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with three enforcement actions counts as three).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use of EPA data systems by states may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Reported inspections and enforcement actions under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Organic Chemicals Compliance History

Exhibit 26 provides an overview of the reported compliance and enforcement data for the organic chemical industry over the past five years (August 1990 to August 1995). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- About 77 percent of the organic chemical producing facilities identified in the IDEA search were inspected in the past five years. These facilities were inspected on average every six months.
- Those facilities with one or more enforcement actions had, on average, over the five year period, almost five enforcement actions brought against them.
- The complexity of reactions and diversity among and within facilities makes it difficult to generalize about the types of compliance problems facilities will face.

Exhibit 26: Five-Year Enforcement and Compliance Summary for Organic Chemicals

A	B	C	D	E	F	G	H	I	J
Region	Facilities in Search	Facilities Inspected	Number of Inspections	Average Months Between Inspections	Facilities with 1 or More Enforcement Actions	Total Enforcement Actions	Percent State Lead Actions	Percent Federal Lead Actions	Enforcement to Inspection Rate
I	14	8	39	22	1	5	0%	100%	0.13
II	63	50	640	6	26	131	78%	22%	0.20
III	35	30	383	5	12	55	93%	7%	0.14
IV	81	57	867	6	23	107	81%	19%	0.12
V	79	59	599	8	20	55	65%	35%	0.09
VI	110	89	1,206	5	66	356	55%	45%	0.30
VII	15	11	80	11	0	0	0%	0%	--
VIII	2	2	6	20	1	4	100%	0%	0.67
IX	11	8	32	21	1	1	0%	100%	0.03
X	2	2	12	10	2	12	33%	67%	1.0
TOTAL	412	316	3,864	6	152	726	66%	34%	0.19

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 27 and 28 allow the compliance history of the organic chemical industry to be compared with the other industries covered by the industry sector notebooks. Comparisons between Exhibits 27 and 28 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past year. Some points evident from the data are listed below.

- The organic chemical industry has a relatively high frequency of inspections compared to the other sectors shown. On average, organic chemical facilities were inspected every six months.

- Over the last five years, the organic chemical industry has had a relatively high ratio of enforcement actions to inspections. This relatively high ratio has continued in the past year.

- Of the sectors shown, the organic chemical industry has one of the highest percentage of EPA led enforcement actions versus state led actions.

Exhibits 29 and 30 provide a more in-depth comparison between the organic chemical industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in Exhibits 29 and 30, the data cover the last five years (Exhibit 27) and the previous year (Exhibit 28) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- Over the past five years, RCRA has accounted for the largest share of inspections and enforcement actions at organic chemical facilities. This trend has increased over the past year.

- The share of enforcement actions and inspections has decreased in the past year for the Clean Water Act and FIFRA/TSCA/EPCRA/Other and has increased for the Clean Air Act and RCRA in comparison to the previous five years.

Exhibit 27: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	**412**	**316**	**3,864**	**6**	**152**	**726**	**66%**	**34%**	**0.19**
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-Metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Nonferrous Metal	844	474	3,097	16	145	470	76%	24%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11

Exhibit 28: One-Year Inspection and Enforcement Summary for Selected Industries

A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	**412**	**195**	**545**	**197**	**101%**	**39**	**20%**	**118**	**0.22**
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10

* Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 29: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	298	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	**316**	**3,864**	**726**	**33%**	**30%**	**16%**	**21%**	**46%**	**44%**	**5%**	**5%**
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	0%	1%
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	0%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	213	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay, and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%

Exhibit 30: One-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	0%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	0%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	0%	6%
Organic Chemicals	**195**	**545**	**118**	**36%**	**34%**	**13%**	**16%**	**50%**	**49%**	**1%**	**1%**
Petroleum Refining	109	437	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	0%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	0%	7%
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	0%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	0%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	0%	6%
Furniture	113	160	5	58%	67%	1%	10%	41%	10%	0%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	0%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	0%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	0%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%

VII.C. Review of Major Legal Actions

This section provides summary information about major cases that have affected this sector, and a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

VII.C.1. Review of major cases

Historically, OECA's Office of Enforcement Capacity and Outreach does not regularly compile information related to major cases and pending litigation within an industry sector. The staff are willing to pass along such information to Agency staff as requests are made. In addition, summaries of completed enforcement actions are published each fiscal year in the Enforcement Accomplishments Report. To date, these summaries are not organized by industry sector. (Contact: Office of Enforcement Capacity and Outreach, 202-260-4140)

VII.C.2. Supplementary Environmental Projects (SEPs)

Supplemental environmental projects (SEPs) are negotiated environmental projects such that a fraction of the costs may be applied to their fine. Regional summaries of SEPs actions undertaken in the 1993 and 1994 federal fiscal year were reviewed. Seventeen projects were undertaken that involved organic chemical manufacturing facilities, as shown in the following table. CERCLA violations engendered approximately half of all projects. Other actions were associated with EPCRA, CAA, RCRA and TSCA violations; the specifics of the original violations are not known.

The majority of SEPs were done in Region VI. Taken alone, Texas accounted for approximately one-third of all projects (6 of 17). The fact that only one fifth of all organic chemical manufactures are located in Region VI; may suggest that negotiating SEPs is a regional priority.

One project was conducted at a facility that manufactured both inorganic and organic chemicals. This project has been included in both industry sector project summaries. Unlike other sectors, none of the organic chemical manufacturing SEPs undertaken in FY-1993 and FY-1994 involved specific manufacturing process changes. The SEPs fall into two categories:

- Non-process related projects: Eleven of the seventeen SEPs involved projects not directly related to the organic chemical manufacturing process or its outputs. Ten of these projects involved a contribution to the Local Emergency Planning Committee (LEPC). Contributions ranged from donation of equipment (e.g., computer systems and emergency materials) to training programs for LEPC members. One project involved the replacement of QA/QC lab equipment with less solvent-requiring alternatives. The other project involved removing and properly disposing of 26 PCB capacitors. Cost to company ranged from $3,000 to $257,000 for these projects.

- Control and recovery technology improvement/installation: In four of the projects, control or recovery technologies were installed or upgraded to reduce toxic chemical production from manufacturing processes. Cost for project implementation ranged from $125,000 to $200,000.

Exhibit 31: FY-1993 and 1994 Supplemental Environmental Projects Overview: Organic Chemical Manufacture

General SEP Information				Violation Information					Pollutant Reduction		
FY	Docket #	Company Name	State/ Region	Type	Initial Penalty	Final Penalty	SEP Credit	SEP Cost to Company	Pollutant of Concern	Pollutant Reduction	Supplemental Environmental Project Description
93	---	High Plains Corp.	KS	EPCRA	---	$47,000	---	$125,000	---	---	Waste management equipment purchased, future computerized record keeping installed, and computer donated to LEPC
93*	---	LaRoche Chemicals, Inc.	LA	CAA	$88,360	$25,000	---	$158,400	CFC/HCFC	---	Company purchased, installed, and operated equipment for recovery of residual CFCs and HCFCs in used gas cylinders returned by customers
93	6-93-004	E.I. Dupont	LA	CERCLA 103(a)	$25,000	$2,000	---	$11,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies
93	6-93-002	Union Carbide	LA	CERCLA 103(a)	$16,500	$7,000	---	$3,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies
93	1-92-1083	Monsanto Chemical Company	MA	RCRA 3008(a)	$488,200	$107,000	$80,250	$160,500	Methanol	1.8 million lbs/yr	Will add methanol recovery systems to current process, which will result in an approx. reduction of 1.8 million pounds/yr. Previously, waste was burned in boiler
93	---	Markwest Hydrocarbon Partners	Reg. 4	EPCRA 311, 312	$28,000	$5,600	---	$22,400	---	---	Enhanced data management and emergency response capabilities of county LEPC
93	---	Chemical Systems Division, United Technologies Corp.	Reg. 9	RCRA	---	---	$160,000	$257,000	Toluene, chloroform, methanol, tetrahydrofuran, pyridine, formaldehyde, and heptane	950 liters	Replaced four pieces of QA/QC lab equipment with less solvent-requiring alternatives
93	6-92-008	Hoecst Celanese	TX	CERCLA 103(a)	$8,250	$0	---	$10,000	---	---	Conducted an outreach for four counties surrounding facility, mailed out information packets to 1,200 targeted facilities, and sponsored compliance workshop
93	6-93-011	OxyChem	TX	CERCLA 103(a)	$25,000	$12,000	---	$9,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies

R0076879

Exhibit 31 (cont.): FY-1993 and 1994 Supplemental Environmental Projects Overview: Organic Chemical Manufacture

General SEP Information				Violation Information					Pollutant Reduction		
FY	Docket #	Company Name	State/ Region	Type	Initial Penalty	Final Penalty	SEP Credit	SEP Cost to Company	Pollutant of Concern	Pollutant Reduction	Supplemental Environmental Project Description
93	6-93-003	E.I. Dupont	TX	CERCLA 103(a)	$25,000	$2,000	---	$14,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies
93	6-93-020	Arco Chemical	TX	CERCLA 103(a)	$8,250	$2,000	---	$7,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies
93	6-92-026	Elf Atochem	TX	EPCRA 312(a)	$8,250	$1,500	---	$5,500	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies, will participate in LEPC activities, and technical assistance
93	6-93-005	Rohm & Haas	TX	CERCLA 103(a)	$16,500	$10,000	---	$3,000	---	---	Donated emergency and/or computer equipment to LEPC for response/planning for chemical emergencies
94	---	Eastman Kodak	NY	RCRA	$8,000,000	---	---	$12,000,000	---	---	---
94	---	Eastman Kodak	NY	TSCA	---	$42,000	$17,000	$3,600,000	---	---	---
94	---	Hatco Corp.	Reg II	TSCA	---	$96,300	---	$647,000	TCA	---	Installed a purification system to replace TCA. Minimized waste generation by recovering and using unreacted raw materials
94	---	Allied Signal, Inc.	IN	TSCA	$7,000	$2,500	---	$7,000	---	---	Removed and properly disposed of 26 PCB capacitors

[*] Facilities identified as combined inorganic and organic chemical manufacturers

Violation Information Terms
Initial penalty: Initial proposed cash penalty for violation
Final penalty: Total penalty after SEP negotiation
SEP credit: Cash credit given for SEP so that, Final penalty - SEP credit = Final cash penalty
SEP cost to company: Actual cost to company of SEP implementation

NOTE: Due to differences in terminology and level of detail between regional SEP information, in some cases the figure listed as Final penalty may be the Final cash penalty after deduction for SEP credit

R0076880

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

Chemical Manufacturer's Association and EPA are discussing developing plant level compliance guides, auditing protocols, and training materials for new regulations.

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of seventeen chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given out to participants meeting their 1992 goals. The list of chemicals includes seventeen high-use chemicals reported in the Toxics Release Inventory. Exhibit 32 lists those companies participating in the 33/50 program that reported the SIC code 286 to TRI. Many of the companies shown listed multiple SIC codes and, therefore, are likely to carry out operations in addition to organic chemical manufacturing. The SIC codes reported by each company are listed in no particular order. In addition, the number of facilities within each company that are participating in the 33/50 program and that report SIC 286 to TRI is shown. Finally, each company's total 1993 releases and transfers of 33/50 chemicals and the percent reduction in these chemicals since 1988 are presented.

The organic chemicals industry as a whole used, generated or processed all seventeen target TRI chemicals. Of the target chemicals, benzene, toluene, xylenes and methyl isobutyl ketone are released most frequently and in similar quantities. Significant amounts of methyl ethyl ketone are also released, although it is only the seventh most frequently reported 33/50 chemical. These five toxic chemicals account for about eight percent of TRI releases and transfers from organic chemicals facilities. From Exhibit 32, 115 companies representing 335 facilities listed under SIC 286 are currently participating in the 33/50 program. They account for 34 percent of the 986 facilities carrying out organic chemicals manufacturing operations (as identified by the 1992 Census of Manufacturers), which is significantly higher than the average for all industries of 14 percent participation. (Contact: Mike Burns, 202-260-6394 or the 33/50 Program 202-260-6907)

Exhibit 32: 33/50 Program Participants Reporting SIC 286 (Organic Chemicals)					
Parent Company	**City, State**	**SIC Codes Reported**	**Number of Participating Facilities**	**1993 Releases and Transfers (lbs)**	**% Reduction 1988 to 1993**
A. W. Chesterton Company	Stoneham, MA	2869, 3053, 3561	1	13,250	65
Air Products And Chemicals	Allentown, PA	2873, 2869	6	144,876	50
Akzo Nobel Inc.	Chicago, IL	2819, 2869	5	930,189	13
Albemarle Corporation	Richmond, VA	2869	3	1,005,108	51
Allied-Signal Inc.	Morristown, NJ	2819, 2869	10	2,080,501	50
American Home Products Corp.	New York, NY	2833, 2869	3	1,210,834	50
American Petrofina Holding Co.	Dallas, TX	2865	1	747,799	40
Amoco Corporation	Chicago, IL	2865	10	4,632,163	50
Aristech Chemical Corporation	Pittsburgh, PA	2865	4	196,400	18
Arrow Eng. Inc.	Dalton, GA	2843, 2865, 2869	1	250	50
Ashland Oil Inc.	Russell, KY	2865	3	723,562	50
Atlantic Richfield Company	Los Angeles, CA	2865, 2869	3	2,435,248	2
B F Goodrich Company	Akron, OH	2869	4	621,207	50
BASF Corporation	Parsippany, NJ	2869, 2865, 2819	6	1,157,548	50
Baxter International Inc.	Deerfield, IL	2869	1	42,570	80
Borden Chem. & Plas. Ltd. Partner	Columbus, OH	2813, 2821, 2869	1	12,662	***
Borden Inc.	New York, NY	2869, 2821	1	1,644,614	*
BP America Inc.	Cleveland, OH	2869	2	1,597,404	24
Buffalo Color Corporation	Parsippany, NJ	2865	1	10,705	8
CPH Holding Corporation	Chicago, IL	2869	1	7,003	50
Capital Resin Corporation	Columbus, OH	2869, 2821	1	62,850	50
Chemdesign Corporation	Fitchburg, MA	2869	2	47,435	*
Chemical Solvents Inc.	Cleveland, OH	2869	2	955,751	***
Chevron Corporation	San Francisco, CA	2865	4	2,794,502	50
Ciba-Geigy Corporation	Ardsley, NY	2879, 2821, 2865	4	1,875,028	50
Citgo Petroleum Corporation	Tulsa, OK	2911, 2819, 2869	1	1,164,354	20
Coopers Creek Chemical	West Conshohocken, PA	2865	1	19,690	20
Crompton & Knowles Corporation	Stamford, CT	2865	5	30,239	50
Cytec Industries	West Paterson, NJ	2819, 2869	2	1,074,646	50
Degussa Corporation	Ridgefield Park, NJ	2819, 2869, 2879	1	676,418	***
Dow Chemical Company	Midland, MI	2800, 2819, 2821	5	2,769,363	50
Dow Corning Corporation	Midland, MI	2869, 2822, 2821	2	1,134,610	16

R0076882

Exhibit 32: 33/50 Program Participants Reporting SIC 286 (Organic Chemicals)

Parent Company	City, State	SIC Codes Reported	Number of Participating Facilities	1993 Releases and Transfers (lbs)	% Reduction 1988 to 1993
DSM Finance USA Inc.	Wilmington, DE	2869, 2873	1	964,346	32
E. I. Du Pont De Nemours & Co.	Wilmington, DE	2865, 2824, 2821	16	11,740,853	50
Eastman Kodak Company	Rochester, NY	2869, 2865	4	5,827,091	50
Elf Aquitaine Inc.	New York, NY	2869, 2821, 2819	4	273,274	43
EM Industries Incorporated	Hawthorne, NY	5169, 2869, 2899	1	9,055	15
Engelhard Corporation	Iselin, NJ	2816, 2865, 2819	1	236,302	50
Ethyl Corporation	Richmond, VA	2869	2	251,519	46
Exxon Corporation	Irving, TX	2869	6	2,469,930	50
Ferro Corporation	Cleveland, OH	2819, 2869	3	165,529	50
First Mississippi Corporation	Jackson, MS	2865	2	200,977	***
FMC Corporation	Chicago, IL	2879, 2869, 2819	2	502,318	50
Gaf Corporation	Wayne, NJ	2869, 2865, 2834	3	944,730	44
Gencorp Inc.	Akron, OH	3764, 2892, 3761	1	5,453,359	34
General Electric Company	Fairfield, CT	2821, 2812, 2869	3	5,010,856	50
Georgia Gulf Corporation	Atlanta, GA	2865, 2812, 2819	2	39,480	80
Georgia-Pacific Corporation	Atlanta, GA	2611, 2631, 2861	1	2,722,182	50
Goodyear Tire & Rubber Co.	Akron, OH	2865, 2869	3	3,932,157	50
Henkel Corporation	King Of Prussia, PA	2869	4	164,363	55
Hercules Incorporated	Wilmington, DE	2861, 2821, 2869	2	5,014,664	50
HM Anglo-American Ltd.	New York, NY	2869	1	1,265,741	2
Hoechst Celanese Corporation	Somerville, NJ	2869, 2821	12	2,603,661	50
Hoffman-La Roche	Nutley, NJ	2869, 2879, 2844	1	902,929	62
ICI Americas	Wilmington, DE	2869, 3089	3	165,162	50
International Paper Company	Purchase, NY	2861	2	2,784,831	50
James River Corp Virginia	Richmond, VA	2621, 2611, 2869	1	961,588	53
Johnson & Johnson	New Brunswick, NJ	2833, 2869	1	317,843	65
Kalama Chemical	Seattle, WA	2865, 2869	1	214,665	37
Laidlaw Environmental Services	Columbia, SC	2819, 2869	1	8,167	***
Laroche Holdings Inc.	Atlanta, GA	2812, 2869	1	81,470	*
Lubrizol Corp.	Wickliffe, OH	2869	4	466,871	50
Lyondell Petrochemical Co.	Houston, TX	2869, 2821	1	285,430	57
Mallinckrodt Group Inc.	Saint Louis, MO	2869, 2873	5	775,206	50
Merck & Co. Inc.	Rahway, NJ	2833, 2869, 2879	1	1,456,238	50
Miles Inc.	Pittsburgh, PA	2865	7	1,095,504	40

Exhibit 32: 33/50 Program Participants Reporting SIC 286 (Organic Chemicals)

Parent Company	City, State	SIC Codes Reported	Number of Participating Facilities	1993 Releases and Transfers (lbs)	% Reduction 1988 to 1993
Milliken & Company	Spartanburg, SC	2869, 2843, 2865	1	13,500	50
Millipore Corporation	Bedford, MA	2869	1	65,529	50
Mobil Corporation	Fairfax, VA	2911, 2869	5	4,263,284	50
Monsanto Company	Saint Louis, MO	2824, 2869, 2821	11	1.683.580	23
Moore Business Forms (Del)	Lake Forest, IL	2761, 2865, 2821	1	107,091	42
Morgan Stanley Leveraged Fund	New York, NY	2869	1	2,166,420	13
Morton International Inc.	Chicago, IL	2821, 2891, 2879	4	721,216	20
Nalco Chemical Company	Naperville, IL	2869, 2899, 2819	4	107,651	50
Nashua Corp.	Nashua, NH	2672, 3572, 3577	1	1.818.504	**
Occidental Petroleum Corp.	Los Angeles, CA	2869	10	8.896.126	19
Olin Corporation	Stamford, CT	2869, 2841, 2843	3	574,673	70
PCR Group Inc.	Jacksonville, FL	2869	1	26,510	3
PCL Group Inc.	Cincinnati, OH	2865, 2873, 2879	1	471,405	***
Perkin-Elmer Corporation	Norwalk, CT	3826, 2869	1	25,865	*
Philip Morris Companies Inc.	New York, NY	2022, 2869	1	259,053	**
Phillips Petroleum Company	Bartlesville, OK	2869, 2821	4	2,367,877	50
PPG Industries Inc.	Pittsburgh, PA	2812, 2816, 2869	3	2,772,331	50
Procter & Gamble Company	Cincinnati, OH	2869	3	612,520	*
Quantum Chemical Corporation	Iselin, NJ	2821, 2869	5	289,235	50
Rexene Corporation	Dallas, TX	2821, 2869	1	128,054	50
Rhone-Poulenc Inc.	Monmouth Junction, NJ	2879, 2869	5	1,437,778	50
Rohm and Haas Company	Philadelphia, PA	2869	5	1,210,244	50
Rubicon Inc.	Geismar, LA	2865, 2869, 2873	1	134,306	75
Sandoz Corporation	New York, NY	2865	1	104,490	50
Sartomer Company Inc.	Exton, PA	2821, 2869, 2899	1	41,893	*
Schenectady Chemical Inc.	Schenectady, NY	2821, 2869	1	239,285	***
Shell Petroleum Inc.	Houston, TX	2869	4	3,240,716	55
Shepherd Chemical Co.	Cincinnati, OH	2819, 2869	1	828	72
Standard Chlorine Chemical Co.	Kearny, NJ	2865, 2819	1	48,246	***
Stepan Company	Northfield, IL	2843, 2865, 2869	1	25,186	***
Sterling Chemicals Inc.	Houston, TX	2869, 2865, 2819	1	182,216	65
Syntex Usa Inc.	Palo Alto, CA	2833, 2048, 2869	2	499,873	33
Texaco Inc.	White Plains, NY	2869	4	514,803	50
Texas Olefins Company	Houston, TX	2869	1	214	33

Exhibit 32: 33/50 Program Participants Reporting SIC 286 (Organic Chemicals)					
Parent Company	**City, State**	**SIC Codes Reported**	**Number of Participating Facilities**	**1993 Releases and Transfers (lbs)**	**% Reduction 1988 to 1993**
Unilever United States Inc.	New York, NY	2821, 2891, 2869	3	164,034	50
Union Camp Corporation	Wayne, NJ	2869	4	835,696	50
Union Carbide Corporation	Danbury, CT	2821, 2869	7	728,129	50
Uniroyal Chemical Corporation	Middlebury, CT	2822, 2869, 2879	2	1,970,357	20
United Organics Corp.	Williamston, NC	2869	1	14,127	*
UOP	Des Plaines, IL	2819, 2869	2	14,169	50
Veba Corporation	Houston, TX	2869, 2992	3	24,254	10
Velsicol Chemical Corporation	Rosemont, IL	2865, 2819, 2869	2	224,664	50
Vista Chemical Company	Houston, TX	2821, 2869	3	106,497	50
Vulcan Materials Company	Birmingham, AL	2869, 2812	2	679,566	85
Wacker Chemical Corporation	Williamsburg, VA	2821, 2891, 2869	1	772	*
Walter Industries Inc.	Tampa, FL	2869	1	859,751	***
Westvaco Corporation	New York, NY	2861	2	877,866	50
Witco Corporation	New York, NY	2869, 2899, 2841	6	327,611	50
Zeneca Holdings Inc.	Wilmington, DE	2869, 2843, 2899	5	1,609,047	*

* = not quantifiable against 1988 data.
** = use reduction goal only.
*** = no numerical goal.

Source: U.S. EPA, Toxics Release Inventory, 1993.

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and state agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentor programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects.

Forty proposals were received from companies, trade associations, and federal facilities representing many manufacturing and service sectors. One chemical company's proposal was accepted (Ciba Geigy of St. Gabriel, LA). Another chemical firm (Akzo Chemicals of Edison, NJ), one pharmaceutical manufacturer (Schering Plough of Kenilworth, NJ) and one manufacturer of agricultural chemicals (Gowan Milling of Yuma, AZ) have submitted proposals. (Contact: Tia-Ming Chang, ELP Director 202-564-5081 or Robert Fentress 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specifc objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Jon Kessler at EPA's Office of Policy Analysis 202 260-4034)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; federal, state, and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Maria Tikoff at 202-233-9178 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA, in turn, provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn 202-260-0700 or the WasteWi$e Hotline at 800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman 202-260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office 303-275-4729)

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Environmental Programs

The Global Environmental Management Initiative (GEMI) is made up of group of leading companies dedicated to fostering environmental excellence by business. GEMI promotes a worldwide business ethic for environmental management and sustainable development, to improve the environmental performance of business through example and leadership. In 1994, GEMI's membership consisted of about 30 major corporations including Union Carbide Corporation and Dow Chemical.

Center for Waste Reduction Technologies under the aegis of the American Institute of Chemical Engineers sponsored research on innovative technologies to reduce waste in the chemical processing industries. The primary mechanism is through funding of academic research.

The National Science Foundation and the Environmental Protection Agency's Office of Pollution Prevention and Toxics signed an agreement in January of 1994 to coordinate the two agencies' programs of **basic research related to pollution prevention**. The collaboration will stress research in the use of less toxic chemical and synthetic feedstocks, use of photochemical processes instead of traditional ones that employ toxic reagents, use of recyclable catalysts to reduce metal contamination, and use of natural feedstocks when synthesizing chemicals in large quantities.

The **Chemical Manufacturer's Association** funds research on issues of interest to their members particularly in support of their positions on proposed or possible legislation. They recently funded a study to characterize the environmental fate of organochlorine compounds.

ISO 9000 is a series of international total quality management guidelines. After a successful independent audit of their management plans, firms are qualified to be ISO 9000 registered. In June of 1993, the International Standards Organization created a technical committee to work on new standards for environmental management systems.

The **Responsible Care® Initiative** of the Chemical Manufacturer's Association requires all members and partners to continuously improve their health, safety, and environmental performance in a manner that is responsive to the public. Launched in 1988, the Responsible Care® concepts are now being applied in 36 countries around the world. Responsible Care® is a comprehensive, performance-oriented initiative composed of ten progressive Guiding Principles and six board Codes of Management Practices. These Management Practices cover all aspects of the chemical industry's operations, from research to manufacturing, distribution, transportation, sales and marketing, and to downstream users of chemical products. Through Responsible Care®, CMA members and partners gain insight from the public through, among other means, a national Public Advisory Panel and over 250 local Community Advisory Panels. This, coupled with the fact that participation in Responsible Care® is an obligation of membership with the Chemical Manufacturer's Association, make this performance improvement initiative unique. The Synthetic Organic Chemical Manufacturer's Association whose membership consists of smaller batch and custom chemical manufacturers with typically fewer than 50 employees and less than $50 million in annual sales, encourages its members to achieve continuous performance improvement in their health, safety, and environmental programs through implementation of the chemical industry's Responsible Care® initiative. SOCMA is a partner in Responsible Care®.

VIII.C.2. Summary of Trade Associations

American Chemical Society
1155 16th Street, NW
Washington, D.C. 20036
Phone: (202) 872-8724
Fax: (202) 872-6206

Budget: $192,000,000
Staff: 1700
Members: 145,000

The American Chemical Society (ACS) has an educational and research focus. The ACS produces approximately thirty different industry periodicals and research journals, including *Environmental Science and Technology* and *Chemical Research in Toxicology*. In addition to publishing, the ACS presently conducts studies and surveys; legislation monitoring, analysis, and reporting; and operates a variety of educational programs. The ACS library and on-line information services are extensive. Some available on-line services are *Chemical Journals Online*, containing the full text of 18 ACS journals, 10 Royal Society of Chemistry journals, five polymer journals and the Chemical Abstracts Service, *CAS*, which provides a variety of information on chemical compounds. Founded in 1876, the ACS is presently comprised of 184 local groups and 843 student groups nationwide.

Chemical Manufacturer's Association
2501 M St., NW
Washington, D.C. 20037
Phone: (202) 887-1100
Fax: (202) 887-1237

Members: 185
Staff: 246
Budget: $36,000,000

A principal focus of the Chemical Manufacturer's Association (CMA) is on regulatory issues facing chemical manufacturers at the local, state, and federal levels. At its inception in 1872, the focus of CMA was on serving chemical manufacturers through research. Research is still ongoing at CMA. Member committees, task groups, and work groups routinely sponsor research and technical data collection that is then provided to the public in support of CMA's advocacy. Much additional research takes place through the CHEMSTAR® program. CHEMSTAR® consists of a variety of self-funded panels working on single-chemical research agendas. This research fits within the overall regulatory focus of CMA; CHEMSTAR® study results are provided to both CMA membership and regulatory agencies. Other initiatives include the Responsible Care® program, which includes six codes of management practices designed to go beyond simple regulatory compliance. CAM is currently developing measurement and appropriate verification systems for these codes. CMA also conducts workshops and technical symposia, promotes in-plant safety, operates a chemical emergency center (CHEMTREC®) which offers guidance in chemical emergency situations, and operates the Chemical Referral Center which provides chemical health and safety information to the public. Publications include the annual *U.S. Chemical Industry Statistical Handbook*, containing detailed data on the industry; *Responsible Care in Action*, the 1993-94 progress report on implementing Responsible Care®; and *Preventing Pollution: A Chemical Industry Progress Report (1988-1992)*, summarizing waste generation and reduction data for the years 1988-92. CMA holds an annual meeting for its membership in White Sulphur Springs, WV.

Ethylene Oxide Industry Council
2501 M St. NW, Ste. 330
Washington, DC 20037
Phone: (202) 887-1198

The Ethylene Oxide Industry Council (EOIC), founded in 1981, is an example of a panel group within the CHEMSTAR® program of the Chemical Manufacturer's Association (CMA). The EOIC consists of ethylene oxide producers and users. Ethylene oxide is used in the manufacture of antifreeze and polyester fibers, and is widely used as a sterilizing agent. The EOIC develops scientific, technological, and economic data on the safe use and manufacture of ethylene oxide. Other duties include informing scientific and governmental organizations of the industry's views and interests.

Synthetic Organic Chemicals
Manufacturer's Association
1100 New York Avenue, NW
Washington, D.C. 20005
Phone: (202) 414-4100 Members: 250
Fax: (202) 289-8584 Staff: 50

Synthetic Organic Chemicals Manufacturer's Association (SOCMA) is the national trade association representing the legislative, regulatory, and commercial interests of some 250 companies that manufacture, distribute, or market organic chemicals. Most of SOCMA's members are batch and custom chemical manufacturers who are the highly innovative, entrepreneurial and customer-driven sector of the U.S. chemical industry. The majority of SOCMA's members are small businesses with annual sales of less than $50 million and fewer than 50 employees. SOCMA assists its members in improving their environmental, safety, and health performance through various programs focusing on continuous improvement. A bi-monthly newsletter provides information on legislative and regulatory developments, as well as on education and training opportunities. SOCMA holds an annual meeting in May and also sponsors INFORMEX, the largest custom chemical trade show in the U.S. In addition, SOCMA's Association Management Center includes two dozen self-funded groups that focus on single chemical issues.

Chemical Specialties Manufacturer's Association
1913 I St. NW
Washington, D.C. 20006
Phone: (202) 872-8110
Fax: (202) 872-8114

Members: 425
Staff: 31

This organization represents the manufacturers of such specialty chemical products as pesticides, cleaners, disinfectants, sanitizers, and polishes. The Chemical Specialties Manufacturer's Association (CSMA) was founded in 1914. Today, the CSMA works with federal and state agencies and public representatives, to provide their membership with information on governmental activities and scientific developments. Some committees include: Government Affairs Advisory and Scientific Affairs. Publications include the quarterly *Chemical Times & Trends*, the biweekly *Legislative Reporter*, and compilations of laws and regulations. CSMA holds an annual December meeting in Washington, D.C.

Halogenated Solvents Industry Alliance
1225 19th St. NW, Ste. 300
Washington, D.C. 20036
Phone: (202) 223-5890

Members: 200
Budget: $1,400,000

The goal of the Halogenated Solvents Industry Alliance (HSIA) is to develop programs to address problems involving halogenated solvents. The group is actively involved in legislative and regulatory issues affecting the industry, providing industry comments and information to agencies, and representing the industry at administrative hearings. The HSIA also sponsors working groups on issues specific to the solvent industry. Publications include the bimonthly newsletter *Halogenated Solvents Industry Alliance*, which includes a listing of publications available from the group and the monthly newsletter *Solvents Update*, which covers regulatory development and HSIA actions.

Methyl Chloride Industry Association
c/o Robert Sussman
Latham and Watkins
1001 Pennsylvania Ave. NW, Ste.1300
Washington, D.C. 20004
Phone: (202) 637-2200

The Methyl Chloride Industry Association (MCIA) was founded in 1981 to meet the needs of the methyl chloride manufacturing industry on the issue of government regulation. The group participates in EPA rulemakings as an industry representative. The MCIA has no publications or annual meetings.

American Institute of Chemical Engineers
1707 L Street, NW, Ste. 333
Washington, D.C. 20036
Phone: (202) 962-8690 Members: 54,000
Fax: (202) 833-3014 Staff: 103

The American Institute of Chemical Engineers (AICHE) is a professional society of chemical engineers. AICHE develops chemical engineering curricula and sponsors a variety of chemical study forums. AICHE is split into twelve divisions including the Environmental, Forest Products, Fuels and Petrochemical, and Safety and Health divisions. Approximately fourteen publications are produced by AICHE, such as the quarterly *Environmental Progress*, a periodic directory of members, and a variety of pamphlets. AICHE holds three conferences per year in various locations.

Color Pigments Manufacturer's Association, Inc.
300 N. Washington St., Ste. 102
Alexandria, VA 22314
Phone: (703) 684-4044 Members: 50
Fax: (703) 684-1795 Staff: 5

The Color Pigments Manufacturer's Association (CPMA) represents North American manufacturers of pigments and pigment ingredients (i.e., dyes). The CPMA also represents the affiliates of manufacturers of those products who happen to manufacture the product overseas. The CPMA represents its membership before government agencies. No further information is available at this time.

Fire Retardant Chemical Association
851 New Holland Ave., Box 3535
Lancaster, PA 17604
Phone: (717) 291-5616 Members: 42
Fax: (717) 295-4538 Staff: 5

Chemical distributors/manufacturers active in promoting fire safety through chemical technology comprise the Fire Retardant Chemical Association (FRCA), founded in 1973. The FRCA serves as a forum for information dissemination on new developments, new applications, and current testing procedures for fire retardants and chemical fire safety products. Publications include the periodic *Fire Retardant Chemicals Association - Membership Directory* and the *Fire Retardant Chemical Association Proceedings*. Educational conferences are held semiannually.

National Paint and Coatings Association
1500 Rhode Island Avenue, NW
Washington, DC 20005
Phone: (202) 462-6272 Members: 700
Fax: (202) 462-8549 Staff: 40

Founded in 1933, the National Paint and Coatings Association (NPCA) represents manufacturers of paints and chemical coatings as well as suppliers of paint manufacturing equipment and raw materials. NPCA is involved in government relations programs, statistical surveys, and industry research. Committees include Labeling, Scientific, and Government Supply. The NPCA publishes an annual report, a periodic newsletter and trade directory, and a variety of guides. The NPCA holds an annual meeting.

Drug, Chemical, and Allied Trades Association
2 Roosevelt Ave., Suite 301
Syosset, NY 11791 Members: 500 Members: 500
Phone: 516-496-3317 Staff: 3 Staff: 3
Fax: 516-496-2231 Budget: $500,000

Drug, Chemical, and Allied Trades Association (DCAT) is comprised of drug, chemical, and related product (e.g., packaging, cosmetics, essential oils) manufacturers, advertisers, brokers, and importers. The association publishes *DCAT*, a monthly with coverage of federal regulations.

National Association of Chemical Recyclers
1875 Connecticut Ave., NW
Suite 1200
Washington, DC 20009
Phone: 202-986-8150 Members: 70
Fax: 202-986-2021 Staff: 3

National Association of Chemical Recyclers (NACR) founded in 1980, consists of recyclers of used industrial solvents. The organization promotes "responsible and intelligent" regulation and the beneficial reuse of waste. NACR monitors and reports on regulatory and legislative action affecting the practice of solvent recycling. NACR also compiles industry statistics. NACR publishes *Flashpoint* and a semiannual membership list. NACR holds a semiannual conference, usually in April or October.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the organic chemical industry a list of publications and contacts are provided below:

Contacts[8]

Name	Organization	Telephone	Subject
Walter DeRieux	EPA/OECA	(202) 564-7067	Regulatory requirements and compliance assistance
Jim Gould	EPA Region VI	(713) 983-2153	Industrial processes and regulatory requirements (CAA, CWA)
David Langston	EPA Region IV	(404) 347-7603	Industrial resources and regulatory requirements (RCRA)
Jim Seidel	EPA/NEIC	(303) 236-5132	Industrial processes and regulatory requirements
Mary J. Legatski	Synthetic Organic Chemical Manufacturers Association	(202) 414-4100	Federal environmental requirements

CAA: Clean Air Act
CWA: Clean Water Act
OECA: Office of Enforcement and Compliance Assurance
NEIC: National Enforcement Investigations Center
RCRA: Resource Conservation and Recovery Act

General Profile

U.S. Industrial Outlook, 1994, Department of Commerce

Chemical and Engineering News, July 4, 1994 "Facts and Figures for the Chemical Industry." This information is produced annually.

[8] Many of the contacts listed above have provided valuable background information and comments during development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

United States International Trade Commission, Synthetic Organic Chemicals, United States Production and Sales, 1992. [Published annually]

1992 Census of Manufactures, Industry Series, Industrial Organic Chemicals, Bureau of the Census.

Process Descriptions and Chemical Use Profiles

Kirk-Othmer Encyclopedia of Chemical Technology (appropriate volumes)

Ullman's Encyclopedia of Chemical Technology (appropriate volumes)

SRI Chemical Economics Handbook (This is a proprietary data source and EPA's Regulatory Impacts Branch has a copy)

SRI Directory of Chemical Producers

Franck, H.G. and J.W. Stadelhofer, 1987. Industrial Aromatic Chemistry, Berlin: Springer-Verlag.

Perry, Robert H. and Cecil H. Chilton, "Chemical Engineers' Handbook" New York: McGraw-Hill Book Company.

Peters, Max S. and Klaus D. Timmerhaus, "Plant Design and Economics for Chemical Engineers," New York: McGraw-Hill Book Company.

Kent, J.(ed.) Reigel's Handbook of Industrial Chemistry, 1992. New York: von Nostrand Reinhold, Ninth Edition.

Shreve, Chemical Process Industries.

Szmant, H. Harry, 1989. Organic Building Blocks of the Chemical Industry, New York: John Wiley and Sons.

Tomes Plus Information System. Denver, CO: Micromedia, Inc. Contains information on chemical use, production, and health effects. (303) 831-1400.

Chemical Manufacturer's Association, Undated. Designing Pollution Prevention into the Process - Research, Development and Engineering.

U.S. Environmental Protection Agency, 1987. Development Document of Effluent Limitations Guidelines for the Organic Chemicals, Plastics and Synthetic Fibers Point Source Category, EPA 440/1-87/009.

Wells, G. Margaret, 1991. Handbook of Petrochemicals and Processes. Aldershot, England: Gower Publishing Company.

Regulatory Profile

Hazardous Waste Consultant, Volume 12, October/November 1994. RCRA Land Disposal Restrictions: A Guide to Compliance, 1995 Edition.

Sustainable Environmental Law, Environmental Law Institute, West Publishing Co., St. Paul, Minn., 1993.

Pollution Prevention

Breen, Joseph J., and Michael J. Dellarco. Pollution Prevention in Industrial Processes: The Role of Process Analytical Chemistry. Washington, DC: American Chemical Society, 1992.

Chemical and Engineering News "Design for the Environment: Chemical Syntheses that Don't Pollute" September 5, 1994. Article on the 1994 American Chemical Society symposium "Design for the Environment: A New Paradigm for the 21st Century."

Chemical Manufacturer's Association, "Designing Pollution Prevention into the Process: Research, Development and Engineering," Washington, DC, 1993. [The reference section from this document is reproduced below to provide reference to additional sources of information.]

Du Pont Corporation and U.S. Environmental Protection Agency, "Du Pont Chamber Works Waste Minimization Project" 1993.

Dorfman, M.H. et al. "Environmental Dividends: Cutting More Chemical Wastes. New York, NY: INFORM, Inc.

Forester, William S., and John H. Skinner. Waste Minimization and Clean Technology: Waste Management Strategies for the Future. San Diego, CA: Academic Press, 1992.

The Hazardous Waste Consultant, New York: Elsevier Science Inc. (A bimonthly journal.)

Overcash, Michael R. "Techniques for Industrial Pollution Prevention: A Compendium for Hazardous and Non-Hazardous Waste Minimization. Chelsea, MI: Lewis Publishers, 1986.

Sawyer, Donald T., and Arthur E. Martell, Industrial Environmental Chemistry: Waste Minimization in Industrial Processes and Remediation of Hazardous Waste. New York, NY: Plenum Press, 1992.

SOCMA Pollution Prevention Study. Prepared for SOCMA Washington, D.C. January 1993. Profiles pollution prevention activities at four specialty chemical manufacturers.

Theodore, Louis, and Young C. McGuinn. Pollution Prevention. New York: Van Nostrand Reinhold, 1992.

U.S. Congress, Office of Technology Assessment "Industry, Technology, and the Environment: Competitive Challenges and Business Opportunities," OTA-ITE-586 (Washington, DC: U.S. Government Printing Office, January 1994).

References from CMA's "Designing Pollution Prevention into the Process".

Information Sources and Agencies

Pollution Prevention Information Clearinghouse (PPIC) U.S. EPA

The International Cleaner Production Information Clearinghouse (ICPIC); United Nations Environmental Programme (UNEP), U.S. EPA

Books, Reports and Documents

Noyes Data Corporation, "Alternative Formulations and Packaging to Reduce Use of Chlorofluorocarbons," 1990, ISBN0-8155-1257-0.

Research Triangle Institute, "Alternatives for Measuring Hazardous Waste Reduction," 1991, PB91-208595.

Noyes Data Corporation, "Aqueous Cleaning as an Alternative to CFC and Chlorinated Solvent-Based Cleaning," 1991, ISBN0-8155-1285-6.

EPA, "Background Document on Clean Products Research and Implementation," 1990, EPA/600/S2-90/048.

EPA, "Case Studies from the Pollution Prevention Information Clearinghouse: Solvent Recovery," 1989, ISM-4 (PPIC).

Government Institutes, "Case Studies in Waste Minimization," 1991, ISBN0-86587-267-8.

United Nations Environmental Programme (UNEP), "Cleaner Production Newsletter," Industry and Environmental Office, ICPIC-1 (PPIC).

EPA, "Degreaser System Pollution Prevention Evaluation," 1990, EPA/600/S2-90/052.

Oregon Department of Environmental Quality, "Guidelines for Waste Reduction and Recycling: Solvents," 1989, ISM-13 (PPIC).

EPA, "Guides to Pollution Prevention: Research and Educational Institutions," 1990, ISM-19 (PPIC).

EPA, "Guides to Pollution Prevention: The Fiberglass-Reinforced and Composite Plastics Industry," ISM-19 (PPIC).

McGraw-Hill, Inc., "Hazardous Waste Minimization," 1990, ISBN0-07-022043-3.

Lewis Publishers, "Hazardous Waste Minimization Handbook," 1989, ISBN0-87371-176-9.

ASTM, "Hazardous and Industrial Solid Waste Minimization Practices," 1989, ISBN0-8031-1269-6.

EPA, "Industrial Pollution Prevention for the 1990s," 1991, EPA/600/S8-91/052.

EPA, "Pollution Prevention Benefits Manual: Volume 1 (Draft), 1989, WAM-1 (PPIC).

EPA, "Pollution Prevention Fact Sheets: Chemical Production," FREG-1 (PPIC), free.

EPA, "Pollution Prevention Information Exchange System (PIES) User Guide," Version 1.1, 1989, EPA/600/9-89/086, free.

City of Los Angeles, "Pollution Prevention Opportunities Checklist: Chemical Manufacturing," FCLA-1-1 (PPIC).

CMA, "Pollution Prevention Resource Manual," 1991, $75.00 (non-members), $50.00 (members, Order no. 018031).

EPA, "Prevention Reference Manual: Chemical Specific, Volume 10: Control of Accidental Releases of Hydrogen Cyanide," 1987, EPA/600-S8-87/034j.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 11: Control of Accidental Releases of Ammonia," 1987, EPA/600-S8-87/034k.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 12: Control of Accidental Releases of Sulfur Dioxide," 1987, EPA/600/S8-87/034l.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 13: Control of Accidental Releases of Methyl Isocyanate," 1987, EPA/600/S8-87/034m.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 14: Control of Accidental Releases of Phosgene," 1987, EPA/600/S8-87/034n.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 15: Control of Accidental Releases of Sulfur Trioxide," 1987, EPA/600/S8-87/034o.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 1: Control of Accidental Releases of Hydrogen Fluoride (SCAQMD)," 1987, EPA/600/S8-87/034a.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 2: Control of Accidental Releases of Chlorine (SCAQMD)," 1987, EPA/600/S8-87/034b.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 3: Control of Accidental Releases of Hydrogen Cyanide (SCAQMD)," 1987, EPA/600/S8-87/034c.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 4: Control of Accidental Releases of Ammonia Cyanide (SCAQMD)," 1987, EPA/600/S8-87/034d.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 7: Control of Accidental Releases of Chloropicrin Cyanide (SCAQMD)," 1987, EPA/600/S8-87/034g.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 8: Control of Accidental Releases of Hydrogen Fluoride," 1987, EPA/600/S8-87/034h.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 9: Control of Accidental Releases of Chlorine," 1987, EPA/600/S8-87/034i.

EPA, "Prevention Reference Manual: Chemical Specific, Volume 6: Control of Accidental Releases of Carbon Tetrachloride (SCAQMD)," 1987, EPA/600/S8-87/034f.

EPA, "Prevention Reference Manual: Control Technologies. Volume 2: Post-Release Mitigation Measures for Controlling Accidental Releases of Air Toxics," 1987, EPA/600/S8-87/039b.

EPA, "Prevention Reference Manual: Control Technologies. Volume 1: Prevention and Protection Technologies for Controlling Accidental Releases of Air Toxics," 1987, EPA/600/S8-87/039a.

EPA, "Prevention Reference Manual: Overviews on Preventing and Controlling Accidental Releases of Selected Toxic Chemicals," 1988, EPA/600/S8-88/074.

EPA, "Prevention Reference Manual: User's Guide, Overview for Controlling Accidental Releases of Air Toxics," 1987, EPA/600/S8-87/028.

EPA, "Proceedings of the International Workshop on Research in Pesticide Treatment/Disposal/ Waste Minimization," 1991, EPA/600-S9-91/047.

Alaska Health Project, "Profiting from Waste Reduction in Your Small Business," 1988, free, QAM-2 (PPIC).

National Academy Press, "Reducing Hazardous Waste Generation: An Evaluation and a Call for Action," 1985, $9.95, ISBN 0-309-03498-1.

Noyes, Data Corporation, "Solvent Waste Reduction," 1990, $45, ISBN 0-8155-1254-6.

EPA, "Solvent Waste Reduction Alternatives," 1989, EPA/625/4-89/021.

EPA, "Source Characterization and Control Technology Assessment of Methylene Choride Emissions from Eastman Kodak Company," Rochester, NY, 1989, EPA/600-S2-043.

Government Institutes, "The Greening of American Business: Making Bottom-Line Sense of Environmental Responsibility," 1992, $24.95, ISBN: 0-86587-295-3.

Van Nostrand Reinhold, "The Recycler's Manual for Business, Government, and the Environmental Community," 1992, $64.95, ISBN 0-442-01190-3.

National Academy Press, "Tracking Toxic Substances at Industrial Facilities: Engineering Mass Balance Versus Materials Accounting," 1990, ISBN 0-0309-04086-8.

EPA, "Waste Exchange Information Package," 1991, free, GEN-13 (PPIC).

EPA, "Waste Minimization: Environmental Quality with Economic Benefits," 1990, free, EPA/530-SW-87-026 (also GEN-14 (PPIC)).

Government Institutes, "Waste Minimization Manual," 1987, $57.00, ISBN: 0-86587-731-9.

EPA, "Waste Minimization Opportunity Assessment Manual," 1988, EPA/625/7-88/003.

CMA, "Waste Minimization Workshop Handbook," 1987, $250.00 (non-members); $100.00 (members), Order no. 018016.

API, "Waste Minimization in the Petroleum Industry: A Compendium of Practices," 1991, $35.00, Order no. 849-30200.

Lewis Publishers, "Waste Minimization: Implementing an Effective Program," due 1992, $59.00, ISBN 0-87371-521-7.

Noyes Data Corporation, "Waste Oil: Reclaiming Technology, Utilization, and Disposal," 1989, $39.00, ISBN 0-8155-1193-0.

California Department of Health Service, "Waste Reduction Fact Sheet: Pesticide Formulating Industry," free, FCAD-7 (PPIC).

Executive Enterprises, "Waste Reduction: Policy and Practice, $39.95, ISBN 1-55840-272-1.

Journals/Newsletters

ChemEcology, Chemical Manufacturer's Association, (202) 887-1100.

Chemical Research in Toxicology, American Chemical Society, (700) 333-9511.

CMA News, Chemical Manufacturer's Association, (202) 887-1100.

Dangerous Properties of Industrial Materials Report, Van Nostrand Reinhold, (212) 254-3232.

Environmental Technology and Chemistry, Persimmon Press, Inc., (914) 524-9200.

Fundamental and Applied Toxicology, Society of Toxicology, Academic Press, Inc., (619) 230-1840.

Green Business Letter, Tilden Press Inc., (202) 332-1700.

Green Marketing Report, Business Publishers, Inc., (301) 587-6300.

Hazard Prevention, System Safety Society, Inc.

Hazardous Substances and Public Health, U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, (404) 639-6206.

Incorporate Environmental Reviews into Facility Design, Chemical Engineering Progress, pp. 46-52 (August 1992).

Industrial Health & Hazards Update, Merton Allen Associates, Info Team Inc., (305) 473-9560.

Journal of Environmental Pathology, Toxicology and Oncology, Blackwell Scientific Publications, Inc., (617), 225-0401.

Literature Abstracts: Health & Environment, American Petroleum Institute, (212), 366-4040.

Occupational Hazards, Penton Publishing Inc., (216) 696-7000.

Pollution Prevention Review, Executive Enterprises, (800) 332-8804.

Recycling--Reclamation Digest, ASM International, (216) 338-5151.

Responsible Care® Newsletter, Chemical Manufacturer's Association, (202) 887-1100.

Reuse-Recycle, Technomic Publishing Co., Inc., (717) 291-5609.

Toxic Substances Journal, Hemisphere Publishing Corporation.

Waste Minimization and Recycling Report, Government Institutes, Inc., (301) 921-2300.

Software/Databases

AQUIRE, Aquatic Toxicity Information Retrieval Database, NTIS, (703) 487-4650.

ATTIC, Alternative Treatment Technology Information Center Database, (301) 816-9153.

CESARS, Chemical Evaluation Search & Retrieval System, Chemical Information Systems Inc., (301) 321-8440.

IRIS, Integrated Risk Information System Database (summary information related to human health risk assessment), EPA, NTIS No. PB90-591330/CCE.

NIOSHTIC, database on bibliographic occupational safety and health, DIALOG Information Services.

STARA, Studies on Toxicity Applicable to Risk Assessment, EPA (919) 541-3629.

SWAMI, Strategic Waste Minimization Initiative, Version 2.0, EPA, contact Doug Williams at (513) 569-7361.

TERRE-TOX, Terrestrial Toxicity Database (aid in evaluating pre-manufacturing notices and research), NTIS.

TOXNET, Toxicology Data Network, National Library of Medicine.

WHWTD, Waste & Hazardous Waste Treatability Database, EPA.

ENDNOTES

1. Amoco - U.S. EPA Pollution Prevention Project, Yorktown, Virginia, Project Summary, January 1992.

2. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Chapter 9, Petroleum Industry*. U.S. EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, U.S. Government Printing Office, Washington, D.C., September 1985.

APPENDIX A
INSTRUCTIONS FOR DOWNLOADING THIS NOTEBOOK

Electronic Access to this Notebook via the World Wide Web (WWW)

This Notebook is available on the Internet through the World Wide Web. The Enviroene Communications Network is a free, public, interagency-supported system operated by EPA's Office of Enforcement and Compliance Assurance and the Office of Research and Development. The Network allows regulators, the regulated community, technical experts, and the general public to share information regarding: pollution prevention and innovative technologies; environmental enforcement and compliance assistance; laws, executive orders, regulations, and policies; points of contact for services and equipment; and other related topics. The Network welcomes receipt of environmental messages, information, and data from any public or private person or organization.

ACCESS THROUGH THE ENVIROENE WORLD WIDE WEB

To access this Notebook through the Enviroene World Wide Web, set your World Wide Web Browser to the following address:

http://es.inel.gov/oeca - then select "EPA Sector Notebooks"

or after 1997, (when EPA plans to have completed a restructuring of its web site) set your web browser to the following address:

www.epa.gov/oeca - then select the button labeled Gov't and Business Sectors and select the appropriate sector from the menu. The Notebook will be listed.

HOTLINE NUMBER FOR E$WWW: 208-526-6956

EPA E$WWW MANAGERS: Louis Paley 202-564-2613
Myles Morse 202-260-3151

United States Government INFORMATION

PUBLICATIONS ★ PERIODICALS ★ ELECTRONIC PRODUCTS

Order Processing Code:
* 3212

Charge your order. It's easy! VISA MasterCard DISCOVER NOVUS

Fax your orders (202) 512–2250
Phone your orders (202) 512–1800

Qty.	Stock Number	**Published in 1995** Title	Price Each	Total Price
	055-000-00512-5	Dry Cleaning Industry, 104 pages	$ 6.50	
	055-000-00513-3	Electronics and Computer Industry, 160 pages	11.00	
	055-000-00518-4	Fabricated Metal Products Industry, 164 pages	11.00	
	055-000-00515-0	Inorganic Chemical Industry, 136 pages	9.00	
	055-000-00516-8	Iron and Steel Industry, 128 pages	8.00	
	055-000-00517-6	Lumber and Wood Products Industry, 136 pages	9.00	
	055-000-00519-2	Metal Mining Industry, 148 pages	10.00	
	055-000-00520-6	Motor Vehicle Assembly Industry, 156 pages	11.00	
	055-000-00521-4	Nonferrous Metals Industry, 140 pages	9.00	
	055-000-00522-2	Non-Fuel, Non-Metal Mining Industry, 108 pages	6.50	
	055-000-00523-1	Organic Chemical Industry, 152 pages	11.00	
	055-000-00524-9	Petroleum Refining Industry, 160 pages	11.00	
	055-000-00525-7	Printing Industry, 124 pages	7.50	
	055-000-00526-5	Pulp and Paper Industry, 156 pages	11.00	
	055-000-00527-3	Rubber and Plastic Industry, 152 pages	11.00	
	055-000-00528-1	Stone, Clay, Glass and Concrete Industry, 124 pages	7.50	
	055-000-00529-0	Transportation Equipment Cleaning Industry, 84 pages	5.50	
	055-000-00514-1	Wood Furniture and Fixtures Industry, 132 pages	8.00	

Qty.	Stock Number	**Published in 1997** Title	Price Each	Total Price
	055-000-00570-2	Air Transportation Industry, 90 pages	$ 7.50	
	055-000-00571-1	Ground Transportation Industry, 130 pages	10.00	
	055-000-00572-9	Water Transportation Industry, 90 pages	7.50	
	055-000-00573-7	Metal Casting Industry, 150 pages	13.00	
	055-000-00574-5	Pharmaceutical Manufacturing Industry, 147 pages	13.00	
	055-000-00575-3	Plastic Resin & Man-made Fiber Industry, 180 pages	15.00	
	055-000-00576-1	Fossil Fuel Electric Power Generation Industry, 160 pages	14.00	
	055-000-00577-0	Shipbuilding and Repair Industry, 120 pages	9.50	
	055-000-00578-8	Textile Industry, 130 pages	10.00	
	055-000-00579-6	Sector Notebook Data Refresh -1997, 210 pages	17.00	
			Total for Publications	

The total cost of my order is $________. Price includes regular shipping and handling and is subject to change.

Company or personal name (Please type or print)

Additional address/attention line

Street address

City, State, Zip code

Daytime phone including area code

Purchase order number (optional)

Check method of payment:

❑ Check payable to Superintendent of Documents

❑ GPO Deposit Account ☐☐☐☐☐☐☐–☐

❑ VISA ❑ MasterCard ❑ Discover/NOVUS

(expiration date) ***Thank you for your order!***

Authorizing signature

7/97

Mail to: Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250–7954

Important: Please include this completed order form with your remittance.

R0076907

EPA

United States
Environmental Protection Agency
(2221A)
Washington, DC 20460

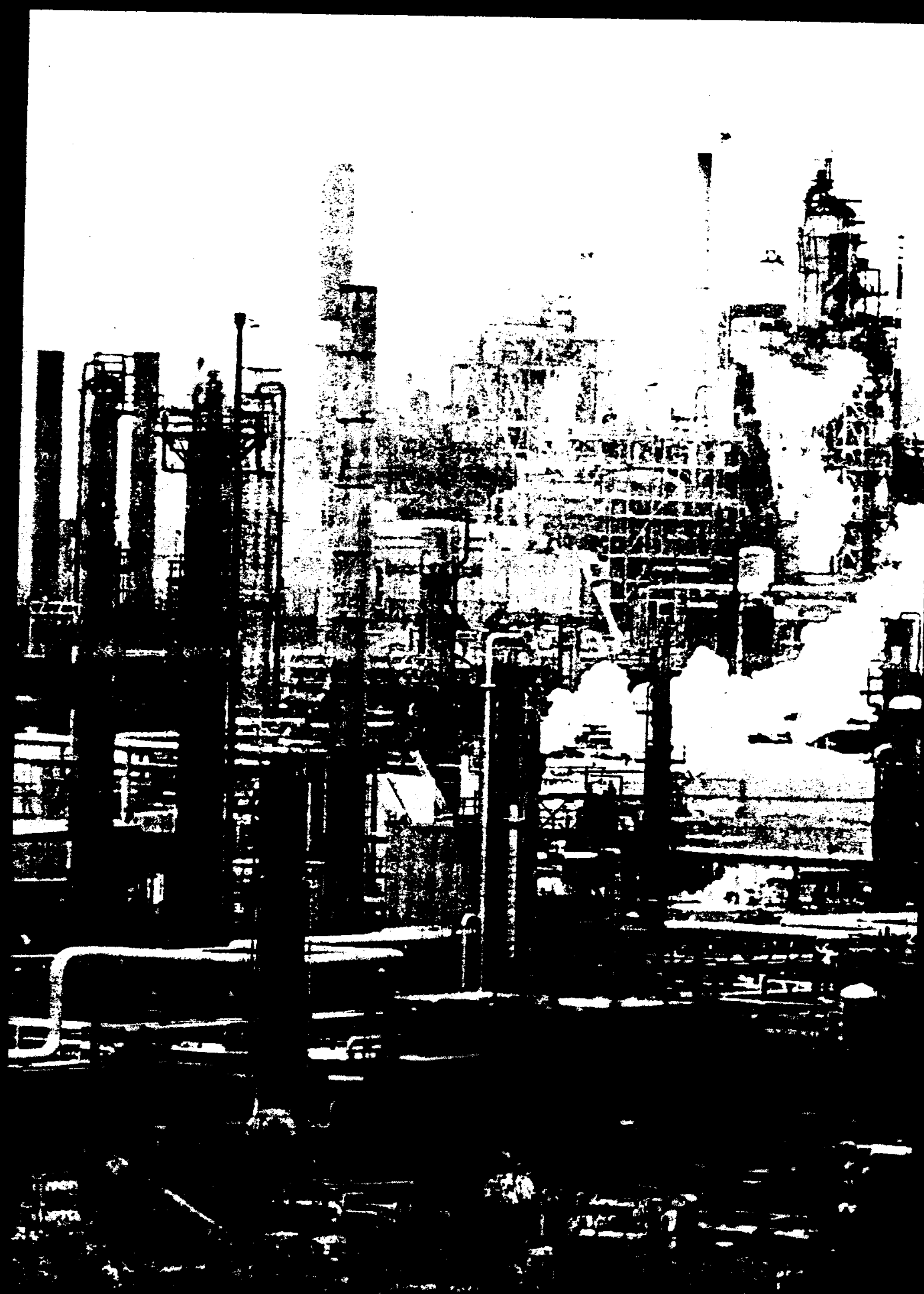
United States
Environmental Protection
Agency

Enforcement And
Compliance Assurance
(2221A)

EPA 310-R-95-013
September 1995

EPA

Profile Of The Petroleum Refining Industry



SECTOR NOTEBOOKS

EPA Office Of Compliance Sector Notebook Project